GEOLOGY AND GROUND-WATER RESOURCES OF PITT COUNTY, NORTH CAROLINA

By
Carlton T. Sumsion
U. S. Geological Survey

GROUND WATER BULLETIN NO. 18

North Carolina
Department of Water and Air Resources
George E. Pickett, *Director*

DIVISION OF GROUND WATER
Harry M. Peek, *Chief*

Prepared by the
United States Geological Survey
in cooperation with the
Pitt County Board of Commissioners
and the North Carolina
Department of Water and Air Resources

MARCH 1970

GEOLOGY AND GROUND-WATER RESOURCES OF PITT COUNTY, NORTH CAROLINA

By

Carlton T. Sumsion

Prepared by the

United States Geological Survey

in cooperation with the

Pitt County Board of Commissioners

and the

North Carolina Department of Water Resources

Raleigh, North Carolina

1970

NORTH CAROLINA

BOARD OF WATER AND AIR RESOURCES

S. Vernon Stevens, Jr., Chairman	Broadway
P. Greer Johnson, Vice Chairman	Asheville
P. D. Davis	Durham
J. Nelson Gibson	Gibson
Wayne Mabry	Badin
Hugh Merritt	Mount Airy
Lee Powers	Lake Lure
J. Aaron Prevost	Waynesville
W. Grady Stevens	Shiloh
Raymond S. Talton	Raleigh
Joe Thomas	Jacksonville
Glenn M. Tucker	Carolina Beach
H. W. Whitley	Murfreesboro

GEORGE E. PICKETT, DIRECTOR
TELEPHONE 829-3003
E. C. HUBBARD, ASST. DIRECTOR
TELEPHONE 829-3006
RALEIGH, N. C. 27611
P. O. BOX 27048

February 12, 1970

The Honorable Robert W. Scott
Governor of North Carolina
Raleigh, North Carolina

Dear Governor Scott:

I am pleased to submit Ground-Water Bulletin Number 18, "Geology and Ground-Water Resources of Pitt County, North Carolina" by Carlton T. Sumsion, U. S. Geological Survey.

This report contains the results of a detailed study of the ground-water resources made by the U. S. Geological Survey in cooperation with the New Hanover County Board of Commissioners and the North Carolina Department of Water and Air Resources. It should prove to be of much value toward the economic and industrial development of the County.

Respectfully submitted,

George E. Pickett

GEP:hbd

CONTENTS

CONTENTS (Continued)

ILLUSTRATIONS

(Plates are inside back cover)

TABLES

GEOLOGY AND GROUND-WATER RESOURCES OF PITT COUNTY, NORTH CAROLINA

By

Carlton T. Sumsion

ABSTRACT

This report describes the geology and ground-water resources of Pitt County in eastern North Carolina. Pitt County comprises an area of 656 square miles and has a population of about 64,000. The climate is humid. Mean annual precipitation in the county is approximately 48 inches. The topography of the county is typical of the Coastal Plain Province, a flat, sandy plain whose only steep slopes are along stream-valley terraces. The northern and central parts of the county are drained by the Tar River and its tributaries. Contentnea and Swift Creeks, which are tributary to the Neuse River, drain the southern part of the county.

Nearly flat-lying surficial sediments of Holocene and Tertiary age overlie strata of Cretaceous age which dip gently to the southeast. The sedimentary strata lie on a basement complex of granitic and metamorphic rocks having an irregular surface which slopes to the southeast.

Seven major aquifers, five of which underlie only part of the county and two of which underlie the entire county, serve as sources of ground water. Ground water is recovered from both confined (artesian) and unconfined (water-table) aquifers; large quantities of ground water suitable for industrial or municipal supplies are obtained from confined (artesian) aquifers tapped by drilled wells. Current ground-water withdrawal in Pitt County is only a small percentage of recharge, and nowhere has there been an overdraft.

Ground water in the shallow unconfined aquifer is generally slightly acidic and in many cases contains objectionable amounts of iron. Most farm water supplies are withdrawn from these shallow aquifers. Deeper confined aquifers, mainly in Cretaceous sediments, yield large amounts of water suitable for most industrial and municipal requirements. Brackish or saline ground water is present in these deeper strata in the eastern part of the county.

INTRODUCTION

OBJECTIVES AND METHODS

Ground water is one of the most valuable natural resources of the Coastal Plain of North Carolina. As the population, economy, and industrial development of this area continue to flourish and expand, the need for adequate information on occurrence, quantity, quality, movement, and use of ground water becomes increasingly important. Recognizing such information as basic to the establishment of sound policies for the effective development and management of ground water, the study of this natural resource in Pitt County (fig. 1) was begun in August 1963 by the U. S. Geological Survey at the request of the Pitt County Board of Commissioners and the State Department of Water and Air Resources (formerly the Department of Water Resources).

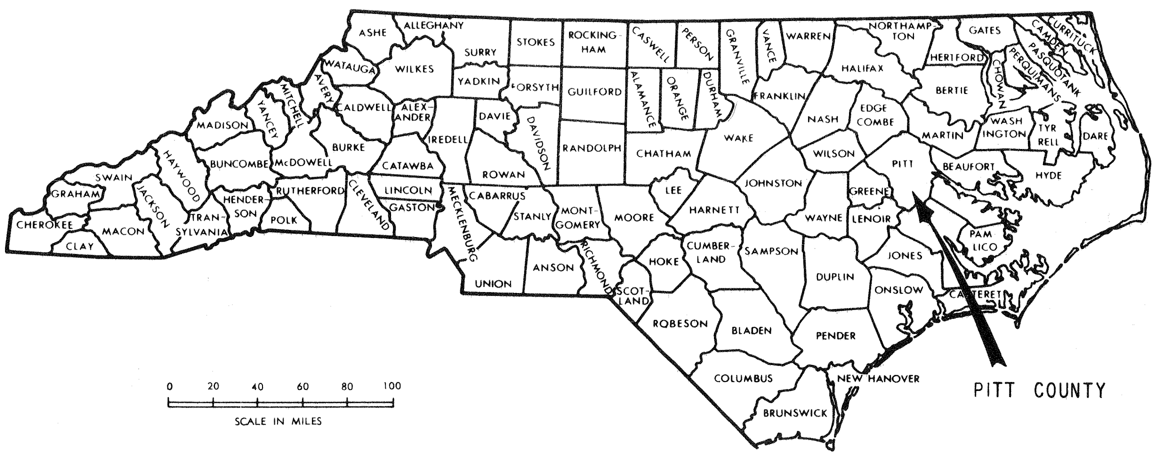


Figure 1.--Index map of North Carolina showing the location of Pitt County.

The principal objectives of this report are to describe the geologic formations and the extent of productive water-bearing zones in Pitt County and to provide the quantitative and qualitative hydrologic data needed for development and management of the ground-water resources.

During the field study data were collected on selected wells in the county. Wherever possible, water levels in the wells were measured. For some wells hydrologic data were obtained from the owners or from well-drilling companies. Data resulting from controlled pumping tests were obtained at the test sites or from drillers well records and from municipal well records. Altitudes of many wells were determined from U. S. Geological Survey topographic maps; others were obtained with surveying altimeters.

Water samples collected from most of the wells inventoried were analyzed by the U. S. Geological Survey laboratory in Raleigh.

The thicknesses of geologic formations and aquifers were determined from well logs and from previously published data.

WELL-LOCATION SYSTEM

The well-location system used in North Carolina conforms to the system adopted by the U. S. Geological Survey for the data card processing of well information.

The well-location system, derived from latitude and longitude coordinates, is based on a grid of one-second parallels of latitude and meridians of longitude. The wells visited in each one-second quadrangle are numbered consecutively in the order inventoried.

The well number is composed of fifteen numbers and letters: the first six numbers and one letter compose the digits of the degrees, minutes, and seconds of latitude, and indicate northern (N) or southern (S) hemisphere latitude of the one-second quadrangle; the next seven numbers compose the digits of the degrees, minutes, and seconds of longitude; the last number indicates the order in which the wells were inventoried within the one-second quadrangle (fig. 2). A one-second quadrangle in North Carolina contains about 6,500 square feet, the length of each side being about 80 feet.

Wells in Pitt County are also designated by local well numbers from 1 to 408 (fig. 3). Table 5 under Basic Data gives information about these wells.

PREVIOUS INVESTIGATIONS

A description of ground-water occurrence in Pitt County is included in volume III of North Carolina Geological and Economic Survey under the section "The Coastal Plain of North Carolina" by Clark and others (1912).

Mundorff (1945) gives an account of the geology of the Coastal Plain of North Carolina.

A general description of the ground-water resources of the North Carolina Coastal Plain is given by LeGrand (1956).

Surface-water resources of that part of Pitt County which lies within the Neuse River drainage basin are described by Billingsley, Fish, and Schipf (1957). They also briefly describe ground-water occurrence in this area.

Geologic outcrops at two Pitt County localities are described in detail by Brown (1957). Brown (1958) presents detailed geologic and paleontologic data from three wells in Pitt County, and a reconnaissance study by Brown (1959) describes the geology and ground water in Pitt County, giving data for 87 wells, including the detailed log of the lithology and paleontology of one well, and the chemical analyses of water samples from 18 of the wells. Swain and Brown (1964) describe microfossils from wells in and near Pitt County.

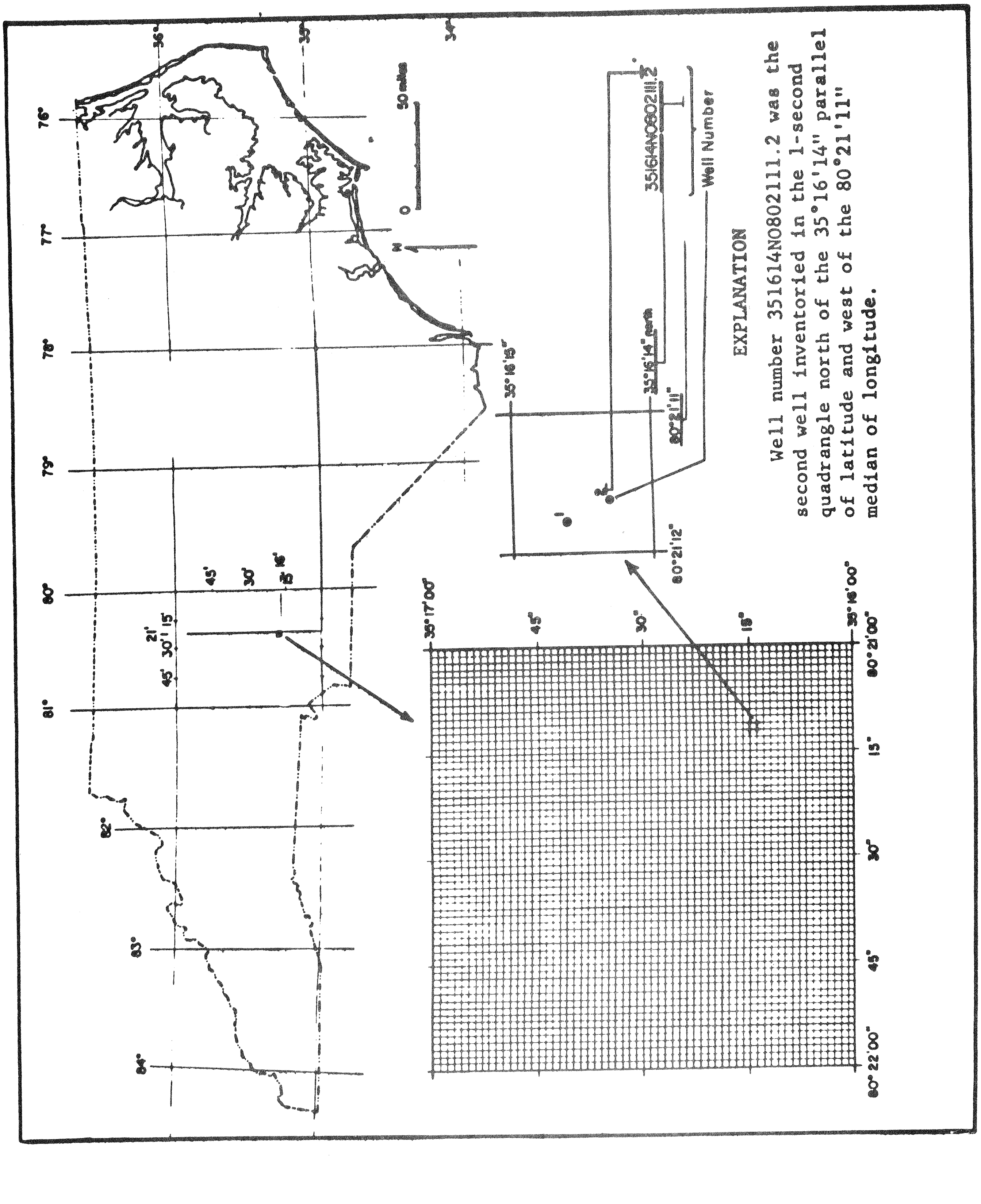


Figure 2.--Diagrams of well-numbering system used in North Carolina.

Detailed water-supply characteristics of creeks and rivers in and near Pitt County are given by Goddard (1963).

A comprehensive account of geology and ground-water occurrence in Martin County, adjacent to Pitt County on the northeast, is given by Wyrick (1966).

Floyd (in press) describes in detail the aquifers and ground water of Craven County, adjacent to Pitt County on the south.

Kimrey (1965) gives detailed descriptions of the geology of Tertiary deposits in Beaufort County which joins Pitt County on the east.

ACKNOWLEDGMENTS

Gratitude and appreciation are due the many interested well owners of Pitt County who contributed information on the construction and other features of their wells. Well data and much other significant information were generously contributed by the Hartsfield Water Co., R. L. Magette and Co., and by Rivers and Associates, Inc. Officials of municipal water systems, the Pitt County Development Commission, the Pitt County Health Department, and the Pitt County Board of Education supplied valuable information. P. M. Brown, Research Geologist, U. S. Geological Survey, provided lithologic and paleontologic descriptions of well cuttings collected during the investigation.

The investigation was made under the direct supervision of G. G. Wyrick, former District Geologist, and under the general supervision of E. B. Rice, former District Chief, U. S. Geological Survey.

REGIONAL SETTING

LOCATION AND ACCESSIBILITY

Pitt County occupies 656 square miles in east-central North Carolina between lat 35°20'N. and lat 35°50'N., and between long 77°05'W. and long 77°45'W. (fig. 3). It is adjoined by Beaufort County on the east, by Martin and Edgecombe Counties on the north, by Wilson and Greene Counties on the west, and by Lenoir and Craven Counties on the south.

Greenville, founded in 1771, is the county seat. Other Pitt County municipalities having populations of more than 1,000 are Ayden, Bethel, Farmville, Grifton and Winterville.

CLIMATE

Temperature, precipitation, and evapotranspiration are factors of climate related to ground-water recharge and discharge. The Coastal Plain of North Carolina lies within a subtropical moist climatic region characterized by warm summers, cool winters, and moderate precipitation during all seasons. However, the seasonal rainfall reaches a maximum during the summer (Yust and Hudson, 1949) as more than 60 percent of the average-annual precipitation occurs during the warmer half-year, April to September. Evapotranspiration becomes noticeably effective during the growing season; vegetation intercepts much of the water reaching the soil zone from near the end of April to the latter part of October. The mean temperature during 1964 at the Greenville weather station was 61.8°F. The length of record was insufficient to obtain a long-term value for temperature. The long-term (64 years) mean-annual precipitation at Greenville is 47.54 inches. Throughout the year the relative humidity is high, seldom being less than 50 percent.

The Coastal Plain lies in the path of occasional hurricanes which move up the coast from the Caribbean area in the late summer or autumn. These infrequent storms may produce unusually heavy rains in the Pitt County area.

Temperatures and the average-monthly precipitation are shown graphically in figure 4. The average-monthly temperatures and precipitation do not vary significantly from place to place within the county.

PHYSIOGRAPHY AND DRAINAGE

Pitt County lies within the embayed section of the Atlantic Coastal Plain physiographic province (Fenneman, 1938). Characteristic surface features of the nearly uniform plain are gently sloping interstream areas with scattered swampy upland flats or "pocosins" and slightly entrenched streams. The streams commonly form a combination of parallel and dendritic drainage patterns. The land-surface profile in Pitt County from the town of Fountain to the mouth of the Tar River has an average slope of about three feet per mile. Present in this part of the Coastal Plain Province but barely discernible are remnants of beaches or erosional terraces of former sea levels.

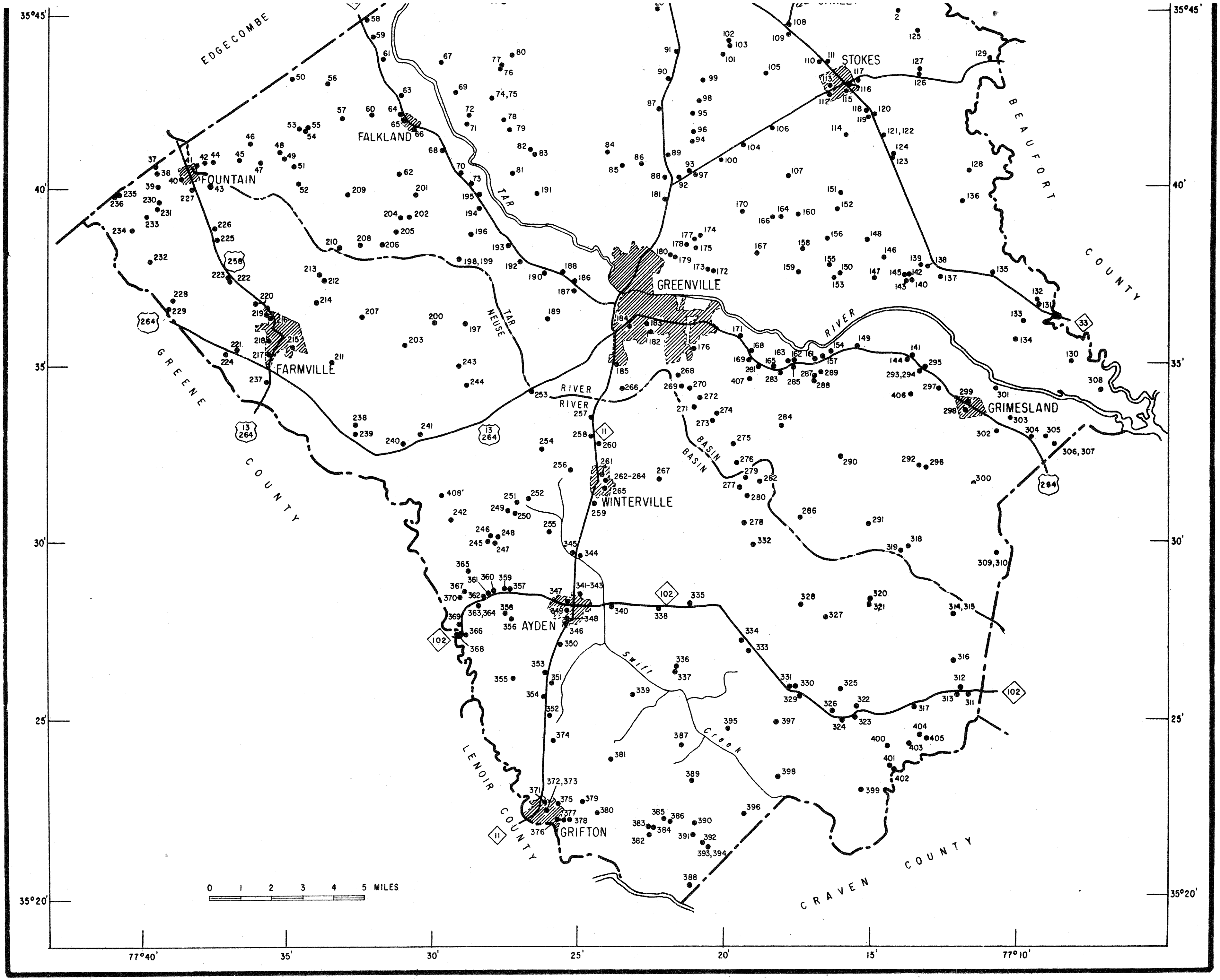
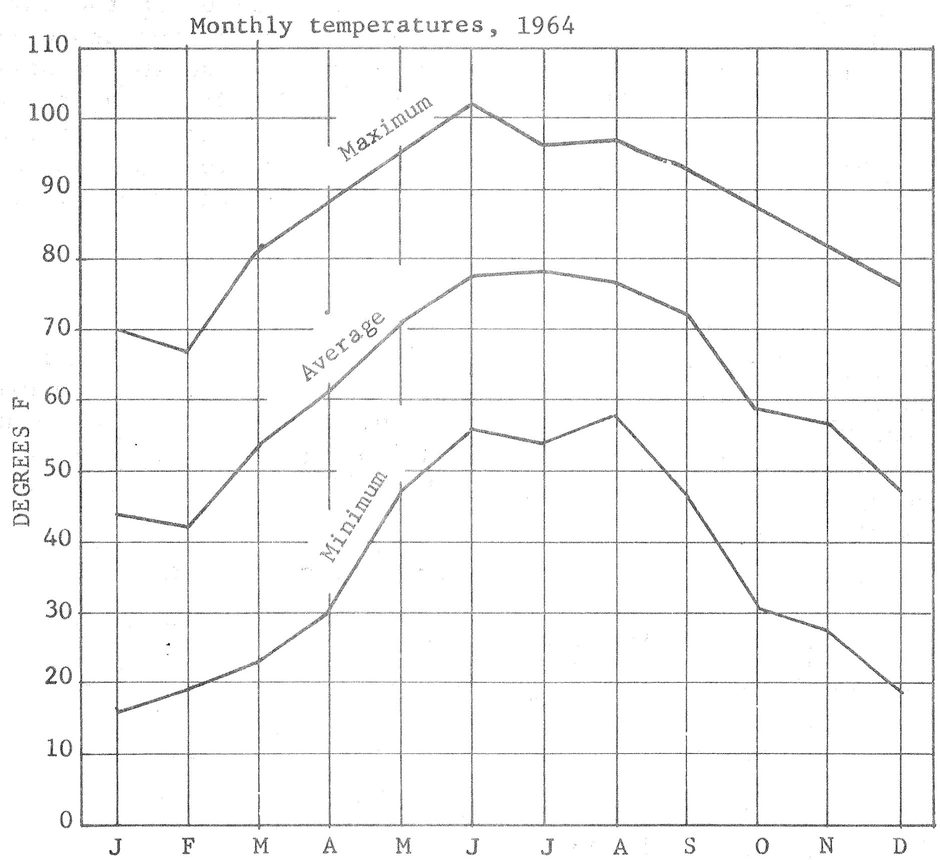


Figure 3 — Well location map.



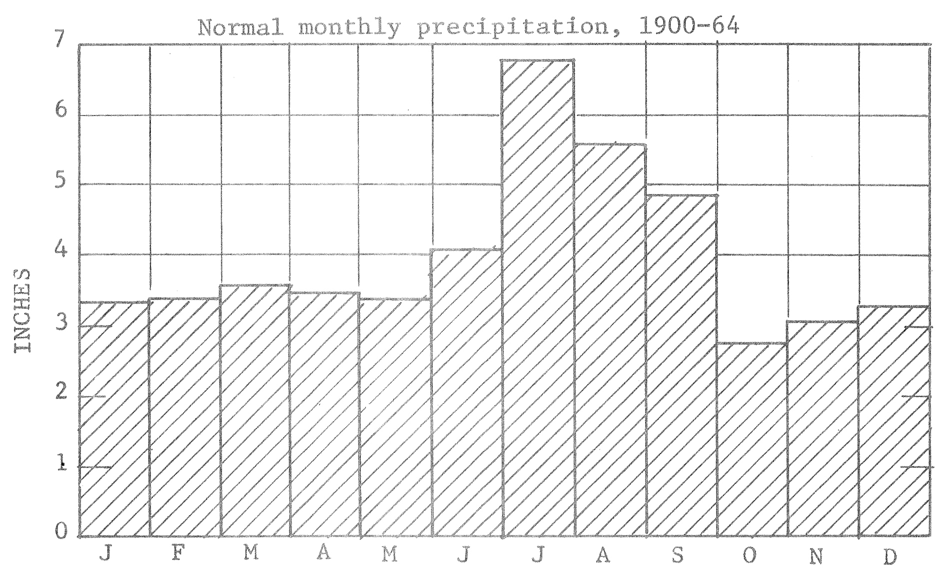


Figure 4.--Graphs showing temperatures and precipitation at Greenville.

Pitt County lies within the Neuse River and Tar River drainage basins--283 square miles in the Neuse River basin and 373 square miles in the Tar River basin. The drainage divide between these basins is located approximately (fig. 3), as it is difficult or nearly impossible to define in some flat or swampy areas. The longitudinal profile of the Tar River has a gradient of about 0.3 foot per mile in the county. Tributary streams are almost parallel to each other as is characteristic of the low-gradient rivers, and winding streams and large areas of swampland are common in the river floodplains.

POPULATION

In pace with the overall economic growth of Pitt County, the general population increased by nearly 10 percent during the period 1950-60 according to the U. S. Bureau of the Census. The larger municipalities in the county and their gains in population during the period 1950-60 are listed below. The very large percentage increase in population at Grifton is due to recent industrial development in that vicinity.

Municipality	Population			
	1950	1960	Increase	Percent Increase
Ayden	2,282	3,108	826	36.2
Bethel	1,408	1,578	170	12.1
Farmville	2,942	3,997	1,055	35.9
Greenville	16,724	22,860	6,136	36.7
Grifton	510	1,546	1,036	203
Winterville	870	1,423	553	63.6
Urban total	24,736	34,512	9,776	39.5
Pitt County	63,789	69,942	6,153	9.6

GENERAL GEOLOGY

Pitt County lies in the middle part of the Atlantic Coastal Plain, which extends from Long Island southward to Florida, and which, in North Carolina, extends more than 100 miles inland from the coast. The Coastal Plain is underlain by beds of sand, clay, and calcareous sediment. The beds are inclined coastward at a rate only slightly greater than the slope of the land surface. Beds tend to thicken coastward, and those that are inland near the land surface occur at greater depths near the coast. The greatest thickness of the wedge of sediments is perhaps a few tens of miles out to sea from the present coastline.

The sediments are grouped according to the geologic period in which they were deposited. Beginning at the top, in Pitt County they include sediments of Quaternary, Tertiary, and Cretaceous Systems. The sediments are further divided into formations according to their lithology or character of the constituent materials. Table 1 in the Basic Data section is a log of a test well at Winterville, the test well penetrating the entire section of Coastal Plain sediments. Formations have distinctive characteristics and may be traced for many miles. The sediments contained in some beds grade from one kind of material to another, such as from coarse to fine sand or to clay. Almost all the sand, clay, and some of the calcareous material in the Atlantic Coastal Plain are unconsolidated. Clays are very common in the sedimentary sequence.

The wedge of formations underlying the Coastal Plain lies on older igneous and metamorphic rocks, such as those exposed in the Piedmont Province to the west. These rocks are not of great significance to the study of the water resources in Pitt County, and accordingly, are referred to simply as basement rocks.

During the geologic development of the Atlantic Coastal Plain, the sea advanced and retreated many times. The inner margin of the Plain west of Pitt County has been submerged during only a fraction of the time that land adjacent to the present coast has been submerged. Most sediments of the Coastal Plain were deposited in the sea, but some were deposited on land along the lowland margins of the Plain. Whether deposited in the sea or along marginal land areas, the sediments tend to be preserved in nearly flat layers which dip gently coastward. Invasions of the sea during Pleistocene time left a veneer of sand and clay, commonly 10 to 20 feet thick at the land surface. Thus, the underlying older formations are mostly hidden from view except along stream banks.

BASEMENT ROCKS

The basement rocks underlying the Pitt County area are similar in composition to rocks exposed in the Piedmont Province. Well cuttings in the Pitt County area indicate that the basement rocks consist generally of weathered schist and gneiss. Rock from the stone quarry at Fountain is gray medium-grained granite gneiss. The linear structure of the gneiss trends generally northeastward.

Logs of the formations penetrated by wells in this area, in addition to geophysical data, indicate that the surface of the basement rocks beneath the sedimentary cover is irregular. Near the town of Fountain the basement rocks have a topographic relief of more than 350 feet--from a surface exposure in the stone quarry about half a mile southeast of town to a depth of 350 feet below land surface at the town's supply wells. This irregular erosional surface slopes generally southeastward from about 300 feet below land surface at the western end of Pitt County to more than 1,150 feet below land surface at the county's southeastern boundary, an average slope of about 26 feet per mile. Figure 5 shows the surface of the basement rocks in Pitt County. The irregularities of the basement surface are not shown on the map owing to the wide spacing of data-control points.

Fracture zones in the gneiss and other rocks of the basement are known to be sufficiently permeable to yield water to wells. However, the yields of such wells are so slight in comparison to the yields of wells in the overlying sand strata that the basement rocks are not considered to be an aquifer in the Pitt County area.

CRETACEOUS SYSTEM

LOWER CRETACEOUS SERIES

Sediments consisting of sand, silt, and clay of Early Cretaceous age lie unconformably on the basement rocks throughout the Pitt County area. These sediments are not known to be exposed, but they have been penetrated by deep wells in and adjacent to Pitt County.

These sediments are predominantly sand and silt, interbedded with green and brown silty clay, not changing greatly from place to place in the county (Swain and Brown, 1964). Studies of the microfauna indicate that the sediments were deposited in a lagoonal environment that may have been similar to the modern-day Pamlico Sound. The sediments were deposited during a generally rising stage of sea level (Brown, 1959, p. 10). The Lower Cretaceous sediments thicken from about 50 feet in the western corner of Pitt County to about 300 feet at the southeastern corner. Figure 6 shows the top and the thickness of the Lower Cretaceous Series. The dip of the top of the Series is to the southeast at about 20 feet per mile.

The sand strata yield ample water of good quality to wells in the vicinity of Farmville. However, at Greenville and in the eastern part of Pitt County water in the deeper sand is slightly brackish.

UPPER CRETACEOUS SERIES

Tuscaloosa Formation

The Tuscaloosa Formation was first referred to by this name in North Carolina by Cooke (1936). Throughout the Pitt County area the Tuscaloosa Formation unconformably overlies the Lower Cretaceous Series.

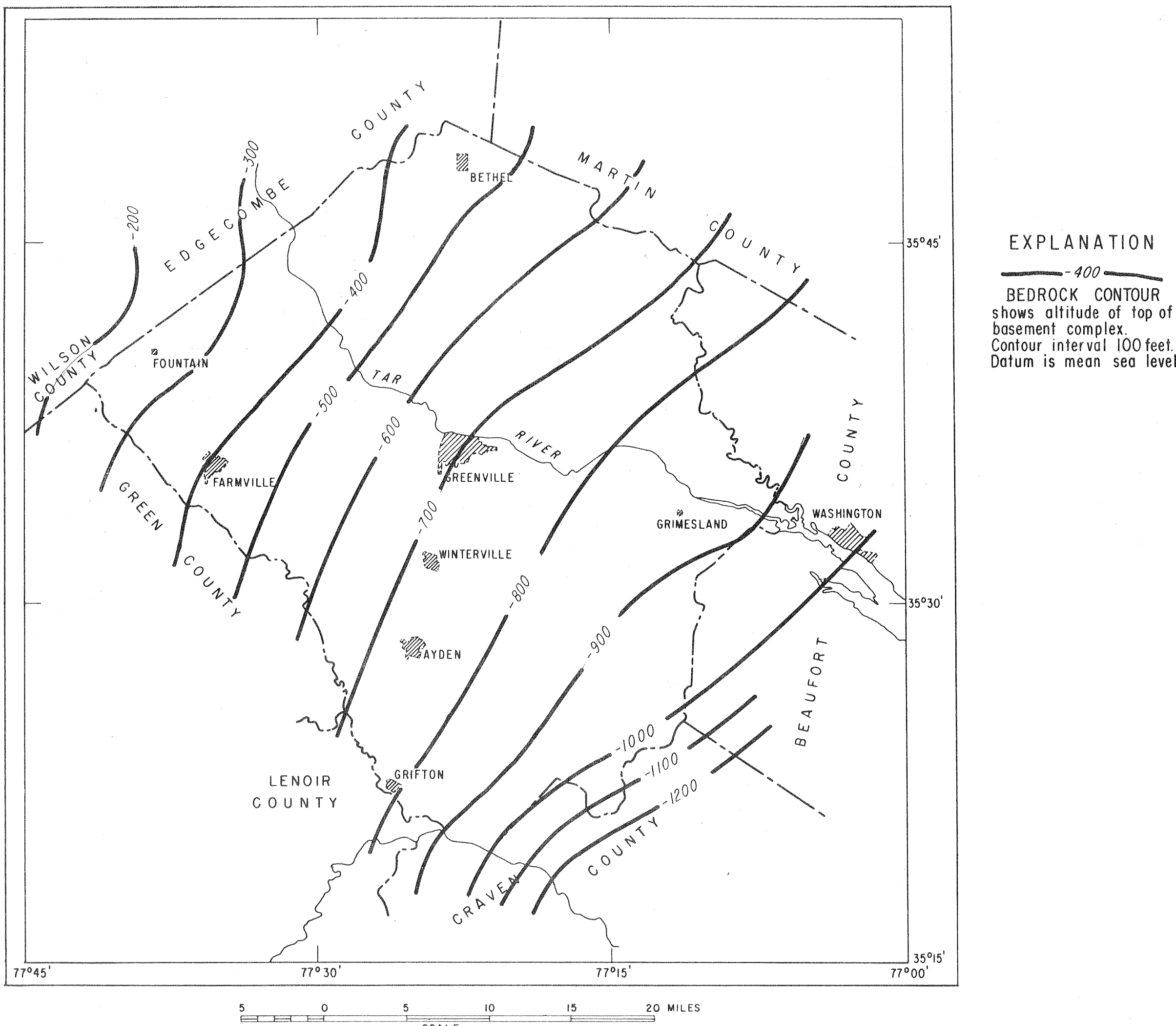


Figure 5.--Map showing generalized configuration of the top of the basement surface.

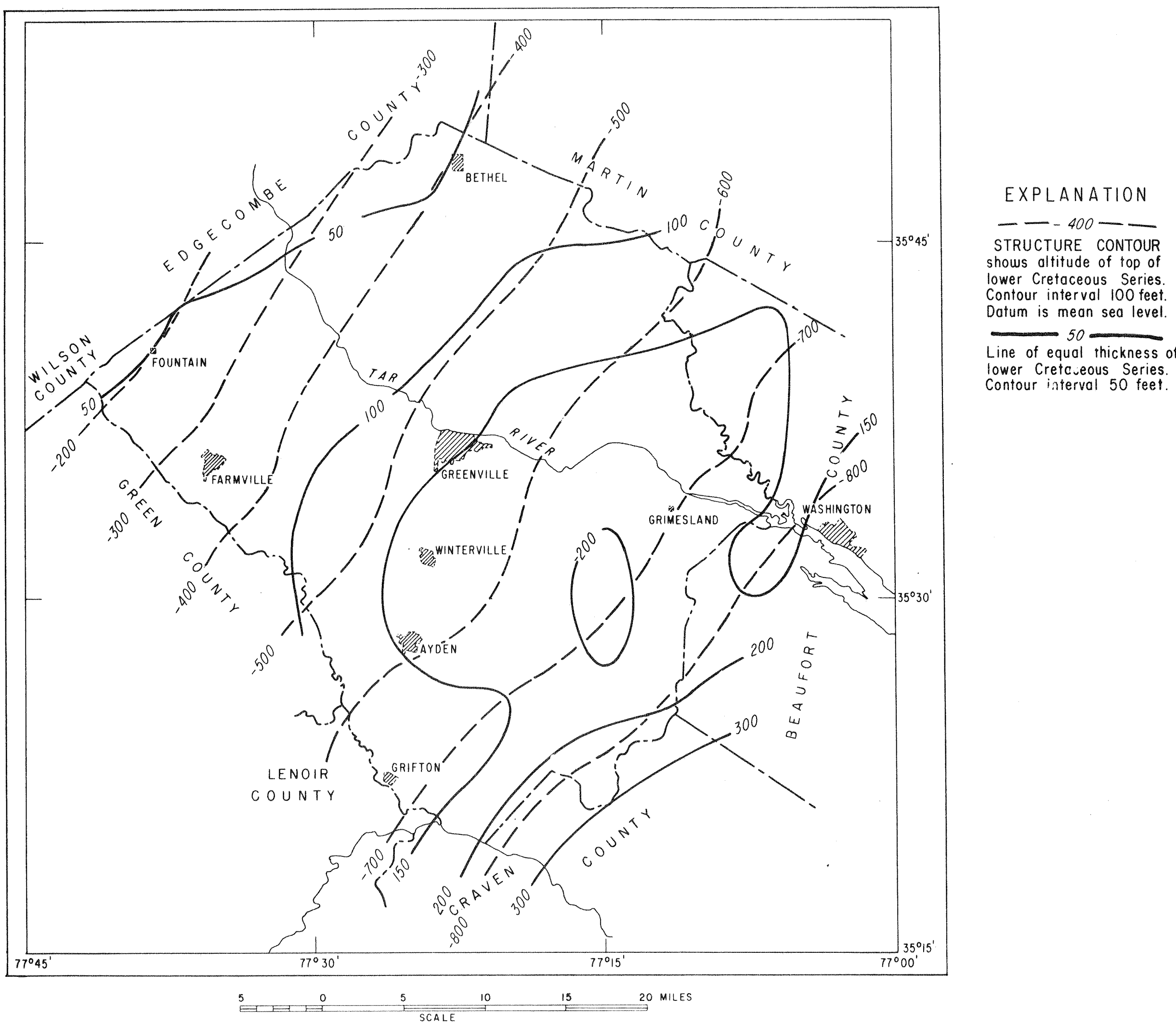


Figure 6.--Map showing the configuration of the top of, and the thickness of, the Lower Cretaceous Series.

In northwest Pitt County the upper part of the Tuscaloosa Formation is exposed in a small area along the banks of the Tar River between Otter Creek and Penny Hill. The composition of the formation varies widely from place to place but generally consists of sand or clay, sandy or silty clay, and poorly sorted silty sand. The Tuscaloosa Formation generally grades upward from fine sand and silt to coarser sand interbedded with silt and clay. Figure 7 shows the altitude of the top of the formation in Pitt County. The formation dips generally to the southeast at about 22 feet per mile. The formation is about 300 feet thick in the vicinity of Farmville and thins both toward the east and toward the west.

Sand in the upper part of the Tuscaloosa Formation yields water of excellent quality to wells at Ayden, Farmville, Greenville, and Grifton. Very thin sand layers near the bottom of the formation contain slightly brackish water at Greenville and in the eastern part of Pitt County.

Black Creek Formation

The Black Creek Formation comprises two members: an unnamed lower member of Austin age which unconformably overlies the Tuscaloosa Formation, and the Snow Hill Marl Member of Taylor age.

The lower member of the Black Creek Formation consists of alternately bedded gray sand and dark-gray clay. The upper part of the Black Creek Formation is exposed along the banks of the Tar River between Otter Creek and Greenville, and southwest of Farmville along the banks of Contentnea Creek. The Snow Hill Marl Member of the formation is composed predominantly of calcareous sand and clay layers.

The western limit of the Black Creek Formation is shown in figure 8, which also shows the configuration of the top of the formation in Pitt County. The dip is generally southeast at about 11 feet per mile. From its margin in western Pitt County, the Black Creek Formation thickens southeastward to about 450 feet near the southeastern county boundary.

In Pitt County the sand layers of the Black Creek Formation compose a major aquifer system, yielding the greatest amounts of water to wells of all the aquifer systems in the area. The water is of excellent quality throughout the county.

Peedee Formation

As shown in figure 9, the Peedee Formation occurs in approximately the southeastern two-thirds of Pitt County. It conformably overlies the Snow Hill Marl Member in some places, but it unconformably overlies the lower member of the Black Creek Formation where the Snow Hill Marl Member does not occur.

The Peedee Formation is exposed along the banks of the Tar River from Greenville to the vicinity of Grimesland, and along the banks of Contentnea Creek and the Neuse River in the vicinity of Grifton. The Peedee Formation consists of lenticular beds of green and gray sands, dark-gray silt, and clay layers. The uppermost sand and silt beds of the formation are characteristically

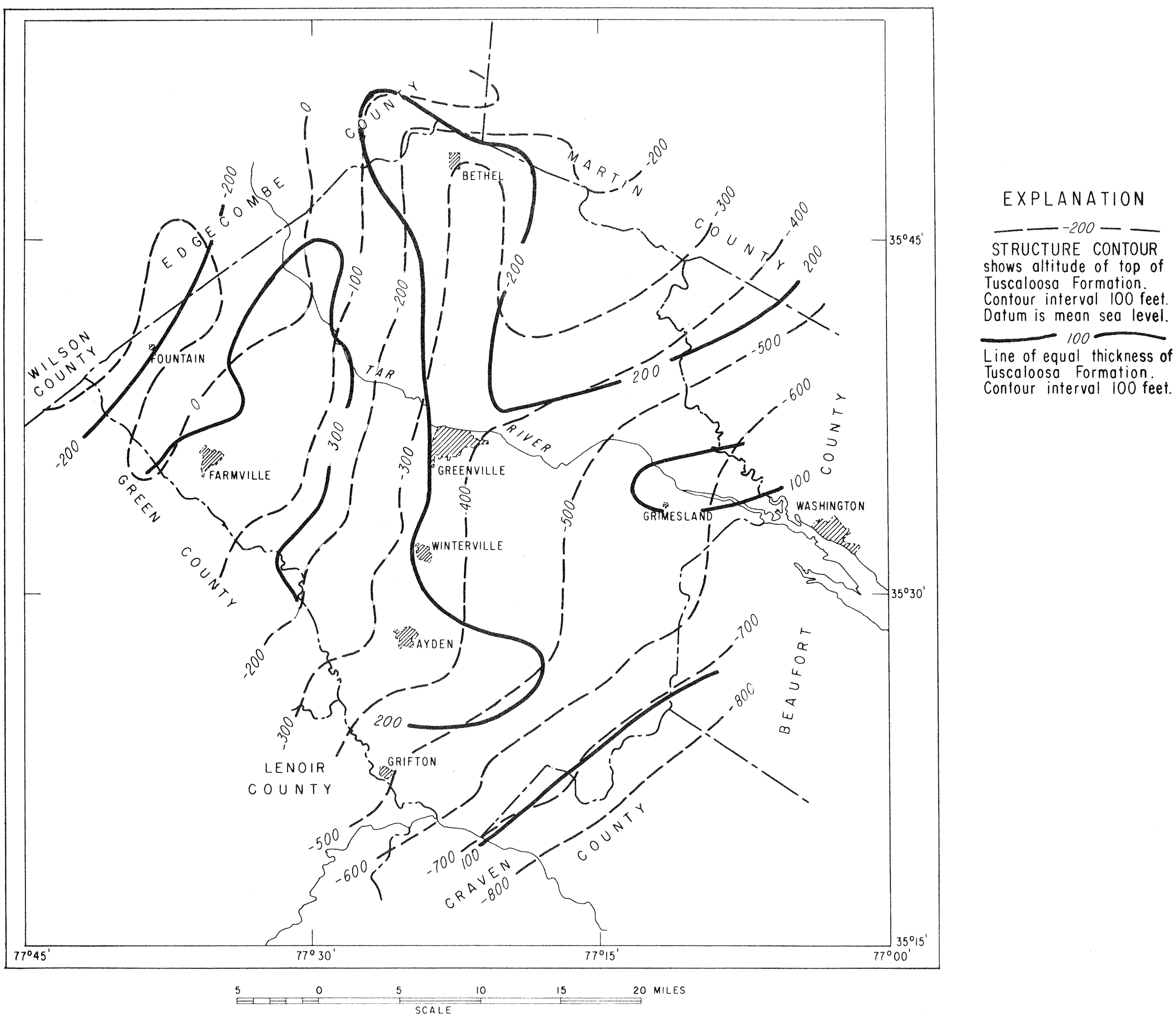


Figure 7.--Map showing the configuration of the top of, and the thickness of, the Tuscaloosa Formation.

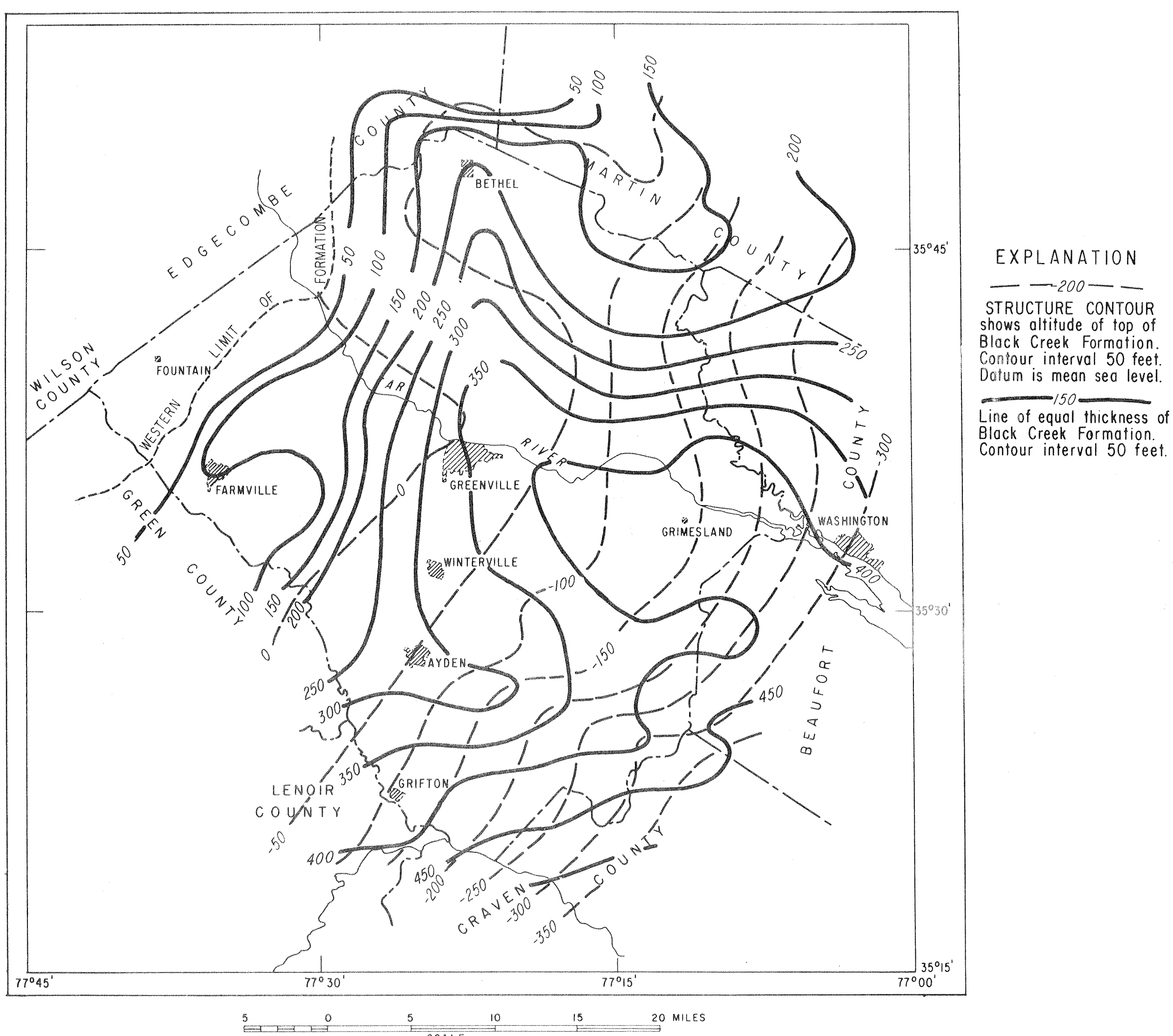


Figure 8.--Map showing the configuration of the top of, and the thickness of, the Black Creek Formation.

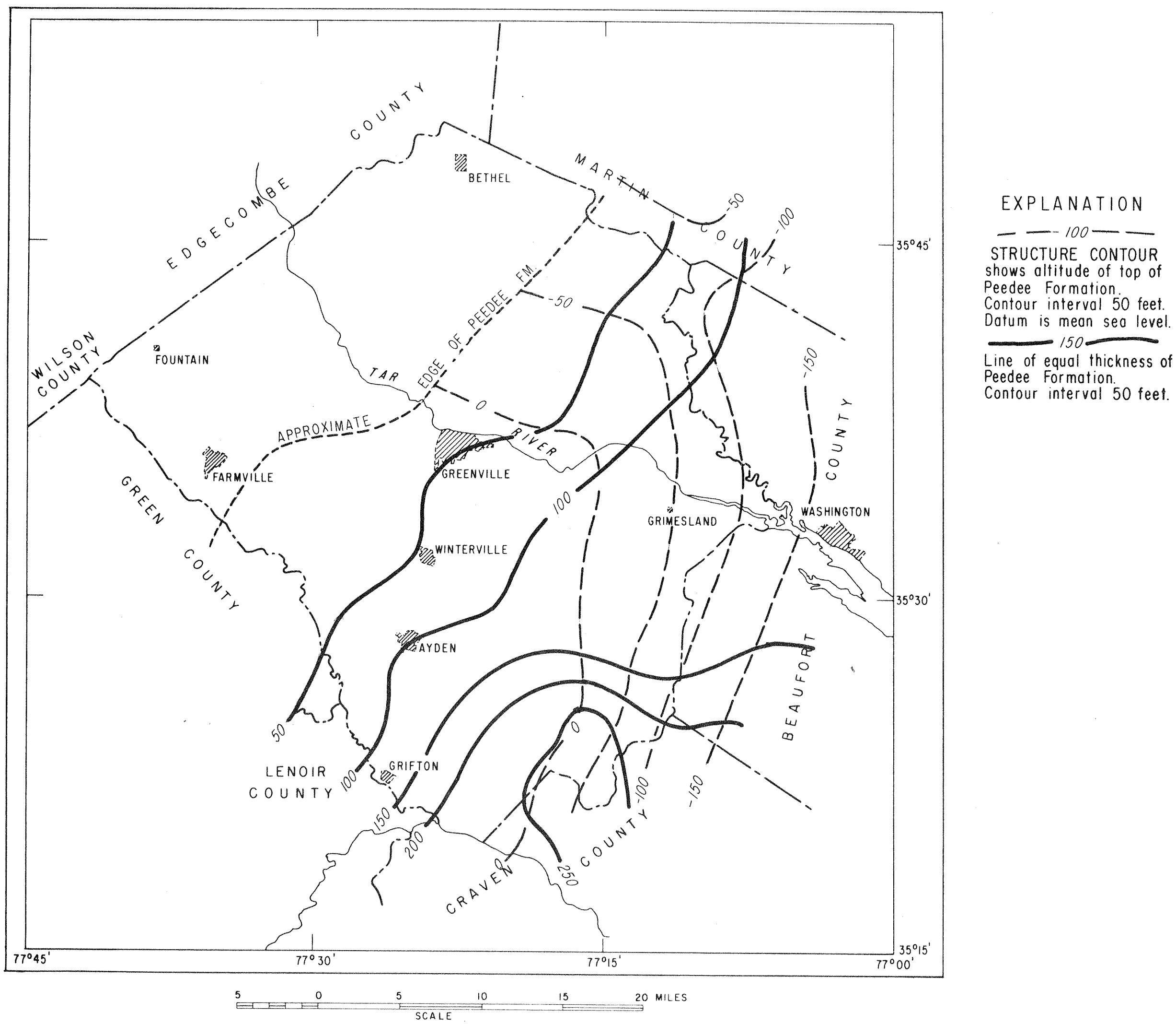


Figure 9.--Map showing the configuration of the top of, and the thickness of, the Peedee Formation.

bright green. Glauconite and collophane are generally present in relatively large proportions in the Peedee sand beds, and well-cemented calcareous lenticular sand and shell layers occur throughout the formation. The Peedee Formation probably was deposited in an estuarine or near-shore environment. The dip is southeast at about 10 feet per mile. From its margin in western Pitt County the Peedee Formation thickens southeastward to about 250 feet near the southeastern county boundary.

Sand layers of the Peedee Formation yield ample water of excellent quality to the municipal well at Grimesland. These sand layers are relatively untapped as a source of ground water in Pitt County but have an excellent potential where they are thickest.

TERTIARY SYSTEM

PALEOCENE SERIES

Beaufort Formation

The Beaufort Formation of Paleocene age occurs in the subsurface of eastern Pitt County as shown in figure 10. The Beaufort Formation overlaps the older Cretaceous formations, and it unconformably overlies the Peedee Formation in eastern Pitt County. In turn, the Beaufort Formation is unconformably overlain by the Eocene Castle Hayne Limestone and the Miocene Yorktown Formation in this area.

In eastern Pitt County the Beaufort Formation consists mainly of glauconitic "salt and pepper" sand, and also of thin calcareous clay and silty marl layers, mostly in the upper part of the formation. The dip in eastern Pitt County is generally to the east at about 14 feet per mile, but it increases northeastward. The Beaufort Formation thickens to about 50 feet at the extreme eastern tip of the county.

A few wells in the eastern corner of Pitt County obtain water for household supplies from the Beaufort Formation. The water from the Beaufort is slightly harder than that from deeper aquifers.

EOCENE SERIES

Castle Hayne Limestone

The Castle Hayne Limestone underlies a narrow strip in the eastern part of the county. Figure 11 shows the altitude of the top of the formation and its thickness. In this area the Castle Hayne Limestone is of middle Eocene age (Brown, 1959). It unconformably overlies the Paleocene Beaufort Formation and the Cretaceous Peedee Formation. The Castle Hayne Limestone is readily identified by its characteristic resistivity and spontaneous-potential patterns on electrical well logs.

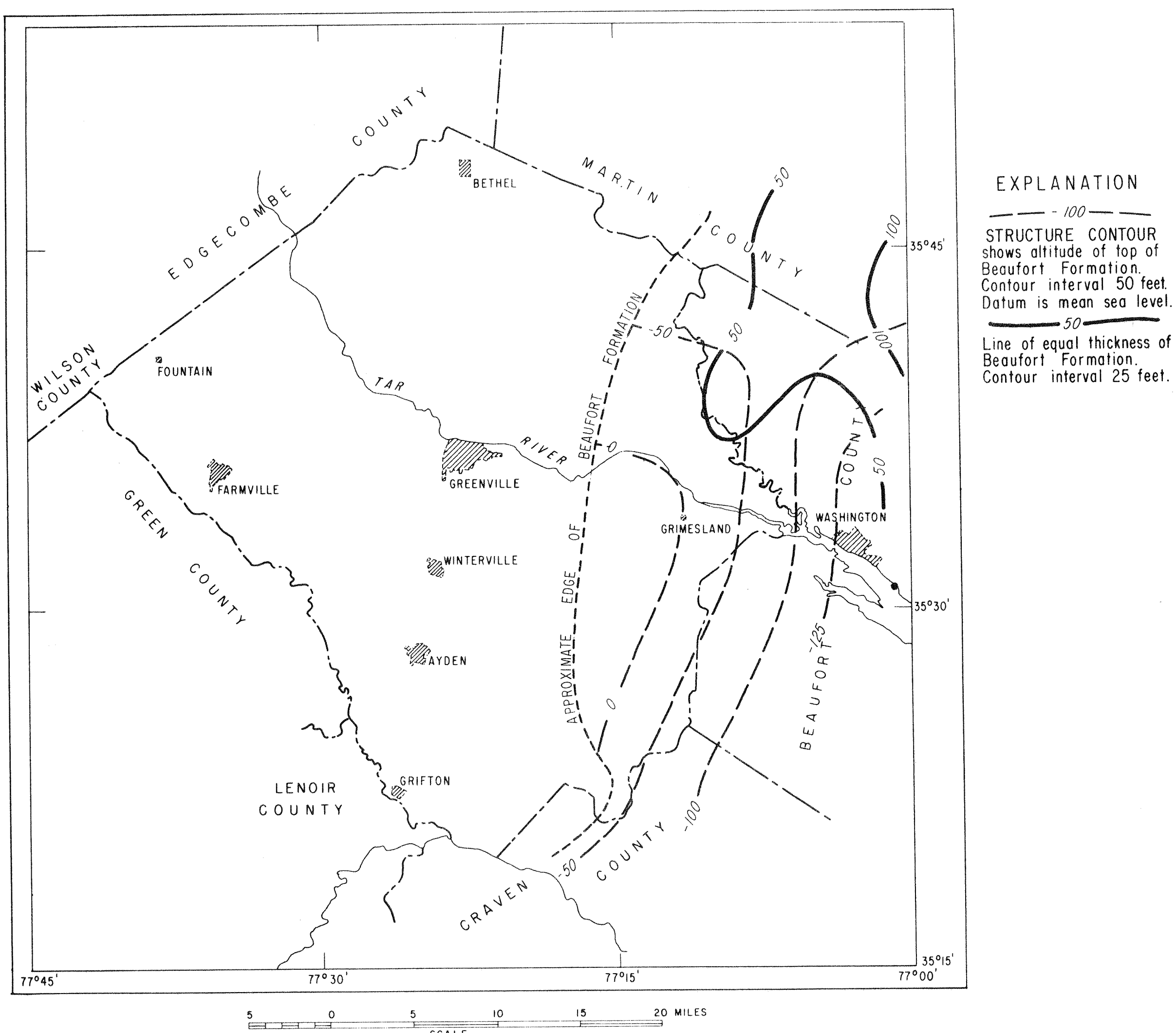


Figure 10.--Map showing the configuration of the top of, and the thickness of, the Beaufort Formation.

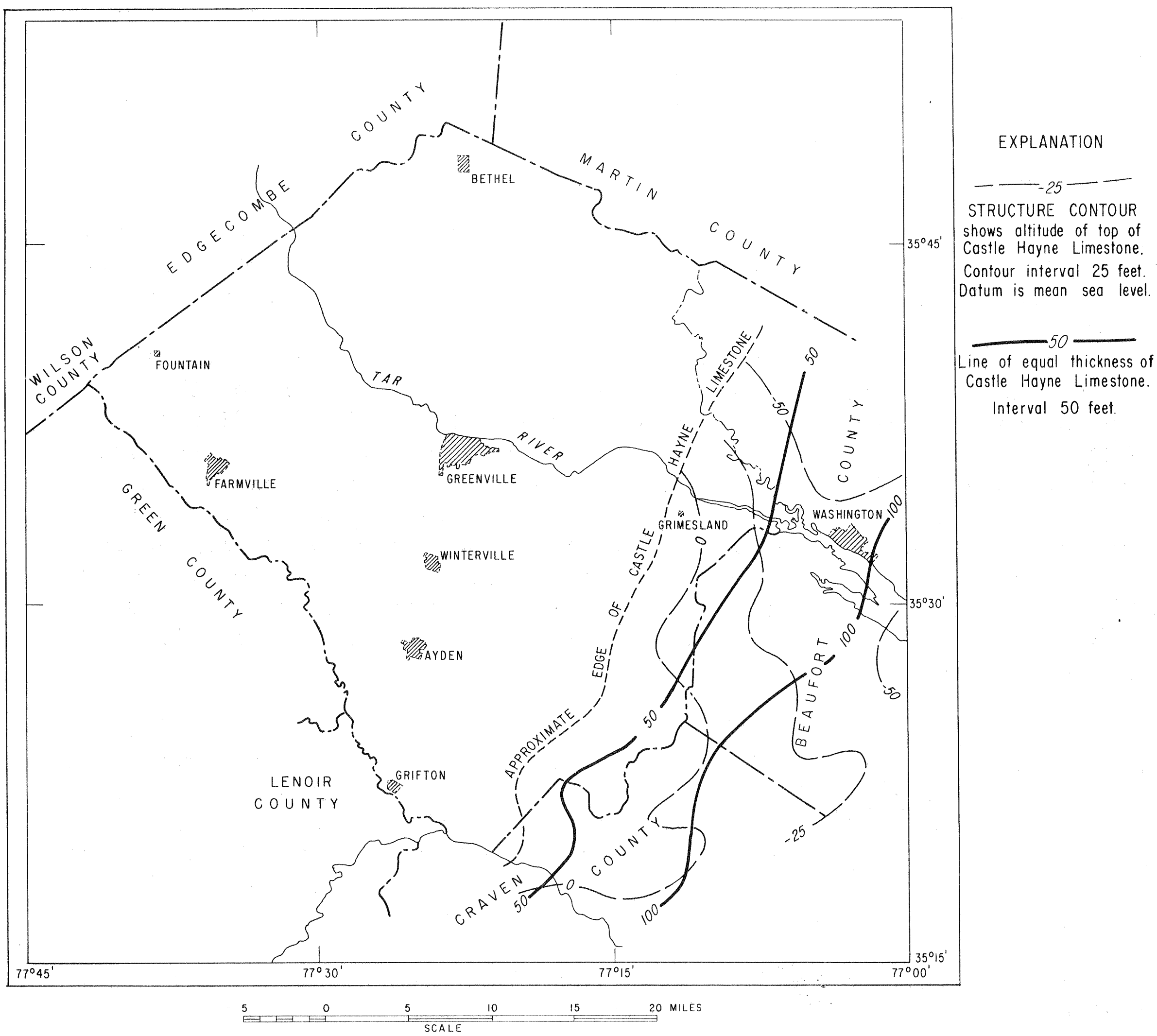


Figure 11.--Map showing the configuration of the top of, and the thickness of, the Castle Hayne Limestone.

This formation consists of light-colored marl, white calcareous sand, light-gray sandy coquina limestone, and sparse green clay in the eastern Pitt County area. Glauconite and phosphorite occur as abundant accessory minerals. The Castle Hayne Limestone was deposited in an environment which may have been similar to that of the present-day Bahama Banks. The formation dips to the southeast at approximately 7 feet per mile. The greatest thickness is about 75 feet at the extreme southeastern county boundary.

The Castle Hayne Limestone is an important aquifer in eastern North Carolina, but it remains essentially untapped in Pitt County where it yields water to wells for household use only. Water from this aquifer is hard but otherwise is of good quality.

MIOCENE SERIES

Yorktown Formation

The Yorktown Formation of late Miocene age underlies most of Pitt County. It unconformably overlies the Castle Hayne Limestone of middle Eocene age and the Peedee, Black Creek, and Tuscaloosa Formations of Late Cretaceous age.

The Yorktown Formation is overlain mainly by thin sands and silts of Pleistocene and Holocene age. Gross similarity of the upper part of the Yorktown Formation to these younger deposits causes difficulty in distinguishing them. The Yorktown Formation is commonly a massive gray silty clay throughout Pitt County. The formation is exposed on the right bank of the Tar River, at the bridge one mile northeast of Grimesland, where the lower part of the formation consists of dark blue-gray sandy clay containing abundant pelecypod and gastropod shells for about 8 feet above river level. Overlying this fossiliferous matrix is about 10 feet of massive gray silty clay. Lenticular layers of sand occur throughout the formation, and phosphorite pebbles are common.

The formation was deposited during a predominantly transgressive stage of sea level (Brown, 1959). Figure 12 shows the older formations that immediately underlie the Yorktown Formation, and the altitude of the pre-Miocene surface. The altitude of this surface decreases toward the northeast at a greater rate than does the land surface, therefore, the Yorktown Formation thickens in that direction. Its greatest thickness in Pitt County is about 105 feet in the vicinity of Bethel.

The generally fine texture of the Yorktown Formation precludes its use as a major aquifer, although it does yield sufficient water for household supplies. Water from the sand and silt layers of this formation is hard.

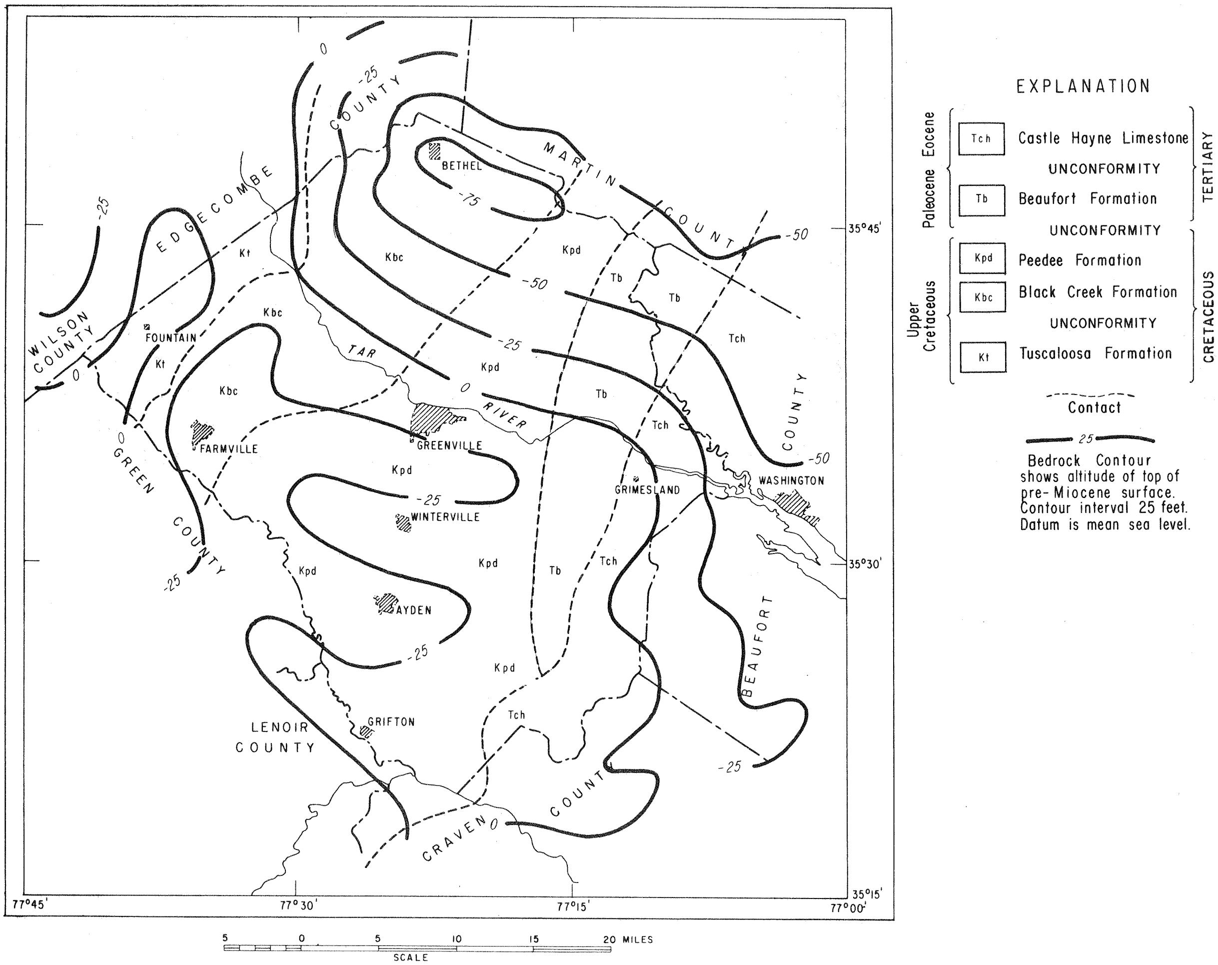


Figure 12.--Geologic map showing the configuration of the pre-Miocene surface.

QUATERNARY SYSTEM

POST-MIOCENE DEPOSITS

Most of the surface of Pitt County is underlain by beds of sand and silt of Pleistocene age. These beds overlie the Miocene and pre-Miocene formations. Remnants of Pleistocene beach-terraces or offshore bars are difficult to recognize because of subsequent erosion. The surficial deposits of sand and silt, where exposed in road cuts or stream banks, generally are crossbedded. The thickness in Pitt County may be as much as 50 feet but commonly ranges from 10 to 20 feet. The Pleistocene sand beds yield ground water to numerous shallow wells. Water from these sand beds is slightly acidic and, therefore, somewhat corrosive to metal; the water commonly contains iron in amounts sufficient to impart its distinctive taste to the water.

Sedimentary deposits of Holocene age, river-laid and windblown sand, are conspicuous along the flood plains of the Tar and Neuse Rivers, as well as along some of their larger tributaries. Well-drained interstream areas generally are covered with sandy soils of Holocene age. Swamps, bogs, pocosins, and other areas in which there are undisturbed acid soils, all contribute to the acidity of the unconfined ground water occurring in the surficial sands and silts.

HYDROLOGY

EVAPOTRANSPIRATION

Because of higher air temperatures, much of the precipitation that falls during the summer is lost by evaporation before it can enter the ground. Since the growth of vegetation reaches its peak during the summer, most of the water absorbed by the ground is intercepted by the soil zone and is used by plants in the process referred to as transpiration. Large amounts of water are required for plant growth, and when rainfall is scarce, water stored in the soil zone is soon depleted. Thus, the rainfall that infiltrates into the ground during the summer is used to replenish this soil moisture, and little, if any, percolates through the zone of aeration to the water table. Conversely, during the fall, winter, and spring, evaporation may return little of the precipitation to the atmosphere; plants are dormant after the first killing frost; a larger proportion of the water infiltrates to the zone of saturation.

Quantitatively, it is nearly impossible to separate the consumptive use of water by evaporation from that of transpiration. In combination they are termed evapotranspiration. These processes return water to the atmosphere; hence evapotranspiration may be regarded as the reverse of precipitation. Actual measurements of this type of consumptive use for any area as large as Pitt County are expensive, time consuming, and beyond the scope of this investigation. However, a method of estimating potential evapotranspiration has been described by Thornthwaite (1948). Potential evapotranspiration is defined as the amount of water that may be lost from a surface entirely occupied by vegetation where no deficiency exists in available soil moisture. At any time, potential evapotranspiration is proportional to the intensity of solar radiation. As the precipitation on a given area increases, water loss by evaporation and transpiration increases also, approaching potential evapotranspiration as an upper limit. Water yield in a given area is the surplus of precipitation over loss by evapotranspiration. Application of Thornthwaite's method requires monthly mean temperature and precipitation records, and the latitude of the area. Annual potential evapotranspiration at Greenville computed by Thornthwaite's method is estimated to be about 34.6 inches, or nearly 12.9 inches less than the annual mean precipitation. During the first part of the growing season potential evapotranspiration exceeds precipitation, which may result in a slight depletion of soil moisture. About the middle of summer, precipitation becomes greater than evapotranspiration, and moisture is added to the soil. If precipitation during the spring occurred as widespread low-intensity storms, there would be little or no runoff or water surplus during this period. However, intense storms yield precipitation at rates that exceed the infiltration capacity of Pitt County soils, resulting in runoff to streams.

OCCURRENCE OF GROUND WATER

Ground water occurs in the pore spaces between the rock particles in the zone of saturation. Rock units containing spaces that are interconnected and large enough to permit flow through them will yield water to wells. These rock units are called aquifers. Two types of aquifers in Pitt County may be distinguished on the basis of the type of spaces that transmit water: beds of sand in which the water moves or is stored in the openings between the sand grains, and beds of shell aggregate characteristic of the Tertiary sediments. The original spaces between the shells have been filled with calcareous cement, but some of the shell material has been dissolved and removed, resulting in large interconnected openings.

The uppermost water-bearing rock unit is the surface material that covers most of Pitt County to depths of generally not more than 40 feet. The upper part of the surface material comprises the zone of aeration through which water percolates downward to the zone of saturation. The zone of aeration does not yield water to wells. The lower part of the surface material is saturated with water. The upper surface of the saturated zone is called the water table. Water below the water table is called ground water. The water table is not usually a flat plane as the name would imply, but generally is a subdued reflection of the land surface. The water table may extend to the land surface, however, as it does obviously in swampy areas, bogs, some drainage ditches, and in stream channels. The water table does not remain static but is continuously rising and falling in response to changes in rainfall and evapotranspiration patterns.

All of the sediments below the water table are saturated, not only in the surface sand, but also in the underlying limestone, clay, and sand. In the Coastal Plain region, clay and silt compose aquicludes that are interlayered with the more permeable sand and limestone aquifers. These interlayered beds dip oceanward, and ground water moving downslope in the permeable beds becomes confined beneath the less permeable beds of silt and clay.

The water level in a well tapping a confined aquifer stands above the top of the water-bearing material. The height to which the water will rise forms an imaginary surface called the piezometric surface. If the piezometric surface is above land surface at the well, water will flow from the well.

RECHARGE AND MOVEMENT

Precipitation is the source of all water in the Coastal Plain of North Carolina. There are no significant local variations in precipitation in Pitt County, and the mean (64 years) annual precipitation of 47.54 inches at Greenville may be regarded as representative of the county. This amount of precipitation is equivalent to nearly 1,662,000 acre-feet per year on the entire county, approximately 2,266,000 gpd (gallons per day) on each square mile, or about 3.5 cfs (cubic feet per second) per square mile. The ability of precipitation to infiltrate the soil zone and percolate downward is dependent on the topographic relief of the surface on which it falls, the permeability of the soil or surface material, the air temperature, the type and density of vegetative cover, and the intensity or rate at which the precipitation falls. Rain falling on the nearly level sandy loam soils that are typical of much of Pitt County has a minimum infiltration rate ranging from about 0.15 to 0.30 inch per hour.

Water-level fluctuations in observation wells indicate that the aquifers receive most of the annual recharge during the period from October through March, mainly because evapotranspiration is lowest in that period (fig. 13).

Although aquicludes, or confining layers, between aquifers are relatively impermeable, they transmit water slowly from aquifer to aquifer where hydraulic gradient exists between the aquifers. The natural movement of ground water from recharge areas to discharge areas is shown diagrammatically in figure 14.

Figure 15 is a map of the county showing the general piezometric surface of water in aquifers 2 and 3. In making this map the water levels used were obtained over a period of several years (1960-1968). The water levels were not adjusted for seasonal fluctuations, which range five to ten feet in well number 18 at Bethel. The altitudes were taken from topographic maps of 1905 or earlier vintage, which are contoured at 10-foot intervals. Thus, the contours were intentionally generalized and do not conform precisely to the water-level altitudes shown for some of the wells. In view of the inaccuracies inherent in the data used in constructing the map, we believe that the map is useful only for general evaluations. The piezometric surface in figure 15 shows prominent depressions in the central and southern part of the county. These depressions probably represent coalescing cones of depression resulting from withdrawals of water for municipal and industrial purposes at Greenville, and at Graingers, in Lenoir County. The reason for the deflection of the contours into western Pitt County has not been determined, but may result from withdrawals in the vicinity of Farmville.

The gross direction of ground-water movement within confined aquifers is from areas of high artesian head to areas of lower head and is generally perpendicular to the contours of the map. Although recharge is widespread, it is especially effective in areas aligned nearly coincident with the drainage divide between the Neuse and Tar Rivers. The ground water from these areas discharges into Contentnea Creek and the Neuse River. Ground water in the northern part of Pitt County discharges into the Tar River and Tranters Creek.

AQUIFER CHARACTERISTICS

The quantity of water contained in a rock material depends on its porosity. Porosity is the ratio of the volume of pore space or interstices to the total volume of the rock and is usually expressed as a percentage. The porosity of sediments depends mainly on the shape, arrangement, sorting, and the degree to which the sediments have been compacted or cemented. The particle sizes of gravel, sand, silt, and clay range widely, but their average porosity, if they are well sorted and relatively uncompacted, does not differ greatly. Fine sediment, such as silt and clay, may have a porosity of 40 to 45 percent, but because of the minute size of the pores, a large percentage of the water stored in the silt or clay is retained by molecular

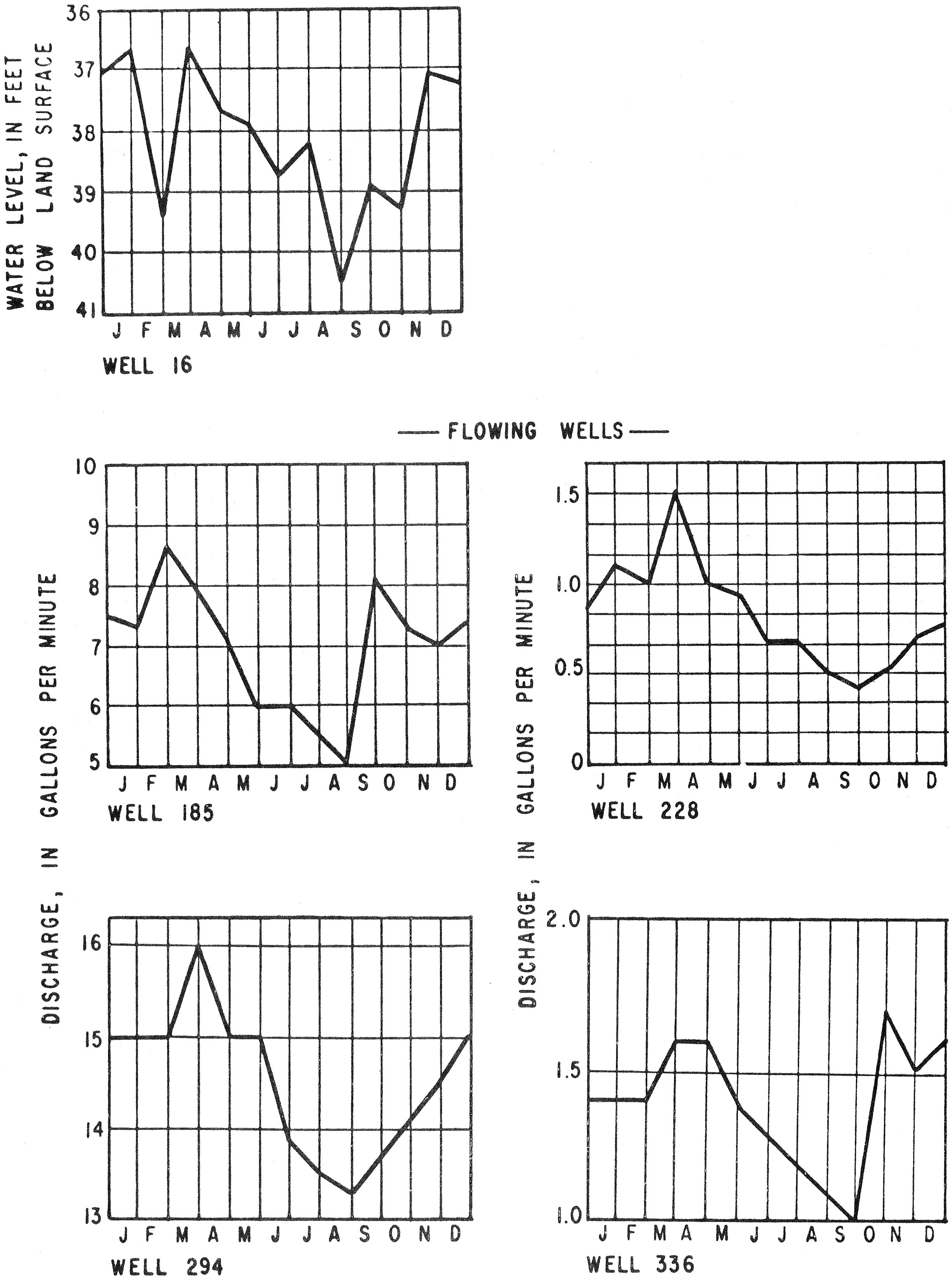


Figure 13.--Seasonal changes in water level in well 16 and in flow of other artesian wells during 1964.

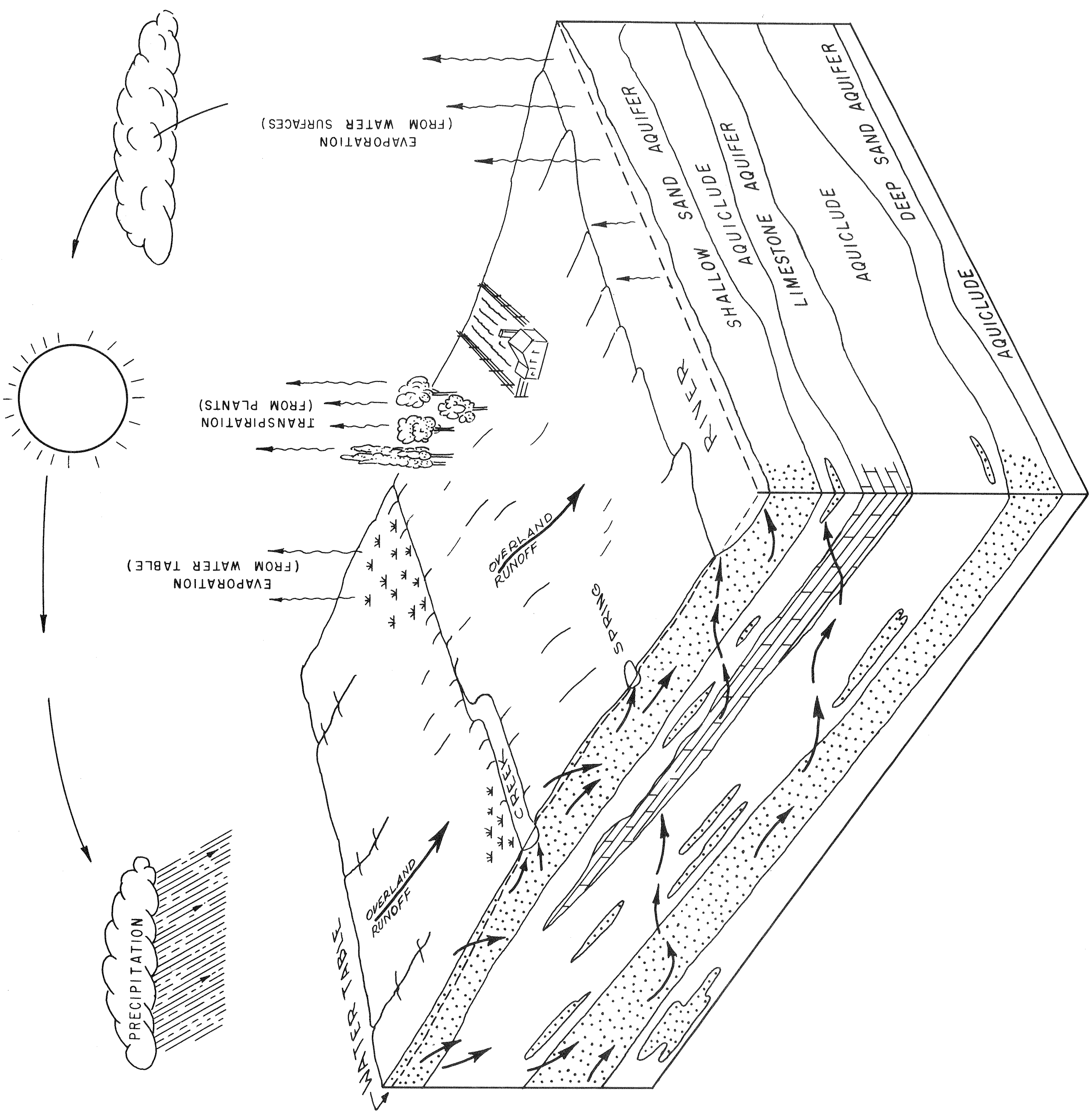
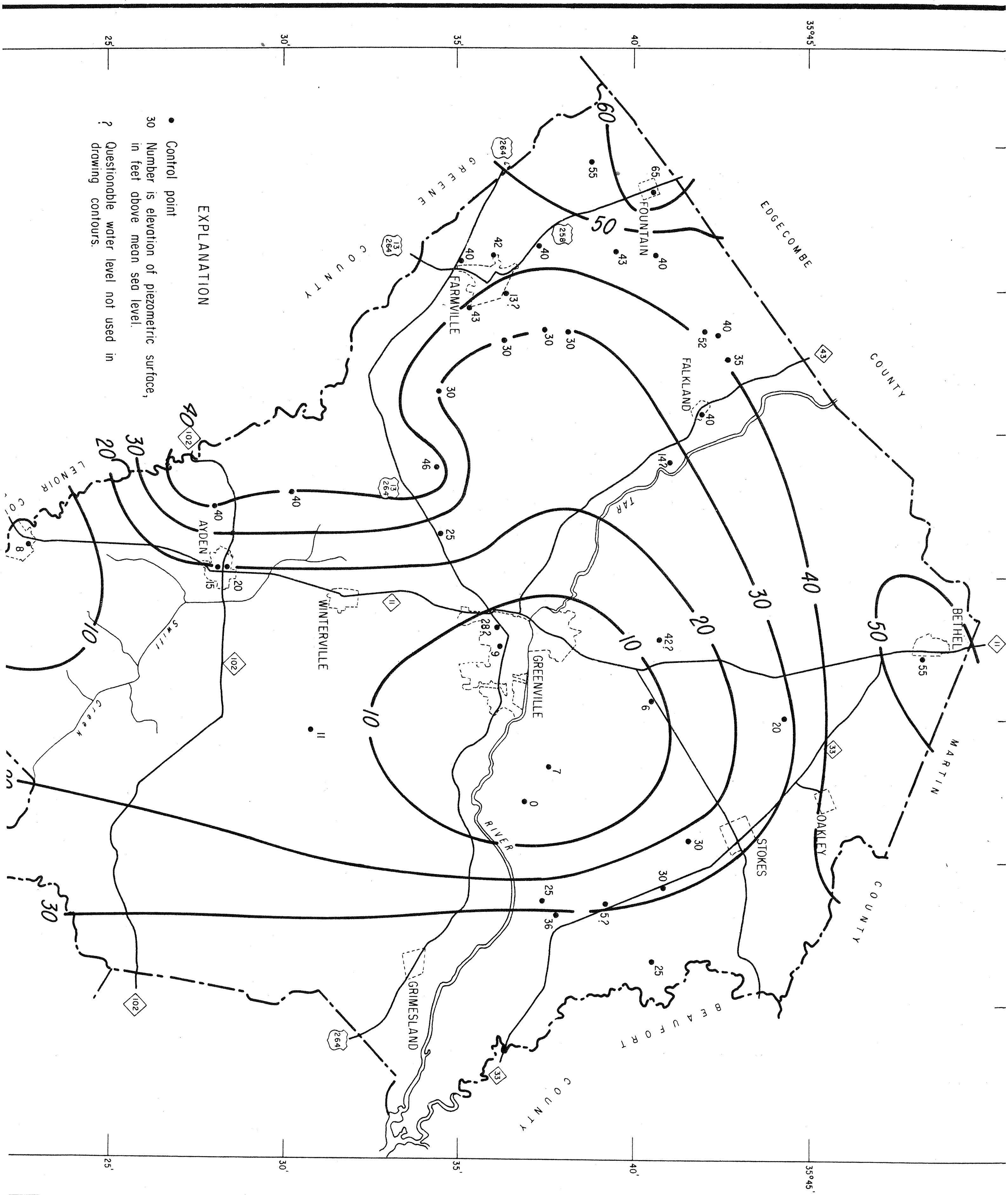


Figure 14.--Hydrologic cycle and generalized directions of ground-water movement.


EXPLANATION
• Control point
30 Number is elevation of piezometric surface, in feet above mean sea level.
? Questionable water level not used in drawing contours.
GREENE COUNTY
EDGECOMBE COUNTY
MARTIN COUNTY
BEAUFORT COUNTY
LENOIR CO.
FOUNTAIN
FARMVILLE
FALKLAND
AYDEN
WINTERVILLE
GREENVILLE
BETHEL
OAKLEY
STOKES
GRIMESLAND
TAR RIVER
SWIFT Creek
25'
30'
35'
40'
35°45'

attraction or surface tension. Some water will always be retained by surface tension in any sediment. The average porosity of Coastal Plain sediments in the Pitt County area is about 30 percent.

The two quantitative hydraulic characteristics that determine the value of an aquifer as a source of water are: (1) the capacity of the aquifer to store water, and (2) the ability of the aquifer to transmit water.

The capacity of an aquifer to store water may be expressed as the coefficient of storage (S). The coefficient of storage is the volume of water released from or taken into storage per unit surface area of the aquifer per unit change in the hydraulic pressure normal to the aquifer surface. The water released from or accepted by an artesian aquifer in response to a change in the hydraulic pressure is due to the compressibility of the aquifer material and the water.

The ability of an aquifer to transmit water is referred to as the coefficient of transmissibility. The coefficient of transmissibility is the rate of flow of ground water at the prevailing water temperature, in gallons per day (gpd), through a one-foot wide vertical strip of an aquifer under a hydraulic gradient of one foot per foot.

The property of any part of a water-bearing formation to transmit water is called its permeability. When the transmissibility (T) is known, the field coefficient of permeability (P) may be found by the relation $P = T/m$, where m is the aquifer thickness.

Hydraulic characteristics of aquifers are usually determined by analyzing the drawdowns produced in observation wells or in the pumped well when a production well is pumped at a constant rate.

The water level in a well not affected by pumping is referred to as the "static" water level. When water is withdrawn from a well, a difference in head between the water in the well and that in the surrounding aquifer is created, resulting in a flow of water toward the well. The surface of the water (or the piezometric surface where artesian conditions occur) around the well assumes the shape of an inverted cone, the cone of depression whose apex is at the well. The vertical distance between the static water level and the pumping level is known as the drawdown. The area in which the water level is lowered by pumping the well is referred to as the area of influence.

The shape and the rate of expansion of the "cone of depression" around the pumped well and thus, the yield of the well, are controlled by the hydraulic characteristics of the aquifer and the rate and duration of pumping.

The specific capacity of a well is the quantity of water in gallons per minute (gpm) that a well yields per foot of drawdown in water level in the pumped well after a given period of pumping at a constant rate. The theoretical specific capacity can be calculated from the transmissibility and storage coefficients of the aquifer. The actual specific capacity is calculated by dividing the yield by the number of feet of drawdown. The efficiency of a well is found by comparing the theoretical and actual specific capacities.

AQUIFERS

There are as many as eight aquifers underlying some areas of Pitt County. These aquifers occur in the following rock units: the Lower Cretaceous Series; the Tuscaloosa, Black Creek, Peedee, and Beaufort Formations; the Castle Hayne Limestone; and the surface sediments. Some of the aquifers extend over most of the county, whereas others are of limited extent. The aquifers generally are separated by beds of clay, but in some areas one aquifer directly overlies another, in which case they are interconnected and act as one aquifer. The aquifers and their relationship to geologic formations are shown in sections A-A' and B-B' of plate 1 and in table 2. In this report they are designated numerically, commencing with the lowermost aquifer. Plate 2 gives information at various places in the county about depths to aquifers. The hydraulic characteristics of the aquifers differ from place to place as the aquifer materials and thicknesses change. Wells yielding large amounts of water commonly penetrate and withdraw water from several aquifers. Municipal wells yielding large amounts of water from one or more aquifers are shown in table 3. The transmissibility of a series of aquifers is equal to the sum of the transmissibilities of the individual aquifers. The yield of wells tapping only one aquifer may be increased, therefore, by deepening the wells to penetrate other aquifers. Descriptions of the aquifers in Pitt County commencing with the deepest aquifer follow.

AQUIFER 1

Aquifer 1 is the lowermost aquifer in the Pitt County area. It occurs in the Lower Cretaceous Series immediately above the basement rocks. It is present throughout Pitt County, and dips to the southeast at an average of 20 feet per mile. The thickest parts of the aquifer are in the vicinity of Fountain and near the southeastern boundary of Pitt County where it is nearly 100 feet thick. The average thickness of aquifer 1 in Pitt County is 50 feet. Although no test was made of aquifer 1 alone, field observations indicate that the transmissibility is quite low, possibly in the range of 1,000 and 2,000 gpd per foot.

Aquifer 1 probably receives most of its recharge in areas adjoining Pitt County to the west and northwest, although some recharge may also reach it in Pitt County, especially in the western part.

Aquifer 1 yields soft bicarbonate-type water of excellent quality to municipal wells at Farmville. At Greenville and in the eastern part of Pitt County, the water in this lowermost aquifer is slightly brackish or saline, containing more than 250 mg/l (milligrams per liter) chloride.

AQUIFER 2

Aquifer 2 is present throughout Pitt County. It occurs in the upper part of the Tuscaloosa Formation and, in a few places, in the lowermost part of the Black Creek Formation as well. It is separated from the overlying aquifer

Table 2.--Geologic units and related aquifers in Pitt County

System	Series	Pitt County, N. C.		Characteristics in Pitt County	Ground-water characteristics in Pitt County
Quaternary	Holocene	Undifferentiated		Fluvial and eolian sand on river flood plains; sandy soil on interfluvial areas; gley soils, ground-water podzols, and acid soils and peat in lower or swampy areas; 0-10 feet.	Yields acidic ground water containing much soluble iron to innumerable shallow wells (10-30 feet) in this area; the most common source of water for homes and farms. Includes aquifer 7.
	Pleistocene			Fluviomarine sands and silts; remnants of beach-terrace deposits, offshore bars, and eolian dune deposits; 0-40 feet.	
Tertiary	Pliocene	--?--			
	Miocene	Yorktown Fm.		Dark, blue-gray, sandy clay with abundant marine pelecypod shells; overlain by massive gray silty clay; 0-105 feet.	Clays and silts of Yorktown Fm. in this area serve generally as an aquiclude, although water is obtained from sparse thin lenticular sand layers.
	Eocene	Castle Hayne Limestone		Light-gray marl, calcareous sand, coquina, and sparse green clay; abundant glauconite and phosphorite; 0-75 feet including the overlying unnamed Oligocene limestone.	Yields hard water to a few home and farm wells in the easternmost part of Pitt County; remains undeveloped because water of better quality at slightly greater depths. Includes aquifer 6.
	Paleocene	Beaufort Fm.		Green-gray glauconitic "salt and pepper" sand with thin calcareous clay and silty marl layers at irregular intervals; 0-50 feet.	Supplies soft, bicarbonate-type water to home and farm wells in the eastern part of Pitt County. Includes aquifer 5.
Cretaceous	Upper Cretaceous	Peedee Fm.		Bright-green glauconitic sand in the upper part; dark-gray clay and silt strata intergradational with thin sand beds in the lower part; 0-250 feet.	Sand aquifers yield soft, bicarbonate-type water of excellent quality to municipal and home or farm wells. Includes aquifer 4.
		Black Creek Fm.	Snow Hill Marl mem.	Mainly a gray calcareous sand with dark-gray and black clay layers.	Yields moderate amounts of water; soft, bicarbonate-type water of excellent quality. Includes aquifer 4.
			Unnamed lower mem.	Gray sand with interbedded dark-gray clay; mica, glauconite, lignite, pyrite, and collophane are conspicuous; 0-450 feet including both members.	Yields large amounts of water to municipal wells in Pitt County; soft, bicarbonate-type water of excellent quality; the principal aquifer in the Pitt County area. Includes aquifers 2, 3, and 3A.
		Tuscaloosa Fm.		Gray to red arkosic sand, gravel, and clay; mica conspicuous with some glauconite and hematite aggregates; 80-300 feet.	Yields large amounts of excellent water to municipal wells in western Pitt County; water in eastern Pitt County is slightly brackish. Includes aquifers 2 and 3.
	Lower Cretaceous	Unnamed sands and clays		Rust and tan sand bed and green clay; mica is a conspicuous accessory mineral and oyster-shell fragments are conspicuous; 50-300 feet.	Yields ample water of excellent quality to wells in western Pitt County; in eastern Pitt County these sand strata contain brackish or saline water. Includes aquifer 1.
Pre-Cretaceous rocks of the metamorphic basement complex similar to rocks exposed in the Piedmont province.				Schist, gneiss, quartzite, and related metamorphic rocks.	Not considered to be an aquifer in this area.

Table 3.--Some quantitative values of aquifers in Pitt County

Location	Well number	Aquifers supplying wells	Total length of screens	Trans-missi-bility 1/	Field perme-ability 2/	Specific capacity 3/
Ayden	349	3A 3	230	28,000	236	7.7
Bethel	22	3	30	18,000	597	3.0
	23	4 3 2	92	22,000	237	7.5
Farmville	218	3 2 1	190	26,000	139	6.0
	221	3	85	36,000	419	6.1
Fountain	40	3 2	81	25,000	311	6.0
Greenville	176	3A 3	70	30,000	437	8.5
	183	3A 3	81	28,000	349	5.7
Winterville	264	3	43	7,000	170	5.3

1/ Transmissibility is in gallons per day per foot.

2/ Field permeability is in gallons per day per square foot, calculated by dividing the transmissibility by the length of screens from the length of the screened interval.

3/ Specific capacity is in gallons per minute per foot of drawdown.

(aquifer 3) by a thin sequence of clay and silt layers which range in thickness from 10 to 60 feet. The top of the aquifer dips generally to the southeast, with local variations, at an average of 17 feet per mile. The thickest part of the aquifer is in southeastern Pitt County, where it is more than 150 feet thick. The average thickness in the county as a whole is 50 feet. The pumping test data, table 3, and field observations indicate that the transmissibility may range from 1,000 to 2,000 gpd per foot. Recharge to this aquifer occurs directly in western and northwestern Pitt County and adjoining areas to the west and northwest.

Aquifer 2 yields soft, bicarbonate-type water of excellent quality to municipal wells at Bethel, Farmville, and Fountain. However, at Greenville and in the eastern part of Pitt County, the water contains more than 250 mg/l chloride.

AQUIFER 3

Aquifer 3 is the principal aquifer in Pitt County. It occurs mainly in the lower part of the Black Creek Formation, and in the uppermost part of the Tuscaloosa Formation in a few places throughout all but the western part of Pitt County. In the westernmost part of Pitt County, aquifer 3 occurs wholly within the Tuscaloosa Formation. The top of aquifer 3 dips southeastward at an average rate of nearly 15 feet per mile. The aquifer is thickest in the central part of Pitt County, centering near Greenville, and near the southern boundary of the county in the vicinity of Grifton where it is more than 150 feet thick. The average thickness of aquifer 3 in Pitt County is 125 feet. The results of pumping tests, table 3, show a transmissibility between 15,000 and 25,000 gpd per foot. Recharge to aquifer 3 occurs directly in the western part of Pitt County.

Aquifer 3 yields soft, bicarbonate-type water of excellent quality to municipal wells at Ayden, Bethel, Farmville, Fountain, Greenville, and Grifton. Only in the easternmost part of Pitt County, beginning about midway between Grimesland and Washington, does the chloride concentration of water from aquifer 3 exceed 250 mg/l.

AQUIFER 3A

Aquifer 3A is a relatively thin aquifer which does not extend throughout Pitt County. Aquifer 3A occurs generally at or near the top of the unnamed lower member of the Black Creek Formation. The aquifer is present in the central and southern parts of the county, but thins to a featheredge northward and westward. Southward, aquifers 3 and 3A are separated by a thin (about 20 feet) aquiclude, and may be locally interconnected as a single aquifer system. The top of aquifer 3A dips southeastward at an average rate of nearly 18 feet per mile. The thickest part of the aquifer in Pitt County is in the vicinity of Grifton where it is more than 100 feet thick. The average thickness of aquifer 3A in Pitt County is 40 feet. Pumping-test data, table 3, and field observations indicate that the transmissibility may be about 10,000 gpd per foot. Recharge to aquifer 3A occurs principally in the central and eastern parts of the county.

Aquifer 3A yields soft, bicarbonate-type water of excellent quality to municipal wells at Ayden and Greenville. The quality of the water is not known to vary appreciably in Pitt County.

AQUIFER 4

Aquifer 4 extends throughout Pitt County except for a small area in the westernmost corner. In eastern Pitt County, aquifer 4 occurs mainly in the Peedee Formation. Westward it transgresses the formation boundary and becomes a part of the Black Creek Formation and pinches out east of Farmville. In the southern part of the county, the top of aquifer 4 dips southeastward at about 15 feet per mile, but the dip averages nearly 8 feet per mile to the northeast in central Pitt County. The average thickness of aquifer 4 in Pitt County is 40 feet. Field observations indicate that the transmissibility may be between 1,000 and 5,000 gpd per foot. Recharge to this aquifer occurs chiefly in the central and northern parts of the county.

Aquifer 4 yields soft, bicarbonate-type water of excellent quality to municipal wells at Ayden, Bethel, Grifton, and Grimesland. The quality of the water does not vary appreciably from one part of the county to another.

AQUIFER 5

Aquifer 5 is limited to the eastern part of Pitt County. This aquifer occurs within the Beaufort Formation in eastern Pitt County and thins westward to a featheredge at a north-trending margin about midway between Greenville and Grimesland. The dip of the aquifer is southeast at nearly 20 feet per mile. The thickest part of aquifer 5 in Pitt County is near the southeastern boundary where it is more than 50 feet thick. The average thickness in Pitt County is 30 feet. Much recharge to this aquifer occurs in the east-central part of the county.

Aquifer 5 is not extensively developed for water supplies in Pitt County. It yields moderately soft, bicarbonate-type water to domestic or stock wells. Generally this water is of excellent quality, but near the western margin of the aquifer the soluble-iron content may be slightly more than desirable.

AQUIFER 6

Aquifer 6 is limited to the easternmost part of Pitt County. This aquifer occurs within the Castle Hayne Limestone. Westward, aquifer 6 thins to a featheredge at a north-northeast-trending margin a short distance west of Grimesland. Aquifer 6 dips east-southeast at an average rate of 8 feet per mile. The limestone aquifer in Pitt County is thickest at the southeastern corner where it is more than 70 feet thick. The average thickness in the county is 20 feet. Recharge occurs throughout the area underlain by the Castle Hayne Limestone except for a narrow area along the Tar River where discharge to the river takes place. The recharge to the aquifer is most effective in the east-central part of the county where the overlying beds are thin. Recharge also occurs farther downdip but is less effective because of the thickening of the overlying beds of sand and clay. Wells in aquifer 6 are commonly cased to the top of the aquifer and then developed as open-hole wells in the indurated but porous limestone.

In adjacent counties to the east of Pitt County permeabilities of aquifer 6 generally range from 1,000 to 1,200 gpd per square foot. In Beaufort County 60-80 mgd (million gallons per day) of water is pumped to dewater an open-pit mine. No significant effects of the removal of this amount of water have been detected in Pitt County. The fact that the aquifer is capable of producing this much water in adjacent areas indicates that it may be more productive in Pitt County than available data indicate.

Aquifer 6 is not extensively developed for water supplies in Pitt County. It yields a hard, calcium bicarbonate type water. In all other respects water from aquifer 6 is of excellent quality, but it remains relatively undeveloped where slightly deeper aquifers yield softer water which does not require treatment for general use.

AQUIFER 7

This is the unconfined or water-table aquifer which underlies the entire county. It consists of the materials underlying the surface of the county and is composed of sand and clay of fluvial and marine origin. The top of aquifer 7 is near the land surface, and the aquifer is thickest in interstream areas. The unconsolidated sediments range in thickness from less than 1 foot to nearly 50 feet, the thickest occurring in the vicinity of Bethel. The average thickness of aquifer 7 in Pitt County is 25 feet. Aquifer 7 is underlain generally by the clays and silts of the Yorktown Formation except in the southern and southwestern parts of Pitt County where it rests on the Peedee and Black Creek Formations. As the mode of deposition of the sediments in aquifer 7 was diverse, so the aquifer characteristics differ within very short distances. The results of pumping tests in Martin County (Wyrick, 1966, p. 39) show that the transmissibility is 700 gpd per foot, and the field permeability is 27 gpd per square foot. Field observations suggest that the characteristics of the shallow aquifer in Pitt County are similar to those in Martin County.

Sand strata of aquifer 7 yield water to numerous shallow wells. Water from aquifer 7 commonly has noticeably large amounts of soluble iron, is slightly acidic, and has a characteristic taste. When exposed to air, the dissolved iron oxidizes, forming a rust-red precipitate which stains laundry and utensils. Large-diameter dug wells provide water with less-noticeable amounts of iron as they permit access of air to the well water. Hence, the soluble iron oxidizes and forms a precipitate which settles to the bottom of the well. Ground water in aquifer 7 may be locally contaminated from waste disposal at the land surface, by effluent from septic tanks, and by chemical contamination from insecticides and fertilizers.

TYPES OF WELL DEVELOPMENT

DUG AND BORED WELLS

Wells are dug into the unconsolidated sand and clay as far below the water table as the well diggers could work, usually during the late summer or early autumn when seasonal ground-water levels are near their lowest. The well shafts are lined with cribbing of wood, brick, or tile to prevent caving or slumping of loose sand and clay from the sides. The well was usually protected at the surface by a wooden house, and water was withdrawn by means of windlass and bucket. In the Pitt County area such wells are about 4 feet in diameter and range from 10 to 30 feet deep. They are now most commonly used as sources of water for farm animals. The obvious disadvantage of the shallow open wells is their susceptibility to contamination. However, where these wells are protected by cement or tile curbing at the land surface, and from any nearby concentrated sources of infiltrating contamination, they may provide satisfactory water for domestic use. In comparison to deeper drilled wells, the yields of shallow excavated wells are very small and the shallow ground water may be slightly acidic, containing considerable amounts of soluble iron.

Bored wells are excavated by power auger to depths of usually not more than 50 feet in the Pitt County area. They are lined with tile or concrete drain pipe which may be from 2 to 3 feet in diameter. Ground water seeps into the wells through the pipe joints and from the open well bottom. In other respects bored wells are similar to dug wells.

These relatively shallow wells are inexpensive and easily constructed. Their small yields are partially compensated for by the volume of storage provided by the excavation. Continuous care must be exercised to prevent contamination from organic or chemical sources.

DRIVEN WELLS

The unconsolidated surficial sands and clays in Pitt County are easily penetrated by driven pipe of small diameter. A screened well point, usually not more than 3 feet in length, attached to a short length of ordinary galvanized pipe commonly 1 or 1-1/4 inches in diameter, may be driven below the water table manually or mechanically. Successive lengths of pipe are attached and driven until a desired depth is attained. Wells of this type range in depth from about 8 to nearly 50 feet in Pitt County. The ease and rapidity with which driven wells may be installed has made them very common. Water is withdrawn manually by pitcher pumps or more conveniently with piston and centrifugal pumps powered electrically or by gasoline engine. Driven wells are not as susceptible to contamination as shallow open wells, but care must be exercised in locating them beyond any concentrated sources of organic or chemical contamination which might infiltrate to the water table. The yields of these shallow wells are small but usually sufficient for domestic or farm uses. Owing to the acidity of the shallow ground water, the well-point screen will corrode so that the usefulness of the driven well may be limited to a few years. However, it may be easily and economically replaced by another driven well. Soluble iron is present in varying concentrations in water from driven wells, but may be lessened by aeration and filtration treatment.

DRILLED WELLS

Abundant quantities of ground water of satisfactory quality for large-scale industrial and municipal uses can only be obtained by deep drilling. Although there are several methods of deep-well drilling, the hydraulic-rotary method has proved to be an efficient one in Coastal Plain sediments during the 50 years or so since its introduction.

The precise depths and thicknesses of aquifers and the chemical quality of their water are rarely known before drilling. Thus, it is advisable in many cases to drill a test well prior to construction of a production well. Representative samples of unconsolidated aquifer sands as they occur naturally are difficult to obtain. Hence, in order to supplement the information derived from drilling the test well, electric and/or gamma-ray well logs are made of the well. The electric well log and the gamma-ray log may be interpreted to determine the depths and thicknesses of aquifers and aquicludes; an electric log may indicate which aquifers have water containing relatively greater concentrations of dissolved solids or saline water. To minimize costs, test wells are usually of small diameter, and test pumping is commonly performed at each aquifer interval only to obtain water samples for chemical analyses. Aquifer characteristics are determined by pumping tests after completion of the production well.

Of the two types of deep-well construction, tubular and graveled-wall, the second is preferred for production of large quantities of water. The tubular-type well is installed with the well screen directly in contact with the aquifer sand; hence much care must be taken to select the proper-sized screen openings. The screen openings for this well type are necessarily very small in order to reduce entrance of very fine sand into the well. Consequently, the intake velocity of water and the friction losses are high. Drawdown of the water level within the well is excessive compared with the quantity of water withdrawn, and pumping costs are therefore relatively high. Tubular wells may be satisfactory when small to moderate quantities of water are withdrawn. In constructing a graveled-wall well, the interval of aquifers to be developed is underreamed to a larger diameter. This underreaming is accomplished by a mechanically or hydraulically expanded well bit. After underreaming, the well screens are placed adjacent to aquifers and the annular space about the screen is hydraulically packed with sorted gravel of a preselected size. The effective diameter of the well is enlarged to approach that of the gravel wall; therefore, the inlet velocity and friction are reduced. Movement of sand from the aquifers is reduced because of the reduction in the inlet velocity through the larger diameter of the graveled wall. Industrial and municipal wells of large specific capacity in the Pitt County area are, without exception, graveled wall.

The length of service or life of wells is dependent upon the manner in which it is constructed, the materials used, and the chemical quality of the ground water it is producing. Reduction of pressure in ground water adjacent to a well caused by the conversion of static head to velocity head tends to release carbon dioxide from the water. As a result, minerals that have been held in solution by virtue of the dissolved carbon dioxide then become insoluble, their precipitates forming incrustations on the well screen and on the pump, thereby reducing the efficiency of the well. When carbon dioxide is released from solution the water is, to a certain limited extent, corrosive to the well and pump materials. Corrosion of this type and screen incrustation is very slight in deep wells of the Pitt County area owing to the favorable quality of the deeper ground water. Well screens of bronze or stainless steel are commonly used, and the minimum length of efficient service of a graveled-wall well may be 20 years. Many wells on the Coastal Plain and in the Pitt County area are producing water efficiently after nearly twice that length of time.

DRAWDOWN AND THE SPACING OF WELLS

When pumping begins, the water level in a well declines proportionately to the rate of pumping. The depth to which this water level declines is known as the pumping level. When drawdown occurs within the well, water flows from the surrounding aquifer toward the well as a result of the hydraulic gradient in the vicinity of the well. The velocity of water in an aquifer flowing toward a well increases as it approaches the well. The increasing rate of flow is proportional to the slope of the water-level or piezometric surface of the aquifer. The drawdown in water levels around a pumping well forms a surface that resembles an inverted cone, the "cone of depression," which in vertical section approaches the configuration of a logarithmic curve. The theoretical relation of time, distance, and drawdown for constant discharge within artesian aquifers is shown in figure 16. The drawdown curves (which appear as straight lines on a logarithmic scale of distance) do not reflect potential aquifer leakage or hydraulic boundaries.

Cones of depression of adjacent wells overlap when the wells are pumped. The overlap of cones of depression is known as well interference. Well interference will cause increased drawdown in each of the pumped wells. Increasing the number of wells in a given area will not increase the yield of ground water proportionately unless the wells are spaced far enough apart to avoid undue interference. However, it is often entirely feasible to operate a series of adjacent wells with some interference. Under such circumstances the total drawdown in each well is equal to the sum of the drawdown effects due to its own pumping and to the interference of the adjacent well or wells, depending on distances and aquifer characteristics. Calculating the spacing of planned adjacent wells that are to be screened in more than one aquifer, as are most industrial and municipal wells on the Coastal Plain, presents some complex problems which are beyond the scope of this report. Interference between wells of large capacity that must be spaced at lesser distances can be accurately determined only by controlled pumping tests. Modified versions of the Theis nonequilibrium formula to obtain equations useful in determining proper well spacing in artesian aquifers are summarized by Lang (1961).

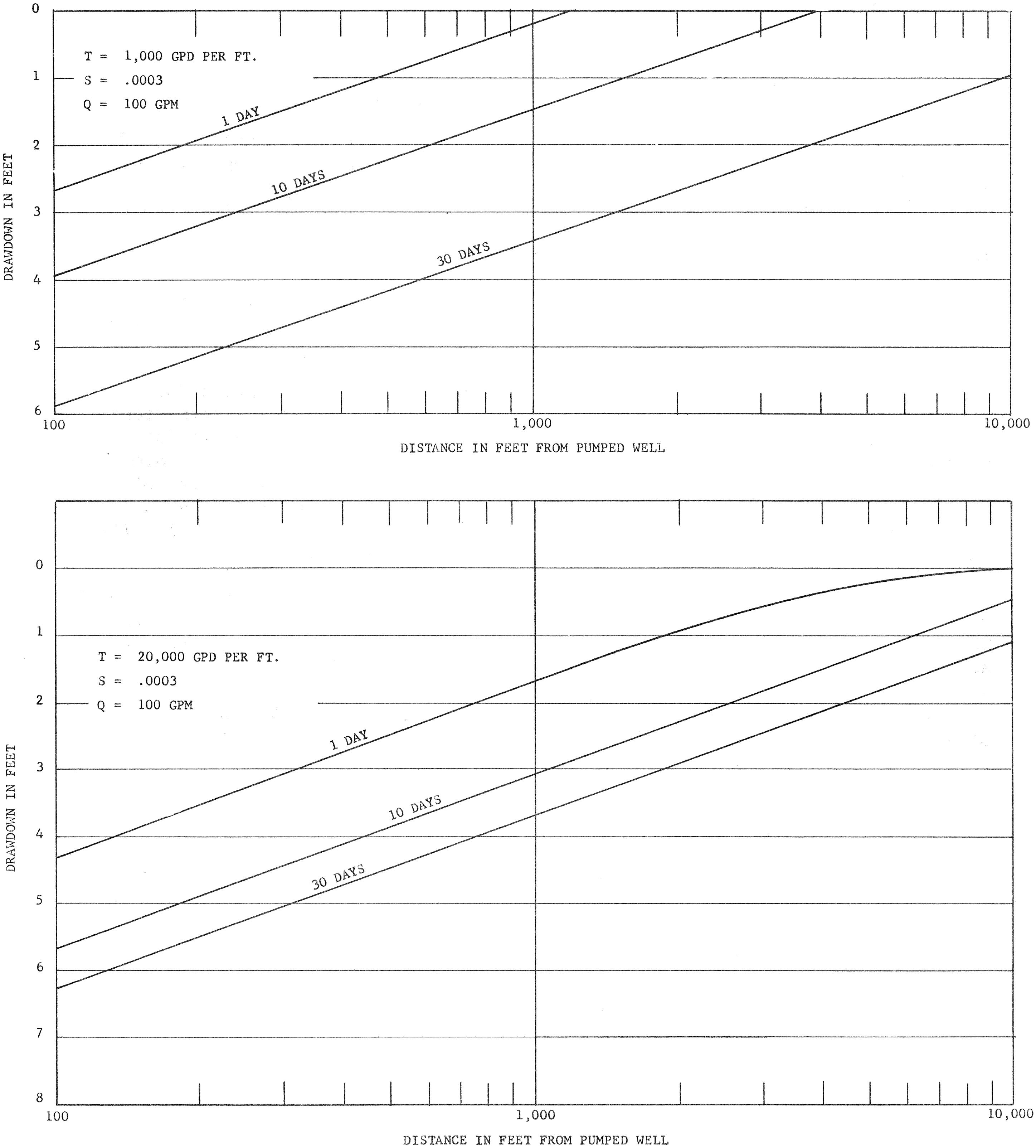


Figure 16.--Relation of drawdown to time in artesian aquifers of different transmissibilities.

UTILIZATION OF GROUND WATER

Without exception, municipal water supplies in Pitt County are obtained from deep graveled-wall wells. There are 19 municipal wells in regular use in the county. The municipal use of ground water of about 3.3 mgd in 1965 accounts for about 95 percent of ground-water pumpage. The filtration plant which processed water from the Tar River for municipal supplies at Greenville is no longer regularly used but is available on stand-by basis.

Industrial use of ground water in Pitt County has a large potential, but remains as yet relatively undeveloped. Most industrial requirements are adequately met by municipal water systems.

Agricultural use of ground water is seasonal. The use of sprinkling systems for irrigation is becoming more common during the short, intermittent rainless periods that sometimes occur during the early part of the growing season. The sources of water for irrigation are commonly the numerous farm ponds excavated to shallow depths in the surficial sands and silts. Use of this shallow source of ground water does not affect the deeper aquifers, as the amount of water used for irrigation is relatively small, and there is little ground-water recharge to deeper aquifers during the growing season.

Domestic uses of municipal water supplies in Pitt County continue to accelerate concurrently with the nation's increasing demands on water supplies. The per-capital use of water in North Carolina approaches that of the nation as a whole (MacKichan and Kammerer, 1961).

The available supplies of water in Pitt County from both streamflow and ground-water sources far exceed present and foreseeable demands.

CHEMICAL QUALITY OF WATER

The chemical quality of water is determined by the amounts and varieties of dissolved substances within it. The quantities and kinds of solutes in ground water are expressed as milligrams per liter (mg/l) or milliequivalents per liter (me/l). One milligram per liter is equal to one part per million.

Rainfall contains dissolved carbon dioxide (CO_2) from the air which imparts acidity to the water. The slightly acid rainfall is capable of dissolving still other substances from the surface materials through which it flows after reaching the earth. Hence, the chemical quality of ground water may change as it moves through the water-bearing materials from place to place in the Coastal Plain. As a result of ion exchange within the aquifers the quality of ground water improves as it moves from shallow aquifers through the deeper water-bearing sands; thus, the acidity of the water is practically neutralized, hardness diminishes, and the water becomes a sodium bicarbonate type, ideal for municipal and most industrial uses.

Contamination of ground water results from the deliberate or inadvertent contribution of undesirable chemical or biological substances to it in concentrations sufficient to render it unpotable or unusable, or by causing saline intrusion into fresh-water aquifers by uncontrolled pumping of near-shore wells. The possibility of ground-water contamination becomes a critical factor as the degree of industrialization increases. Contamination of ground water has not been detected in any of the artesian aquifers in Pitt County.

Nearly all ground waters sampled in Pitt County are suitable for most household and industrial uses. A discussion follows of each constituent or characteristic commonly reported in the chemical analyses of water. Table 4 contains chemical analyses of ground water from 16 wells in the county.

HARDNESS

The property of hardness is generally associated with the amount of soap required to maintain a lather in a particular water. Incrustation on cooking utensils from boiling water and some of the scale or incrustation in steam boilers are caused by the hardness of water. Calcium (Ca) and magnesium (Mg) are the principal solutes causing hardness. When water evaporates or reacts with soap, these cations form insoluble residues. The U. S. Geological Survey uses the classification of water hardness which is reported in terms of calcium carbonate ($CaCO_3$) as follows:

Hardness as $CaCO_3$ in milligrams per liter (mg/l)	Classification
0 - 60	Soft water
61 - 120	Moderately hard water
121 - 180	Hard water
More than 180	Very hard water

Table 4.--Chemical analyses of water from selected wells in Pitt County
(Reported in milligrams per liter except as indicated)

Well location and sequence number	Well number	Depth of well (ft)	Aquifer Number	Date of collection	Specific conductance (micromhos at 25°C)	pH	Temperature (°F)	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Iron (Fe)	Manganese (Mn)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Ca, mg	Hardness as $CaCO_3$: Noncarbonate
354809N0772212.2	18	376	3,4	07-30-58	170	5.5	63	13	7.1	1.8	20	3.4	4	24	28	0.1	4.9	0.02	0.00	108	26	22
A/ 354018N0773846.1	40	213	2,3,	05----60	224	7.5	62	19	19	6.1	20	5.4	132	2.1	9.0	.1	.0	.03	.00	147	73	0
B/ "	40	213	2,3,	05----60	249	8.4	62	31	3.4	2.4	48	8.7	151	3.1	7.5	.0	.0	.15	.01	179	19	0
354036N0773816.1	42	35	7	10-28-63	42	6.0	62	20	2.9	.8	2.4	2.2	8	5.0	4.5	.0	2.7	1.3	--	46	10	4
354059N0771951.1	100	200	3A	02-17-55	384	7.4	61	18	1.0	.8	86	7.0	172	8.6	32	.4	.3	.00	.00	244	6	0
353528N0772101.1	176	484	3,3A	11-11-65	410	8.0	--	17	1.6	.1	100	1.1	223	13	18	2.2	.0	.07	.02	274	5	0
353608N0772316.1	184	373	3,3A	02-27-56	366	8.0	--	19	2.3	.7	86	6.0	224	6.7	8.3	1.3	.0	.13	--	240	9	0
353646N0773609.1	220	480	2,3,3A	09-03-64	303	7.6	62	17	1.8	2.5	62	8.5	182	3.2	4.7	.4	.4	.25	.03	191	15	0
353242N0773048.1	240	98	3A	01-02-64	298	8.1	--	20	27	6.4	31	7.5	193	1.6	1.0	.4	--	1.2	--	191	94	0
C/ 353152N0772410.1	261	675	3	07-29-65	363	8.4	66	12	1.2	.4	80	5.7	202	7.0	10	1.6	.2	.09	.01	218	4	0
D/ "	261	675	3	07-25-65	551	8.6	--	16	2.0	.7	124	6.1	247	26	34	3.2	.2	.05	.02	343	8	0
353140N0772210.1	267	63	4	10-28-63	340	7.8	--	38	51	7.2	12	8.4	215	.4	5.2	.0	2.7	.06	--	231	156	0
353342N0771132.1	298	188	4	11-07-63	498	7.7	--	17	13	5.4	94	22	300	8.4	9.4	2.1	.1	.14	.00	320	56	0
352804N0772521.1	348	240	3,3A	02-02-54	550	8.1	--	9.2	6.8	4.1	E/118	--	296	14	22	1.1	.5	.05	.00	326	34	0
352801N0772522.1	349	480	3,3A	04-03-63	430	8.6	--	10	.9	.0	104	4.7	226	11	18	1.1	.8	.06	.01	274	2	0
352236N0772606.1	371	580	3,3A	02-05-64	290	8.0	--	11	.6	.1	68	4.5	157	6.0	11	.3	--	.07	--	181	2	0

A/ Depth of interval sampled 132'-135'.
B/ Depth of interval sampled 207'-213'.
C/ Depth of interval sampled 420'-430'.
D/ Depth of interval sampled 500'-510'.
E/ Calculated Na plus K, reported as Na.

Water from the shallow unconfined aquifer in Pitt County is generally moderately hard to very hard. In the uppermost artesian aquifers water is soft or in the lower range of moderately hard. The deeper artesian aquifers yield soft water of sodium bicarbonate type which does not require treatment for hardness.

TURBIDITY

The filtering effect of the sand layers of deep aquifers prevents movement of fine material in ground water. Turbidity in water from shallow wells becomes apparent if it contains soluble ferrous iron, which on standing in contact with air, oxidizes to insoluble rust-red ferric oxide. Colloidal material, generally clays, may also cause varying degrees of turbidity.

The amount of turbidity tolerable in ground water depends on the nature or cause of turbidity and the use for which the water is intended. For drinking water, the recommended tolerance is 10 mg/l (as silica). Only two deep wells in Pitt County have produced water with noticeable turbidity, and in both cases this was reduced to negligible amounts of continuous pumping.

Turbidity caused by oxidation of ferrous iron may be removed by sand filtration. Traces of turbidity caused by colloidal clays may also be removed from water by simple filter systems.

TEMPERATURE

Water temperatures in the shallow unconfined aquifer in Pitt County are affected seasonally by changes in air temperature and may range from about 55°F to about 64°F. In the deeper artesian aquifers, water temperatures are more constant, averaging about 62°F. Water temperature and its seasonal fluctuation, if any, are major considerations when water is to be used for industrial cooling. Ground water is ideal for this purpose because of its relatively low, uniform temperature. Having been used for industrial cooling, ground water may be recharged to the aquifer to avoid excessive depletion of the supply.

SPECIFIC ELECTRICAL CONDUCTANCE

Electrical conductance is the ability of a substance to conduct an electrical current. Specific conductance is the conductance of a 1-centimeter cube of the substance, or "volume conductivity" and "conductivity per centimeter." Chemically pure water, as a liquid, has a very low conductance. The presence of ionized solutes in water renders it electrically conductive. Specific conductance values are expressed in reciprocal ohms times 10^6 (Micromhos) at a standard temperature of 25°C (77°F). The relation of dissolved solids to specific conductance may be expressed as:

Dissolved solids (mg/l) = A (a variable factor) x Specific conductance (micromhos)

The variable factor A ranges in value from 0.55 to 0.75 unless the water has an unusual composition (Hem, 1959, p. 40).

High specific conductance in waters of the Coastal Plain area may indicate salinity, although it is commonly considered to be a measure of other dissolved solids as well.

HYDROGEN-ION CONCENTRATION (pH)

The chemical symbol pH denotes the negative logarithm of the concentration of hydrogen ions in gram atoms per liter, and expresses either the acidity or alkalinity of a solution. Values of pH are scaled from 0 to 14. A pH value of 7 is neutral, values greater than 7 indicate alkalinity, and values of pH less than 7 indicate acidity. The pH values are important as indicators of the corrosive potential of ground water. Ground water which has a low pH value is acidic and may be corrosive to well screens, pumps, and plumbing systems.

In Pitt County, water from the shallow unconfined aquifer has pH values of less than 7, indicating that the water is acidic. Water from the deeper aquifers has pH values somewhat greater than 7, indicating slight alkalinity. Water from the municipal wells in Pitt County has pH values ranging from about 7.2 to about 8.9, and does not require treatment for municipal and most industrial uses. The acidity or alkalinity of water is easily controlled by simple treatment.

SILICA (SiO_2)

The major constituent of the Coastal Plain sands is crystalline quartz (SiO_2). However, because of its resistance to direct reaction with water, quartz sand is not regarded as a likely source of dissolved silica in Coastal Plain waters. The decomposition of silicate minerals such as the relatively sparse amphibolites and feldspars accessory to Coastal Plain quartz sand may result in the formation of clay minerals having surplus silica which is more directly soluble. Not all silica is considered to be in dissolved or ionic form but may occur as a very finely divided colloid.

In ground waters of Pitt County, silica ranges from 9 mg/l to 38 mg/l averaging about 18 mg/l. Most industrial processes tolerate silica in these concentrations.

ALUMINUM (Al)

Aluminum is present in most silicate minerals, but is highly resistant to weathering or solution, even more so than silica. Residual aluminum is present in clays and shales. Concentrations of aluminum great enough to be reported in chemical analyses are rare, particularly in Coastal Plain ground waters. An aluminum concentration as great as 0.1 mg/l was reported in one analysis in Pitt County. The usual analysis of ground water in Pitt County does not report concentrations of aluminum.

IRON (Fe)

Iron sulfide, as pyrite or marcasite, is very common in the beds of clay, silt, and shale of the Coastal Plain and particularly in those of Cretaceous age. Iron oxide, as rust-brown limonite, stains the more recent surficial sand and clay. Iron is a component of the ferrosilicate accessory minerals which occur with quartz sand of the Coastal Plain, but these minerals are sparse and not major contributors of iron to the Coastal Plain waters.

The acidity of water is the limiting factor of iron solubility. In the shallow unconfined aquifer, ferrous iron occurs in acidic ground water. When this water is exposed to air, the ferrous iron oxidizes to the rust-red insoluble ferric state commonly observed on some laundry and plumbing fixtures. Water containing soluble iron may favor the growth of bacteria commonly known as crenothrix. This bacterial infestation occurs mainly during warm weather as red-brown masses of algal-like growths which may cause clogging of water mains and meters or pumps. Although not hygienically injurious, this bacteria imparts an unpleasant taste to water and may stain laundry. Crenothrix may be controlled or eliminated from water mains by chlorination.

Excessive iron concentrations are common where water is pumped from the shallow sediments. The shallow ground water generally is more corrosive than deeper water. Oxygen and carbon dioxide are the principal constituents of ground-water causing corrosion. As the shallow water moves downward through the soil and rock sediments, the oxygen is used up in the oxidation of organic and inorganic matter; the carbon dioxide reacts with carbonates to form bicarbonates.

It is not always apparent whether the iron is in the water as it enters the well, or whether the water dissolves the iron from the well casings and pipes. It is important to determine the source of the iron, whether dissolved from the rocks or the pipes, before methods for its removal are employed.

In the deeper artesian aquifers soluble iron may be present, but generally not in excess of 0.2 mg/l, and some wells produce ground water with less than 0.1 mg/l iron.

MANGANESE (Mn)

As it occurs in natural waters, manganese resembles iron in its chemical characteristics. However, it is much less abundant than iron and is seldom reported in chemical analyses because of its very small concentrations. Manganese in water may support growths of crenothrix-types of bacteria in the same manner as iron.

The greatest concentration of manganese reported from analyses of artesian ground water in Pitt County is only 0.03 mg/l.

CALCIUM (Ca) AND MAGNESIUM (Mg)

Calcium is a component of nearly all rock types but is most abundant in limestone, which is predominately calcium carbonate ($CaCO_3$). Magnesium occurs in varying amounts in limestone as a double carbonate with calcium [$CaMg(CO_3)_2$] or as magnesite ($MgCO_3$). Calcium is a constituent of many silicate minerals which may weather to yield soluble calcium and a residue of clay minerals. Magnesium-silicate minerals yield soluble magnesium in the same manner. The sources of calcium and magnesium in waters of Pitt County aquifers are marl and limestone interbedded with quartz sand, and shell layers such as those so prominent in the Yorktown Formation. Calcium and magnesium are quite soluble in acidic waters where carbon dioxide is present. Both calcium and magnesium contribute to hardness in water, although hardness is reported in chemical analyses as calcium carbonate.

Of chemical analyses of ground water from 20 deep wells in Pitt County, calcium values range from 0.4 mg/l to 51 mg/l, averaging about 5 mg/l. In these same analyses magnesium values range from 0.0 mg/l to 8.9 mg/l, and average about 2.4 mg/l.

SODIUM (Na) AND POTASSIUM (K)

The high concentration of sodium in sea water indicates the tendency of this ion to remain in solution once it has been dissolved. Potassium is less common than sodium in natural waters, because the potassium bearing minerals are less soluble. Sodium most commonly occurs in high concentrations in saline ground water in near-shore areas and in connate or fossil sea water. Even in sea water, potassium occurs in far smaller concentrations than sodium. Base exchange, or adsorption by clays, is one of the means by which potassium is removed from solution. The conversion of montmorillonite to illite (both are clay minerals) is likely one of the most effective processes in removal of potassium from natural waters (Mason, 1952, p. 136-137).

In the bicarbonate waters of the deeper artesian aquifers in Pitt County, sodium concentrations in samples from 16 wells ranged from about 2 mg/l to 210 mg/l averaging 95 mg/l. Potassium in the same analyses ranged from 1 mg/l to 22 mg/l.

CARBONATE (CO_3) AND BICARBONATE (HCO_3) ALKALINITY

The alkalinity of water may be defined as its capacity to neutralize acid. In chemical analyses it is usually reported in terms of equivalent amounts of carbonate and bicarbonate. Anions, which form only weakly ionized acids in solution, thus entering into hydrolysis reactions, are those that contribute to alkalinity. Owing to the relative abundance of carbonate sediments such as limestone and marl in the Coastal Plain, and to carbon dioxide which goes into a state of chemical equilibrium with them, bicarbonate and carbonate are common in most waters. Alkalinity as hydroxide in natural waters is uncommon and may indicate artificial contamination.

Of water from eight deep wells in Pitt County in which alkalinity is reported as equivalent calcium carbonate in milligrams per liter, values range from 120 mg/l to 212 mg/l averaging about 165 mg/l. The pH values of these same analyses average about 7.8.

SULFATE (SO_4)

In natural waters, sulfur occurs most commonly in a completely oxidized state as sulfate. In the clays, silts, and shales of Coastal Plain sediments, unaltered sulfide minerals may be in part oxidized in an acidic environment to yield soluble sulfur as sulfate. Where calcium, magnesium, and sodium sulfate minerals are present in limestones and marls, sulfate may be released into solution. The sulfate ion is chemically stable under most conditions after it is in solution. The recommended tolerance for sulfate in drinking water is 250 mg/l.

The results of analyses of water from 23 deep wells in Pitt County showed sulfate values ranging from less than 1 mg/l to 62 mg/l and averaging about 13 mg/l.

CHLORIDE (Cl)

The predominant anion (and the most abundant ion) in sea water is chloride. When porous rocks or sediments such as those comprising the formations of the Coastal Plain are submerged by the sea after deposition, the sediments become infused or permeated by the soluble salts present in sea water. Relict or connate sea-water salts may be retained by incompletely leached sediments after their emergence from the marine environment. The salinity of water is commonly expressed in terms of chloride-ion concentration although other solutes are involved, so that sea water may contain about 35,000 mg/l of solutes, of which about 19,000 mg/l are chloride. The recommended tolerance of chloride in drinking water is 250 mg/l.

Of 20 deep wells in Pitt County, chemical analyses of ground water show chloride ranging from about 1 mg/l to 86 mg/l, and averaging about 20 mg/l. The greatest concentration of chloride in water from deep test holes in Pitt County is 335 mg/l.

FLUORIDE (F)

Fluorine, like chlorine, is a member of the halogen group of elements. Most fluorides are much less soluble than chlorides and less common in natural waters. Fluorite (calcium fluoride) is the most common of the fluoride-bearing minerals. The source of the fluoride in ground water in sedimentary formations has been attributed to several different minerals, but the source is uncertain. The recommended tolerances for fluoride in drinking water depend on the annual averages of maximum daily air temperatures, ranging from 0.6 mg/l fluoride at 90.5°F to 1.7 mg/l fluoride at 50°F. The recommended maximum limit of fluoride concentration in drinking water is 1.5 mg/l.

Chemical analyses of water from 22 deep wells in Pitt County show a range of concentration of fluoride from less than 0.1 mg/l to 3.2 mg/l. The average concentration of fluoride of these same analyses is 1.0 mg/l.

NITRATE (NO_3)

Nitrogen, oxygen, and moisture in the atmosphere are combined by the effects of electrical discharges during storms to produce nitrates and ammonia. Much of the nitrate in rainfall is very likely relinquished to the soil. Legumes increase the nitrate in the subsoil, and chemical fertilizers may add to this. Nitrates not consumed by vegetation may reach the unconfined aquifer and eventually even the artesian aquifers. However, nitrate concentrations in artesian ground waters in Pitt County are commonly so slight that nitrate is not reported in chemical analyses. Of 16 chemical analyses of water from deep wells in the county the nitrate concentration ranges from less than 0.1 mg/l to 4.9 mg/l, averaging about 0.2 mg/l.

PHOSPHATE (PO_4)

Phosphate is present in igneous rocks, largely in the mineral apatite. Weathering of igneous rocks may produce calcium phosphate, which is slightly soluble in the presence of carbon dioxide. Phosphates in soils occur largely as cyclic products of vegetation. Chemical fertilizers may be a source of phosphates in the subsoil, and in surface waters. Phosphate occurs in sedimentary formations as phosphorite. The composition of this rock is complex, consisting of what is probably a group of closely related minerals. Chemically, phosphorite is tricalcium phosphate with varying amounts of calcium carbonate and fluoride.

Chemical analyses of water from 29 deep wells in Pitt County show a range of phosphate concentration of less than 0.1 mg/l to 2.2 mg/l. The average phosphate concentration of these same analyses is only 0.9 mg/l.

WATER CONDITIONING

The quality of water from deep wells in Pitt County is excellent for municipal use and for most industrial processes. Water treatment, other than occasional chlorination in warm weather to control algae and crenothrix bacteria, is not required for water from the deeper artesian aquifers.

Water from the shallow unconfined aquifer is slightly acidic and corrosive, thus containing varying amounts of soluble iron. It has sufficient dissolved calcium and magnesium so that the hardness (as $CaCO_3$) ranges from moderately hard to very hard. However, this shallow source of ground water should not be overlooked as a potential water supply. Economics and the intended uses of the water will, of course, determine what the source of the ground water will be. In the event that economics indicate use of water from the shallow unconfined aquifer, water conditioning or treatment will very likely be desirable.

Iron is one of the most troublesome substances in water. It is readily soluble in acidic ground water where it may be present as ferrous bicarbonate, a common constituent of shallow ground water in the Coastal Plain. The rust-red turbidity occurring in such water on exposure to air results from oxidation of the ferrous iron to insoluble ferric oxide. The soluble iron and acidity of shallow ground water may be reduced or nearly eliminated by aeration and filtering. Aeration may be very simple; it requires that the maximum surface of the water be exposed to air. This may be accomplished by pumping the water through a sprinkler system against a series of baffles before it is filtered. Passing this aerated water over crushed limestone, such as that available from a number of quarries in eastern North Carolina, will remove much of the carbon dioxide serving to hold the iron in suspension. Limestone filtering will also reduce the acidity of the water. Passing the water through a bed of fine sand will remove the rust-red insoluble iron. Fine, clean, well-sorted sand is available from many dune deposits throughout the area. The filter bed should be constructed to permit a reverse flow for occasional backwashing or replacement of the sand when necessary. Other means of treating water for removal of iron are described by Nordell (1961).

The cation-exchange process, more commonly known as the zeolite process, is used to reduce the hardness in water when relatively small volumes of water are to be used. The zeolites may be either natural or synthetic silicates, and as hard water passes over them, calcium and magnesium are exchanged for sodium. Zeolites may be reactivated after this exchange is completed by passing a solution of sodium chloride (from common rock salt) through the water softener and then backwashing with clean water. Large volumes of water are usually treated for hardness by the soda-lime (zeolite) process. This and other methods of treating water for hardness are described by Nordell (1961).

SUMMARY AND CONCLUSIONS

Pitt County lies within the Neuse River and the Tar River drainage basins; 283 square miles are in the Neuse River basin and 373 square miles are in the Tar River basin. Land-surface relief is gentle, averaging about 3 feet per mile from west to east over the county. The Tar River flows through the county from northwest to east.

Pitt County is underlain by sedimentary formations common to the Atlantic Coastal Plain, the formations ranging in age from Early Cretaceous to Holocene. These sediments range in total thickness from about 300 feet in the west to nearly 1,200 feet in the southeastern part of the county. Seven major artesian aquifer systems have been defined in these sediments. The average coefficient of storage of the artesian aquifers in Pitt County is 0.0003, and coefficients of transmissibility of these aquifers range from about 1,000 to about 18,000 gallons per day per foot. Recharge to the aquifers takes place mainly during the first half of the water year, October through March.

Chemical quality of the ground water in the county is generally good. Water from the shallow unconfined aquifer is hard and may contain objectionable amounts of soluble iron. Artesian aquifers throughout the county provide water of excellent quality except where brackish or saline water occurs at greater depths in eastern Pitt County. There has been no evidence of contamination of artesian aquifers by industrial effluents or by saline intrusion.

Ground water in Pitt County has been developed mainly for municipal, private domestic, and farm supplies. Private industrial use of ground water is not yet great. Nowhere in the county has there been an overdraft, and the full potential of ground water remains to be utilized.

REFERENCES

Billingsley, G. A., Fish, R. E., and Schipf, R. G., 1957, Water resources of the Neuse River basin, North Carolina: U. S. Geol. Survey Water-Supply Paper 1414, 89 p.

Brown, P. M., 1957, Upper Cretaceous Ostracoda from North Carolina: North Carolina Dept. Conserv. and Devel. Bull. No. 70, p. 5-6.

______ 1958, Well logs from the Coastal Plain of North Carolina: North Carolina Dept. Conserv. and Devel. Bull. No. 72, p. 45-46.

______ 1959, Geology and ground-water resources in the Greenville area, North Carolina: North Carolina Dept. Conserv. and Devel. Bull. No. 73, p. 78-85.

Clark, W. B., Miller, B. L., Stephenson, L. W., Johnson, B. L., and Parker, H. N., 1912, The Coastal Plain of North Carolina: North Carolina Geol. and Econ. Survey, v. 3, 552 p.

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

Fenneman, N. M., 1938, Physiography of eastern United States: McGraw Hill Book Co., New York, 714 p.

Floyd, E. O., 1969, The ground-water resources of Craven County, North Carolina: U. S. Geol. Survey Hydrol. Inv. Atlas, HA-343 (in press).

Goddard, G. C., Jr., 1963, Water-supply characteristics of North Carolina streams: U. S. Geol. Survey Water-Supply Paper 1761, 223 p.

Hem, John D., 1959, Study and interpretation of the chemical characteristics of natural water: U. S. Geol. Survey Water-Supply Paper 1473, 269 p.

Kimrey, J. O., 1965, Description of the Pungo River Formation in Beaufort County, North Carolina: North Carolina Dept. Conserv. and Devel. Bull. No. 79, 131 p.

Lang, S. M., 1961, Methods for determining the proper spacing of wells in artesian aquifers: U. S. Geol. Survey Water-Supply Paper 1545-B, 16 p.

LeGrand, H. E., 1956, Ground-water resources in North Carolina: North Carolina Dept. Conserv. and Devel. Bull. No. 69, p. 16-19.

MacKichan, K. A., and Kammerer, J. C., 1961, Estimated use of water in the United States: U. S. Geol. Survey Circ. 456, 44 p.

Mason, Brian, 1952, Principles of geochemistry: John Wiley and Sons, Inc., New York, 276 p.

Mundorff, M. J., 1945, Progress report on ground water in North Carolina: North Carolina Dept. Conserv. and Devel. Bull. No. 47, p. 41-58.

Nordell, Eskel, 1961, Water treatment for industrial and other uses: Rheinhold Publishing Corp., New York.

Swain, F. M., and Brown, P. M., 1964, Ostracoda from wells in southeastern United States: North Carolina Dept. Conserv. and Devel. Bull. No. 78, 55 p., 5 pls.

Thornthwaite, C. W., 1948, An approach toward a rational classification of climate: Geog. Rev., v. 38, p. 55-94.

Wyrick, G. G., 1966, The ground-water resources of Martin County, North Carolina: North Carolina Dept. Water Resources Ground-Water Bull. No. 9, 85 p.

Yust, Walter, and Hudson, D. G., editors, 1949, Encyclopedia Britannica world atlas: Encyclopedia Britannica, Inc., Chicago, Ill.

BASIC DATA

Table 1.--Log of test well 261 at Winterville, N. C.

Location: About 0.1 mile north of county road 1133 and about 300 feet east of Highway 11 in Winterville.
Date drilled: July 1965.
Altitude: 70 feet above mean sea level.
Diameter of well: 6 inches, from surface to bottom.
Depth of well: 675 feet.
Static water level: 13.4 feet below land surface 24 hours after completion.

Depth (feet) below land surface	Interval in feet	Log of well
		Quaternary - post-Miocene deposits
0-10	10	Brick fragments, red. Soil and ash, dark gray. Surficial detritus.
10-18	8	Silt and fine sand, yellow. Sparse white clay.
18-24	6	Sand, yellow, medium to coarse, subangular, sparse yellow and white clay matrix, limonite stained.
		Miocene - Yorktown Formation
24-34	10	Sand, gray, fine, subangular, and gray silt and clay matrix.
34-42	8	Clay, gray, silty and fine gray sand, white shell fragments. Sand phosphoritic and glauconitic.
42-62	20	No samples recovered.
62-70	8	Clay, gray-green, abundant white shell fragments, silty and sparse fine sand, phosphoritic and glauconitic.
		Upper Cretaceous - Peedee Formation
70-90	20	Sand, dark gray, fine to coarse and sparse grit, phosphoritic and traces of glauconite, blue quartz grit, and shell fragments.
		Upper Cretaceous - Black Creek Formation
90-112	22	Sand, gray, fine to medium, phosphoritic and glauconitic, water-bearing "Salt and pepper" sand.
112-133	21	Sand, gray, fine to medium, and sparse blue quartz grit. Phosphoritic and glauconitic, some white shell fragments.

Depth (feet) below land surface	Interval in feet	Log of well
133-143	10	Clay, dark-gray, silty and sandy. Sparse blue quartz grit. Traces of weathered mica (muscovite?).
143-154	11	Sand, very fine, dark-gray with dark-gray clay and silt matrix, micaceous. Glauconitic and sparse white shell fragments.
154-194	40	Sand, dark-gray, very fine with abundant dark-gray silt and clay. Micaceous and white shell fragments.
194-235	41	Sand and clay, dark-gray and gray-green, silty, micaceous, abundant glauconite and phosphorite.
		Upper Cretaceous - Tuscaloosa Formation
235-287	52	Sand, gray, fine to medium, glauconitic and sparse silt and traces of gray clay.
287-307	20	Sand and clay, gray, fine, glauconitic and micaceous.
307-317	10	Sand, gray, fine, and sparse red clay fragments.
317-328	11	Sand, gray, fine, and sparse red and medium-gray clay fragments.
328-338	10	Sand, gray, fine, sparse gray silt and clay, glauconitic and micaceous.
338-389	51	Sand, gray, fine to medium, sparse mica and glauconite.
389-399	10	Clay, dark-gray, silty and sparse fine to medium sand, and mica and glauconite.
399-451	52	Sand, gray-tan, fine to medium-coarse, sparse fragments of dark-gray clay, micaceous and glauconitic. Water sample taken from 420-430 ft. interval for chemical analysis.
451-461	10	Clay, dark-gray, sparse fine sand and silt, mica and glauconite.
461-471	10	Sand, gray-tan, fine to medium, micaceous and glauconitic. Water sample taken from 460-470 ft. interval for chemical analysis.
471-482	11	Sand, gray-tan, medium to coarse, and mica and fine glauconite.
482-492	10	Clay, gray-green, and traces of sparse, red, medium sand.
492-502	10	Clay, red-gray, and traces of medium sand.

Depth (feet) below land surface	Interval in feet	Log of well
502-512	10	Sand, light-gray fine, and silt and gray clay. Water sample taken from 500-510 ft. interval for chemical analysis.
512-553	41	Sand and clay, tan and red-gray, silty to medium, glauconitic, sparse hematite aggregates.
553-563	10	Sand, tan, fine to coarse, limonite-stained, glauconitic, sparse hematite and gray-green clay.
563-625	62	Sand and clay, tan and gray-green, fine to medium sand, sparse hematite and white shell fragments.
		Lower Cretaceous - undifferentiated
625-635	10	Sand, tan, fine to medium, sparse green clay fragments, sparse hematite and green feldspar grains.
635-675	40	Sand, tan, fine to medium, very sparse green clay fragments, green feldspar grains and hematite aggregates. The test was terminated at 675 feet.

Basement complex is estimated to be at about 790 feet below land surface.

(Lithologic descriptions by C. T. Sumsion)

Table 5.--Records of wells in Pitt County, N. C.

Ownership: C-County; F-Federal Government; M-Municipal; N-Corporation or Company; P-Private. Type of QW analysis available: P-Partial; C-Complete. Log data available: D-Driller's log; E-Electric log; J-Gamma-ray log. Well finish: O-Open-end; S-Screen; T-Sand point; G-Gravel wall, screen; X-Open hole. Water level: f-flowing well. Aquifer: Number shown is same as described in this report. Quality of water: Iron, Sulfate, Chloride, Hardness, and Specific Conductance are coded according to range in concentration. Explanation of code given on last page of table.

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp. Cond	
354522N	0771314	1	1	T R CRANDALL	P	P		49	49	30	O			2		2	3	2	7
354502N	0771356	1	2	M D MOBLEY	P	P		16		24	O	60		4		2	1	2	7
354522N	0771358	1	3	C HARDY	P	P		120		1	T			0		2	4	3	5
354525N	0771604	1	4	E B PARKER	P	P		100		1	S			0		0	1	4	4
354606N	0771640	1	5	V WHITEHURST	P	P		30	27	1	T			1		1	2	2	7
354548N	0771656	1	6		P			15	12	1	T			0		2	2	2	7
354522N	0771718	1	7	M C THOMAS	P	P		300		2	S			2		0	1	4	3
351154N	0771832	1	8	W O MANNING	P	P		30		1	T			2		2	3	3	7
354656N	0771846	1	9	L E HEATH	P	P		35	35	30	O			7		2	3	2	7
354820N	0771906	1	10					22	19	1									7
354812N	0771958	1	11	C G WHITEHURST	P	P		70		2				5		0	5	3	4
354627N	0772000	1	12	W K WHITEHURST	P	P		25			T			2		2	1	2	7
354612N	0772010	1	13	G C WHITEHURST	P	P		15	12	1	T			5		2	1	2	7
354612N	0772020	1	14	J V WHITEHURST	P	P		16	13	1	T			3		2	2	2	7
354630N	0772050	1	15	K MANNING	P	P		20	17	1	T			5		0	1	1	7
354809N	0772212	1	16		M			445	400	8	G	36	100	2	4	3	1		3
354809N	0772212	1	17	BETHEL	M	C		383		8	G	25	600	2	0	0	2	1	3,4
354809N	0772212	2	18	BETHEL	M	C		376		8	G	24	200	0	1	2	2	2	3,4

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location Lat	Well location Long	Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water: Iron	SO_4	Cl	Hardness	Sp.Cond.	Aquifer No.
354714N	0772216	1	19	J L GURGANUS	P	P		196	186	4	G	57	6	0		2	1	3	4
354510N	0772212		20	J V TALOR	P	P		20	20	30	O		50	4		1	0	1	7
354630N	0772214	1	21	H C BROWN	P	P		35	32	1	T			3		2	2	3	7
354838N	0772242	1	22	BETHEL	M	C	E,J	320	240	8	G	31	300	2	1	2	2	3	3
354817N	0772248	1	23	BETHEL	M	C		402	72	8	G	36	750	2	3	3	1	4	3,4
354816N	0772448	1	24	M J BRILEY	P	P		30	27	1	T			2		0	2	1	7
354811N	0772509	1	25	F C JAMES	P	P		20	17	1	T			3		2	4	3	7
354756N	0772512	1	26	R M JAMES	P	P		20	17	1	T			5		0	2	2	7
354808N	0772546	1	27	R SUMMERS	P	P		55	52	1	T	10		5		0	3	3	4
354801N	0772550	1	28	M T BATCHELOR	P	P		26	23	1	T			3		1	2	1	7
354702N	0772708	1	29	W D LEWIS SR	P	P		261	246	4	T			2		0	3		3
354524N	0772728	1	30	J B BULLOCK	P	P		18	15	1	T			5		1	3	2	7
354602N	0772732	1	31	E C LEWIS	P	P		18	15	1	T			2		0	3	2	7
354618N	0772732	1	32	O R CLARK	P	P		15	12	1	T			5		1	3	3	7
354520N	0772734	1	33	J J BULLOCK	P	P		18	15	1	T			1		1	4	2	7
354620N	0772740	1	34		P	P		13	10	1	T			3		1	3	2	7
354554N	0772910	1	35	R SUMMERS	P	P		130		1		F		2		1	2	3	3
354530N	0773044	1	36	M NICHOLS	P	P		21	18	1	T			7		1	2	1	7
354036N	0773942	1	37		P	P		20	17	1	T			5		2	2	2	7
354022N	0773952	1	38	GULF STATION	P	P		12	12	24	O			4		2	2	2	7
354002N	0773938	1	39	D GAY	P	P		24	24	30	O			2		2	2	2	7
354018N	0773846	1	40	FOUNTAIN	M	C	E	213	132	8	G		350	3	0	0	2	2	2,3
354036N	0773816	1	41	FOUNTAIN	M	C		190		8	O		103	7	0	0	2	2	3
354036N	0773816	1	42		P			35		1		5	1	5	0	0	0	2	7

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp.Cond.	
354008N	0773746	1	43	SUPERIOR STONE	N	P		100	20	2	X			1		0	2	1	7
354044N	0773743	1	44	J L JEFFERSON	P	P		225		6	G			4		3	5	4	3
354035N	0773646	1	45	R D JEFFERSON	P	P		180		2	S			3		0	2	2	3
354117N	0773624	1	46	C B PHILLIPS	P	P		20	17	1	T			2		2	1	2	7
354046N	0773604	1	47	R M DILDA	P	P		24	21	2	T			2		0	2	1	7
354059N	0773520	1	48	S L DILDA	P	P		100		2	T			5		1	2	3	4
354053N	0773520	1	49	B L PHILLIPS	P	P		18	15	1	T			2		2	2	2	7
354306N	0773500	1	50	M COBB	P	P		28	28	30	O			2		0	1	1	7
354036N	0773458	1	51					20	17	1	T	2							7
354010N	0773448	1	52	C E CASE	P	P		30	27	2	T			6		1	0	1	7
354140N	0773446		53	J A MOORE	P	P		25	25	36	O								7
354142N	0773430	1	54	C W GAYNOR	P	P		20	17	1	T			4		3	2	4	7
354145N	0773428	1	55	C W GAYNOR	P	P		109		1	T			2		2	2	2	4
354304N	0773344	1	56	C G HARRIS	P	P		187		2	G			4		0	3	2	3
354206N	0773312	1	57	R B HAYWOOD	P	P		50	50	30	O			3		2	2	2	4
354448N	0773228	1	58	J W WEBB	P	P		30	27	1	T			1		0	2	1	7
354419N	0773214	1	59	V WATERS	P	P		30	30	24	O			7		2	2	2	7
354204N	0773214	1	60	J EDWARDS	P	P		40	37	2	T			3		1	0	1	7
354341N	0773152	1	61	W W DAVIS	P	P		18	15	1	T			1		1	2	1	7
354026N	0773112	1	62	N M DUKE	P	P		180	175	2	G			1		2	1	3	3
354240N	0773114	1	63	J F CORBETT	P	P		20	17	1	T			3		1	0	1	7
354206N	0773102	1	64	R R STOKES	P	P		20	17	1	T			2		2	3	3	7
354156N	0773056	1	65	ESSO STA	P	P		105		1	S			3		1	0	2	3
354142N	0773038	1	66	ELEM SCHOOL	C	P		350		4	S			2		0	2	3	1

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp.Cond.	
354338N	0772950	1	67	D H PARKER	P	P		15	12	1	T			3		1	2	1	7
354104N	0772940	1	68	J E WATSON	P	P		220		4	S			0		2	0	3	3
354252N	0772915	1	69	W R TYSON	P	P		15	12	1	T			2		0	2	1	7
354024N	0772904	1	70	T CARTER	P	P		20	17	2	T			2		0	2	1	7
354156N	0772846	1	71	J T DUPREE	P	P		218	213	2	G	4	5	0		2	2	3	3
354209N	0772844	1	72	J T DUPREE	P	P													3
354007N	0772844	1	73	W H WOOTEN	P	P		192		2	S			2		1	2	3	3A
354230N	0772800	1	74	G TUCKER	P	P		27	24	2	T			3		0	2	1	7
354230N	0772800	2	75	G TUCKER	P	P		21	18	2	T			3		0	2	1	7
354330N	0772738	1	76	R M MANNING	P	P		20	17	1	T			5		0	2	1	7
354334N	0772734	1	77	G R HARRIS	P	P		20	17	1	T			2		1	3	2	7
354200N	0772732	1	78	BELVOIR SCHOOL	C	P		28	25	1	T		50	2			1	1	7
354144N	0772724	1	79	G R HARRIS	P	P		25	22	1	T			5		2	2	2	7
354338N	0772724	1	80	B HARRIS	P	P		20	17	1	T			2		1	2	1	7
354029N	0772703	1	81	A A GARRIS	P	P		20	17	1	T			0		0	3	2	7
354110N	0772638	1	82	B T HARRIS	P	P		30	27	1	T			5		1	2	1	7
354102N	0772630	1	83	E WARREN	P	P		20	17	1	T			6		2	2	2	7
354101N	0772402	1	84	L RICKS	P	P		20	20	30	O	8		7		0	3	2	7
354032N	0772324	1	85	F A MCLAWHORN	P	P		12	9	1	T			2		3	3	4	7
354040N	0772250	1	86	J L STANLEY	P	P		400		4	G	8		0		3	0	4	3
354214N	0772212	1	87	S P LANGLEY	P	P		20	17	1	T			3		1	2	2	7
354020N	0772200	1	88					23	20	1	T	70							7
354054N	0772156	1	89	W L BALDREE	P	P		15	12	1	T			7		0	1	0	7
354308N	0772148	1	90	C W MARTIN	P	P		18	15	1	T			6		2	0	1	7

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location: Lat	Well location: Long	Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water: Iron	Quality of water: SO_4	Quality of water: Cl	Quality of water: Hardness	Quality of water: Sp.Cond.	Aquifer No.
354356N	0772130	1	91	C E BROWN	P	P		15	15	30	O	6		3		1	2		7
354018N	0772130	1	92	E L OSBORNE	P	P		30	1	1	T			2		1	2	1	7
354030N	0772132	1	93	HENDRIX : DAIL	P	P		20	17	1	T			5		2	3	2	7
354124N	0772106	1	94	H JAMES	P	P		18	15	1	T			7		2	2	1	7
354212N	0772058	1	95	A C BARNHILL	P	P		30	27	1	T			2		1	4	3	7
354136N	0772056	1	96	R B FUTRELL	P	P		25	22	1	T			9		3	2	4	7
354028N	0772054	1	97		P	P		20	17	1	T			7		2	3	2	7
354236N	0772052	1	98	W L RAWLINS	P	P		309	299	4	G			3		1	0	3	3
354306N	0772038	1	99	E W TETTERTON	P	P		15	12	1	T			1		1	3	2	7
354059N	0771951	1	100	M BREWER	P	C		200		2	O	f		1	0	2	0		3A
354348N	0771958	1	101	W G BARNHILL	P	P		60	57	1	T			0		0	0	1	4
354414N	0771942	1	102	C H BRILEY	P	P		23	20	1	T			2		2	1	1	7
354406N	0771938	1	103	C H BROWN	P	P		30	27	1	T			5		1		1	7
354118N	0771912	1	104	GRIMES STA	P	P		21		1	T			5		0	4	3	7
354318N	0771830		105	F WHITEHARDS	P	P		100		1	T			1		1	0	2	4
354146N	0771818	1	106					15	12	1	T	4							7
354022N	0771740	1	107	J GRIMES	P	P		280		2	S			5		0	1	1	3
354425N	0771744	1	108	W C PARK	P	P		30		1	T			5		0	4	1	7
354422N	0771738	1	109	C BRILEY	P	P		40	37	1	T			2		4	4	5	7
354336N	0771636	1	110	B BRILEY	P	P		96	93	1	T			2		0	4	3	4
354334N	0771624	1	111	F WHITLEY	P	P		96	91	1	T			3		0	4	3	4
354254N	0771618	1	112	C JAMES	P	P		100		1	T			2		0	4	3	4
354240N	0771628		113	HIGH SCHOOL	C	P		100		4		20		0		0	2	3	7
354130N	0771538	1	114	C S WHICHARD	P	P		372	362	2	S			5		3	1	5	3

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location Lat	Well location Long	Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water: Iron	SO_4	Cl	Hardness	Sp.Cond.	Aquifer No.
354348N	0771542	1	115	J C STOKES	P	P		20	17	1	T			3		2	1	2	7
354258N	0771532	1	116	ROEBUCK :PARKER	P	P		90		2				3		0	2	3	7
354306N	0771521	1	117	M WHICHARD	P	P		110	107	1	T	f	A		1	1	3		4
354214N	0771458	1	118	G BRILEY	P	P		43	40	1	T			5		2	3	3	7
354202N	0771454	1	119	R PAGE	P	P		250	245	2	S			2		2	1	5	4
354206N	0771450	1	120	BRIERY SWAMP CH	P			17	14	1	T	1							7
354130N	0771424	1	121	H FLEMING	P	P		250	245	2	S			2		2	0	5	4
354130N	0771424	1	122	H FLEMING	P	P		18		1	T			3		0	3	1	7
354050N	0771408	1	123	J M FORBES	P	P		407	402	2	S	5		1		3	1	5	3
354052N	0771408	1	124	J M FORBES	P			15	12	1	T	2							7
354429N	0771312	1	125	J B CONGLETON	P	P		23	20	1	T		75	2		1	2	1	7
354312N	0771308	1	126	D S JAMES STORE	P	P		116	113	1	T			0		1	4	3	5
354322N	0771308	1	127	D S JAMES	P	P		35	32	1	T			4		2	1	2	7
354022N	0771128	1	128	A B EDWARDS SR	P	P		408	400	4	S	f	41	0		3	1	5	3
354338N	0771048	1	129	H BULLOCK	P	P		113	100	1	T	f	3	0		0	2	3	5
353500N	0770816		130	M D BAKER	P	P		20	17	1	T			0		0	2	1	7
353642N	0770902	1	131	L A HARDEE JR	P	P		70	67	1	T			1		0	4	2	5
353646N	0770906	1	132	W W PRIDGEN	P	P		20	17	1	T			0		0	2	1	7
353612N	0770936	1	133	N LEE JR	P	P		16	13	1	T			2		0	1	2	7
353540N	0770948	1	134					13	10	1	T	1							7
353730N	0771040	1	135	M BEACHAM	P	P		115		1	T			3		0	2	1	5
353936N	0771136		136					18	15	1	T	1							7
353730N	0771224	1	137	ALBEMARLE PAPER	N	P		12		1	T			3		0	1	0	7
353746N	0771256	1	138	C J SATTERTHWAI	P	P		293	273	2	S	f	3	2		3	1	5	3

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp.Cond.	
353746N	0771304	1	139	W B SATHERWAITE	P	P		405	400	2	S	f		0		3	0	5	3
353724N	0771340	1	140	ELEM SCHOOL	C	P		345		4	S	f				3	0	2	3
353518N	0771328	1	141	J H NICHOLS	P	P		117	114	1	T			2		0	4	2	4
353730N	0771328	1	142	J P DAVENPORT	P			15	12	1	T	10		4		0	3	2	7
353720N	0771336	1	143	J P DAVENPORT	P	P		450	445	4	S	f	5	2		0	3	2	3
353510N	0771334	1	144	W B MCLAWHORN	P	P		92	89	1	T			1		0	4	2	4
353728N	0771340	1	145	JP DAVENPORT JR	P			18	15	1	T	10		2		0	3	2	7
353800N	0771422	1	146	G ROBINSON	P	P		18	15	1	T			1		2	3	3	7
353800N	0771444	1	147	T E GRAY	P	P		20	17	1	T			3		0	2	1	7
353834N	0771458	1	148	J T LEE	P	P		18	15	1	T			4		2	2	2	7
353530N	0771516	1	149	M MOYE	P	P		35	32	1	T			1		2	2	2	7
353732N	0771554		150	J GARRIS JR	P	P		388		4	S			0		2	0	4	3
353952N	0771552	1	151	H C SIMMONS	P	P		363		2	S			0		0	0	4	3
353926N	0771600	1	152	J H PEELE	P	P		25		1	T			5		1	3	4	7
353730N	0771606	1	153	RILEY STA	P	P		17		1	T			2		1	3	2	7
353522N	0771610	1	154	W R ELKS STORE	P	P		25	22	1	T			5		0	2	1	7
353750N	0771614	1	155	G BRILEY	P	P		20	17	1	T			2		0	3	2	7
353834N	0771614	1	156					13	10	1	T	4							7
353514N	0771628	1	157	J HARDEE	P	P		30	27	1	T			1		1	2	2	7
353816N	0771708	1	158	D R HOUSE	P	P		13	10	1	T			0		1	3	2	7
353736N	0771716	1	159	J L SIMMONS	P	P		216	211	2	S			0		2	1	4	3A
353918N	0771720	1	160		P	P		20	17	1	T			5		1	3	2	7
353508N	0771644	1	161	J E MILLS	P	P		35	32	1	T			4		1	1	1	7
353506N	0771730	1	162	L MILLS	P	P		30	27	1	T			2		1	1	1	7

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp.Cond.	
353504N	0771738	1	163	J T NICHOLS	P	P		30	27	1	T			8		1	0	1	7
353914N	0771856	1	164	G L SAULS	P	P		30	27	1	T			2		0	1	1	7
353456N	0771806	1	165	C R HARDEE JR	P	P		30	2	1	T			2		1	3	2	7
353914N	0771814	1	166	R BARNHILL	P	P		28	25	1	T			5		0	2	1	7
353810N	0771846	1	167	D THORNE	P	P		30	27	1	T			2		1	3	2	7
353524N	0771858	1	168	S EDWARDS	P	P		30	27	1	T			3		0	1	1	7
353510N	0771900	1	169	H C BUCK	P	P		30	30	30	O			2		0	2	1	7
353910N	0771924	1	170	L S WORTHINGTON	P	P		20	17	1	T			7		1	2	1	7
353546N	0771920	1	171	LARRY HARDEE	P			70	70	1	T	6	3	1	0	0	4	6	4
353738N	0772020	1	172	M WORTHINGTON	P	P		15	12	1	T			1		0	1	1	7
353742N	0772026	1	173	J L HARRIS	P	P		20	17	1	T			4		1	2	2	7
353838N	0772044	1	174	L H LEE	P	P		15	12	1	T			7		2	3	3	7
																			7
353822N	0772054	1	175	D T JONES JR	P	P		20	17	1	T			2		1	3	2	7
353528N	0772101	1	176	GREENVILLE	P	C		484	210	10	S	55	1100	1	0	1	0	3	3,3A
353834N	0772056	1	177	J WARREN	P	P		20	17	1	T			5		0	5	3	7
353820N	0772112	1	178	C A LANGLEY	P	P		20	17	1	T			3		0	2	1	7
353802N	0772140	1	179	E WINDOM	P	P		28	25	1	T			5		0	3	2	7
353806N	0772146	1	180	D LAUGHINGHOUSE	P	P		30	27	1	T			3		0	3	2	7
353942N	0772156	1	181	T BAKER	P	P		395	385	4	G	2		2		2	0	4	3
353558N	0772232	1	182		P	P		22	19	1	T	f				0	4	2	7
353611N	0772238	1	183	GREENVILLE	M	C	E	460	167	10	G	50	750	1	0	1	0	3	3A
353608N	0772316	1	184	PEPSI-COLA	N	C	E	373	190	10	G	35	200	2	0	0	0	3	3,3A
353506N	0772344	1	185	C H EDWARDS JR	P	C		41		1	T	6	8	4	0	0	4	2	4
353720N	0772506	1	186	V SIMMONS	P	P		360		2				4		0	6	3	3

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp.Cond.	
353712N	0772506	1	187	C E MANNING	P	P		140		2		23		4		0	6	3	3A
353736N	0772531	1	188	R STANCIL	P	P		142		1	T			5		0	3	3	3A
353620N	0772556	1	189	H POLLARD	P	P		120		1				6		0	5	3	4
353740N	0772607	1	190	A A FORBES JR	P	P		0		2	S					0			3A
353952N	0772630	1	191	F L BLOUNT JR	P	P		20	17	1	T			2		1	2	2	7
353757N	0772656	1	192	C W WHITEHURST	P	P		35	32	1	T			5		1	0	1	7
353824N	0772720	1	193	W MCLAWHORN	P	P		115		1	T	30		7		0	4	2	4
353928N	0772822	1	194	A WOOTEN	P	P		30	27	1	T			2		2	2	2	7
353450N	0772826	1	195	T DAIL	P	P		70		1	T			2		1	1	1	4
353838N	0772840	1	196	J JAMES	P	P		16	16	24	O			1		1	1	1	7
353614N	0772854	1	197	J A JONES	P	P		22	19	2	T			5		1	2	1	7
353802N	0772906	1	198	US VOA SITE C	F	C	E	180		8	G		100	5	0	0	3	1	3A
353802N	0772906	2	199	US VOA SITE C	F	C	E	180	140	8	G		100	6	0	0	1	2	3A
353615N	0772954	1	200					32	29	1	T	3							7
353946N	0773036	1	201	W M WINDHAM	P	P		55	55	30	O			2		1	2	1	4
353912N	0773052	1	202	L E GARRIS	P	P		30	30	24	O			1		1	1	1	7
353532N	0773058	1	203	H L TENNEY	P	P		30	27	1	T			4		0	4	2	7
353909N	0773106	1	204	B HONEYCUTT	P	P		40	37	1	T			7		0	3	1	4
353848N	0773119	1	205	R JONES	P	P		40	37	1	T			2		2	4	3	4
353824N	0773146	1	206	MONK BROS FARM	N	P		75		1	T			7		0	2	1	4
353626N	0773224	1	207	W TUGWELL	P	P		24	24	30	O			0		2	2	2	7
353824N	0773233	1	208	B S ATKINSON	P	P		85		1	T			6		1	2	1	4
353952N	0773256	1	209	J M JONES	P	P		23	20	2	T			5		1	2	1	7
353816N	0773314	1	210	G HARRIS	P	P		30	27	2	T			7		0	2	1	7

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp.Cond.	
353500N	0773324	1	211	J A WOOTEN	P			30	30	30	O	80		2		2	2	2	7
353727N	0773350	1	212	R HEATH	P	P		100		1	T			2		0	1	3	3
353730N	0773354	1	213	J T CORBETT	P	P		180		2	S			1		0	1	3	3
353644N	0773406	1	214	J W MOORE	P	P		80		2				7		1	1	2	3A
353529N	0773447	1	215	FARMVILLE	M	C	E	335	192	10	G	67	500	4	0	0	3	3	2,3
353620N	0773538	1	216	FARMVILLE	M			330		8	G								2,3
353518N	0773539	1	217	FARMVILLE	M	C		285	192	10	G	67	500	4	0	0	2	3	2,3
353542N	0773540	1	218	FARMVILLE	M	C		425	230	8	G	54	800	2	0	0	1	2	1,2,3
353628N	0773546	1	219	FARMVILLE	M	C		496	215	8	G	47	340	2	1	2	0		1,2,3
353646N	0773609	1	220	FARMVILLE	M	C		480	145	8	G	22	400	1	1	2	1	3	2,3,3A
353526N	0773548	1	221	C : A CO	N			304	215	10	G	50	500	3	0	0	2	1	3
353718N	0773658	1	222	J L NANNEY	P			212	202	2	G	47		3		0	2	2	3
353730N	0773702	1	223	W E FULFORD	P	P		67		1	T			4		0	4	2	3
353526N	0773710	1	224		P	P		200		2	S			2		0	2	2	3
353833N	0773733	1	225	I C TUGWELL	P	P		30	27	1	T			6		0	0	1	7
353854N	0773742	1	226	G POLLARD	P	P		37	34	1	T			3		1	2	1	7
353958N	0773824	1	227	FOUNTAIN MILL	P	P		30	27	1	T			8		1	2	1	7
353648N	0773900	1	228	B F LEWIS	P	C		90		1	T	4	1	4	0	0	5	3	3
353634N	0773906	1	229	B F LEWIS	P	P		150	140	6	S	3		4		0	3	2	3
353934N	0773936	1	230	K BELL	P	P		26	23	1	T			3		1	1	1	7
353924N	0773938	1	231	R L BELL	P	P		183		1	S			4		0	2	2	3
353752N	0773952	1	232	J E HOLLOMAN	P	P		25	25	24	O			1		0	2	1	7
353910N	0773954	1	233	R BELL	P	P		20	17	1	T			3		0	2	2	7
353848N	0774026	1	234	C H CARROWAY	P	P		18	18	24	O			4		2	3	4	7

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp.Cond.	
353948N	0774056	1	235	M GARDNER	P	P		17	17	24	O			5		2	2	2	7
353946N	0774106	1	236	H PITMAN	P	P		50		2				5		0	2	4	7
353430N	0773540	1	237	WHITE CONCRETE	N	P		180		2	S			5		0	2	1	3
353315N	0773240	1	238	L E TURNAGE	P			15		A2	X			2		2	1	2	7
353258N	0773240	1	239	J SHACKELFORD	P	P		100		2				7		1	4	2	3A
353242N	0773048	1	240	M PRICE	P	P		98		1	T	7	4			1	3	2	3A
353258N	0773018	1	241	L F BATTS	P	P		25	22	1	T			0		2	2	3	7
353036N	0772920	1	242	L DALE	P	P		100		1	T			6		0	5	3	3A
353456N	0772906	1	243		P	P		30	27	2	T			3		0	1	1	7
353426N	0772850	1	244	G R GURGANUS	P	P		385	380	2	G	34		0		0	0	2	3
353000N	0772802	1	245	E C MORRIS	P	P		80		1	T			5		0	0	1	4
353008N	0772758	1	246	C MCLAWHORN	P	P		300		2	G	20		1		0	2	4	3
353000N	0772858	1	247					22	19	1	T	7							7
353006N	0772752	1	248	R H MCLAWHORN	P	P		100		2	S			6		0	3	2	4
353036N	0772720	1	249	D T MCLAWHORN	P	P		26	23	1	T			3		2	1	1	7
353049N	0772714	1	250	G DAIL	P	P		80		1				6		1	1	1	4
353104N	0772703	1	251	L BAKER	P	P		30	27	1	T			5		0	1	1	7
353108N	0772640	1	252	D WHISNANT	P	P		30	27	1	T			3		1	1	1	7
353418N	0772634	1	253	L SUTTON	P	P		25	22	1	T			4			1	1	7
353234N	0772616	1	254	H H MAY	P	P		92		4	S			5		0	4	2	4
353018N	0772604	1	255	H L HEATH	P	P		99		4	G			5		0	5	3	4
353202N	0772513	1	256	WINTERVILLE	M	P		83	68	4	S		20	7		0	5		4
353330N	0772430	1	257	C D LANGSTON	P	P		90		1	T			6		0	5	3	4
353300N	0772430	1	258	INDUS TR SCHOOL	C	C		285	280	4	G	35	20	2	0	0	2	4	3A

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp.Cond.	
353106N	0772426	1	259	PROPANE GAS	P	P		25	22	1	T			7		1	2	1	7
353244N	0772426	1	260	V WHITE	P	P		100		2				4		0	4	2	4
353152N	0772410	1	261	USGS	F	C	E	675	60	6	O	13		0	2	2	0	4	3
353132N	0772404	1	262	WINTERVILLE	M	C		157		6		43	80	5	0	0	5	3	4
353122N	0772404	2	263	WINTERVILLE	M	C		306		8	G	12	400	0	0	1	0	3	3A
353132N	0772404	3	264	WINTERVILLE	M	C		393	450	8	G	43	250	0	0	0	0	3	3
353130N	0772402	1	265	HIGH SCHOOL	C	P		87		4	S			0		0	4	2	4
353424N	0772329	1	266					28	25	1	T	4							7
353140N	0772210	1	267		P			63	80	1		4	1	1	0	0	5	7	4
353446N	0772128	1	268	O R PADGETT	P	P		180	170	2	S			6		0	4	2	3A
353426N	0772120	1	269	J B JOYNER	P	P		25	22	1	T			7		0	1	1	7
353420N	0772108	1	270	R H SCHELLER	P	P		30	27	1	T			7		1	1	1	7
353354N	0772058	1	271	W BRANCH	P	P		40	37	1	T			5		1	1	1	4
353406N	0772050	1	272	L H KITTRELL	P	P		105		1	T			0		0	4	2	4
353330N	0772016	1	273	J A BRANCH	P	P		100	95	2	S			5		0	5	3	4
353334N	0772014	1	274	H H BRANCH	P	P		30	27	1	T			3		1	3	2	7
353244N	0771930	1	275	W ROBINSON	P	P		75	72	1	T			3		0	4	2	4
353212N	0771922	1	276	J L ROUSE	P	P		400	390	4	G			1		1	0	3	3
353134N	0771916	1	277	R ADAMS	P	P		30	27	1	T			5		0	2	1	7
353034N	0771906	1	278	C T MOORE	P	P		99	96	1	T			1		0	4	2	5
353152N	0771910	1	279	W T FORNES	P	P		30	27	1	T			0		0	4	2	7
353118N	0771906	1	280	A CARROL	P	P		38	35	1	T			7		1	2	1	7
353500N	0771838	1	281	DICKS GROC	P	P		30	27	1	T			5		0	2	1	7
353140N	0771842	1	282	W T FORNES	P	P		90		1	S			3		0	5	3	4

Table 5 .--Records of wells in Pitt County, N. C--Continued

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp.Cond.	
353450N	0771800	1	283	W A HARDEE	P	P		23	20	1	T			5		1	2	2	7
353312N	0771756	1	284	R STOKES	P	P		35	32	1	T			4		0	4	2	7
353456N	0771730	1	285	C R HARDEE JR	P	P		46	43	1	T			5		0	2	1	4
353030N	0771710	1	286	W H MILL	P	P		105						2		0	5	3	4
353440N	0771646	1	287	L VARRON	P	P		100	97	1	T			2		0	4	2	4
353436N	0771644	1	288	J W DIXON	P	P		106	103	1	T			2		0	4	2	4
353444N	0771634	1	289	L EDWARDS	P	P		100	97	1	T			2		0	0	0	4
363222N	0771548	1	290	W P MILLS	P	P		25	22	1	T			6		1	2	2	7
353028N	0771458	1	291	F COX	P	P		120		1	S			5		1	5	3	5
351206N	0771306	1	292	A EDWARDS	P	P		25	22	1	T			0		0	4	2	7
353448N	0771304	1	293	C POWERS	P	P		22	19	1	T			2		1	2	2	7
353446N	0771300	1	294	C POWERS	P			110		1		8	14	2	0	0	5	3	4
353454N	0771300	1	295	S HODGES	P	P		300		2	S	7	10	2		0	4	3	3
353206N	0771304	1	296	O B HADDOCK	P	P		70		1	S			6		0	5	3	5
353420N	0771224	1	297	F TUCKER	P	P		30	27	1	T			6		1	5	3	7
353342N	0771132	1	298	GRIMESLAND	M	C	E	188	134	8	G	16	300	2	0	0	3	3	4
353354N	0771128	1	299	HIGH SCHOOL	C	P		100		4	S			0		0	2	3	5
353138N	0771120	1	300	R LEWIS	P	P		20	17	1	T			6		2	6	3	7
353421N	0771021	1	301		P			80	80	1		8	10	3	0	1	3		4
353308N	0771028	1	302	J F TAYLOR	P	P		55	55	1	O			5		0	5	3	6
353328N	0771002	1	303	V E WHITE	P	P		100	100	1	T			5		0	6	3	5
353256N	0770914	1	304	D E HILLS	P	P		120	115	1	S			5		0	4	2	5
353256N	0770846	1	305		P	P		200	195	2	S			2		0	5	3	4
353242N	0770846	1	306	B D HADDOCK	P	P		130		1	S			5		0	5	3	5,6

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp.Cond.	
353242N	0770846	2	307	B D HADDOCK	P	P		18	15	1	T			7		0	5	3	7
353410N	0770652	1	308	W D MORGAN	P	P		100		1	T			2		0	4	2	6
353452N	0771030	1	309	T HODGES	P	P		85		1	S			5		0	6	3	6
353452N	0771030	2	310	T HODGES	P	P		22	19	1	T			8		2	1	2	7
352532N	0771132	1	311	H A BOYD	P	P		35	32	1	T			2		2	1	1	7
352552N	0771150	1	312	L W SUTTON	P	P		35	32	1	T			8		1	1	1	7
352546N	0771154	1	313	M B HARDY	P	P		35	32	1	T			5		0	5	3	7
352800N	0771202	1	314	US VOA SITE B	F	P	E	504	380	8	G	15	100	2		2	1	4	3
352800N	0771202	2	315	US VOA SITE B	F	P	E	430	255	8	G	20	100	1		2	0	4	3A
352642N	0771216	1	316					25	22	1	T	5							7
352526N	0771330	1	317	T J STOCKS JR	P	P		38	38	24	O			6		0	0	1	7
352950N	0771333	1	318	J DIXON	P			95		1	T	3							5
352946N	0771348	1	319					18	15	1	T	4							7
352824N	0771458	1	320		P	P		90		1	T			4		0	5	3	5
352816N	0771500	1	321	R L WHITE	P	P		20	17	1	T			9		1	2	1	7
352513N	0771524	1	322	M C VENTERS	P	P		18	15	1	T			7		1	3	1	7
352512N	0771526	1	323	D GASKINS	P	P		20	17	1	T			0		2	0	3	7
352502N	0771554	1	324	G W GUNTERS JR	P	P		185	180	2	S			5		0	6	3	4
352550N	0771554	1	325	R IVES	P	P		40	37	1	T			5		1	5	3	6
352510N	0771616	1	326	E A VENTERS	P	P		50		1	O			3		0	5	3	6
352754N	0771626	1	327	CHICOD SCHOOL	C	P		125		4	S			0		0	3	3	4
352814N	0771712	1	328	L W SMITH	P	P		120		1	T			2		0	4	3	5
352532N	0771718	1	329	J J EDWARDS	P	P		300	295	4	G			2		1	2	4	3A
352552N	0771744	1	330	J B JONES	P	P		390	380	2	S			3		2	0	4	3A

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp.Cond.	
352552N	0771754	1	331	A STOKES	P	P		18	15	1	T			9		1	1	1	7
352958N	0771850	1	332	W H MILLS	P	P		100		1	S			1		1	4	2	4
352700N	0771856	1	333	M HARDEE	P	P		21	18	1	T			4		2	2	2	7
352720N	0771926	1	334	J HARDEE	P	P		157		2				0		0	3	3	4
352826N	0772058	1	335	M D WORTHINGTON	P	P		102		1				0		0	4	3	4
352624N	0772132	1	336		C			50	50	1		5	1	0	0	0	4	6	5
352623N	0772133	1	337		P			50	50	1		4	2	1	0	0	4	6	5
352812N	0772248	1	338	R E CANNON	P	P		40	37	1	T			4		1	1	1	7
352542N	0772258	1	339	H WINGATE STORE	P	P		25	22	1	T			7		0	2	1	7
352816N	0772346	1	340	A CANNON	P	P		30	27	1	T			2		1	2	2	7
352832N	0772454	1	341	AYDEN	M	C		172	152		G		200	4	0	0	4		3A,4
352832N	0772454	2	342	AYDEN	M	C		155		8	G		150	3	0	0	4		3A,4
352832N	0772454	3	343	AYDEN	M	C		436	395	8	G	16	350	0	1	0	2	1	3,3A
352938N	0772458	1	344	NIAGARA CHEM	N	P		80		2		f	1	4		0	5	3	4
352938N	0772502	1	345	M MCLAWHORN	P	P		86		2		f	5	2		0	4	3	4
352742N	0772514	1	346	J R WORTHINGTON	P	P		30	27	1	T			2		1	1	1	7
352818N	0772518	1	347	AYDEN	M	C		505		8	G	45	500	0	0	1	2	3	3,3A
352804N	0772521	1	348	F J LITTLE	P			240	235	4	S		15	0	1	1	2	4	3,3A
352801N	0772522	1	349	AYDEN	M	C	E	480	240	8	G	50	750	1	1	1	0	3	3,3A
352708N	0772536	1	350	R F HART	P	P		28	25	1	T			4		1	1	1	7
352556N	0772554	1	351	C E HART	P	P		182		4	G			6		0	4	2	4
352508N	0772600	1	352	H L WILSON	P	P		30	27	1	T			5		0	0	0	7
352620N	0772602	1	353	J B PATRICK	P	P		240		2	S			1		2	2	4	3A
352538N	0772606	1	354	F HART	P	P		34	31	1	T			2		1	1	1	4

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp.Cond.	
352610N	0772710	1	355	B SUGGS	P	P		30	27	1	T			4		0	1	1	7
352754N	0772722	1	356	C Y GRIFTON	P	P		100		2				5		0	1	2	4
352826N	0772722	1	357	F PIERCE	P	P		100		1	T			4		0	5	3	3A
352756N	0772724	1	358	E B COX	P	P		345		4	G	10		0		1	0	3	3
352836N	0772730	1	359	M CLAYROOT	P	P		30	27	1	T			6		0	5	2	7
352832N	0772756	1	360	T NORRIS	P	P		270		2	G			5		1	0	3	3A
352830N	0772804	1	361	C M WHITEHURST	P	P		100		1	T			5		0	5	3	3A
352828N	0772806	1	362	J C WHITEHURST	P	P		30	27	1	T			3		1	2	1	7
352816N	0772826	1	363	I J MCLAWHORN	P	P		98	95	1	T			5		0	4	2	3A
352816N	0772816	2	364	I J MCLAWHORN	P	P		35	32	1	T			4		1	4	2	4
352908N	0772844	1	365	C M STOKES	P	P		30	27	1	T			4		2	2	2	7
352720N	0772856	1	366	S B NEWELL	P	P		25	22	1	T			3		0	1	1	7
352842N	0772854	1	367	W CARMAN	P	P		90		2				7		0	2	1	4
352722N	0772902	1	368	H M BUTLER	P	P		30	27	1	T			5		0	4	2	7
352740N	0772902	1	369	J W STOX	P	P		30	27	1	T			4		0	4	2	7
352827N	0772858	1	370	A SPEER	P	P		30	27	1	T			5		2	2	2	7
352236N	0772606	1	371	GRIFTON	M	C	E,D	580	280	8	G	22	750	1	0	1	0	2	3,3A
352222N	0772606	1	372	GRIFTON	M	P		280		1	O	f	8	1	0	1	0		3A,4
352222N	0772606	2	373	GRIFTON	M	C		130		3		14	85	1	0	0	4	3	4
352426N	0772546	1	374	F R CRAFT	P	P		25	22	1	T			5		0	4	2	7
352237N	0772538	1	375	GRIFTON	M	C	D	132	60	8	G	21	380	0	0	0	4	3	4
352210N	0772540	1	376	S A ROUNTREE	P	P		28	25	1	T			3		1	3	2	4
352210N	0772524	1	377	H J JACKSON	P	P		38	35	1	T			9		2	4	3	7
352210N	0772522	1	378	GRIFTON INVEST	N	P		152	93	8	G	18	225	0		0	4	3	4

Table 5 .--Records of wells in Pitt County, N. C.--Continued

Well location Lat	Well location Long	Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water: Iron	SO_4	Cl	Hardness	Sp.Cond.	Aquifer No.
352242N	0772450		379	T HODGES	P			300		2	S	11							4
352220N	0772420	1	380	WITN-TV	N	P		30	27	1	T			2		0	2	1	7
352348N	0772354	1	381	C T JACKSON	P	P		20	17	1	T			9		0	0	0	7
352146N	0772230	1	382	J R HARVEY	P	P		100		1	T	15		2		0	3	3	4
352 56N	0772228	1	383	J W GRAVES	P	P		30	27	1	T			4		0	0	0	7
352156N	0772226	1	384	W E FUTCH	P	P		130		1	T			1		0	4	3	4
352208N	0772154	1	385	J L QUINERLY	P	P		135		1				4		0	3	3	4
352208N	0772148	1	386	J L QUINERLY	P	P		135		1				1		0	3	3	4
352412N	0772124	1	387	M SUGG	P	P		30	27	1	T			5		1	2	1	7
352024N	0772112	1	388	W G MCLAWHORN	P	P		30	27	1	T			4		0	2	1	7
352308N	0772104	1	389	R H SMITH	P	P		130		1	T			5		0	2	3	4
352226N	0772046	1	390	E F DENNIS	P	P		100	97	1	T			2		0	3	3	4
352146N	0772056	1	391	E CARTER	P	P		30	27	1	T			2		0	2	1	7
352130N	0772036	1	392	F D TAYLOR	P	P		140		1	T			1		0	4	3	4
352120N	0772026	1	393	W FLEMING	P	P		96		2	T			2		0	5	3	6
352120	0772026	2	394	W FLEMING	P	P		20	17	1	T			5		0	1	1	7
352438N	0771946	1	395	O HALLEY	P	P		106		1	T			3		1	1	1	4
352214N	0771926		396	L C MOORE	P	P		20	17	1	T			5		1	3	2	7
352458N	0771814	1	397	M STOKES	P	P		125		1	T			0		1	2	4	4
352326N	0771802	1	398	STOKES : LANE	P	P		15	12	1	T			4		2	2	2	7
352252N	0771514	1	399	O HADDOCK	P	P		12	9	1	T	2		2		0	1	1	7
352412N	0771420	1	400	B R HADDOCK	P	P		35	2	1	T			4		2	2	2	7
352340N	0771408	1	401	M LILLY	P	P		30	27	1	T			5		2	1	2	7
352334N	0771404	1	402					21	18	1	T	4							7

Table 5 .--Records of wells in Pitt County, N. C.--Continued

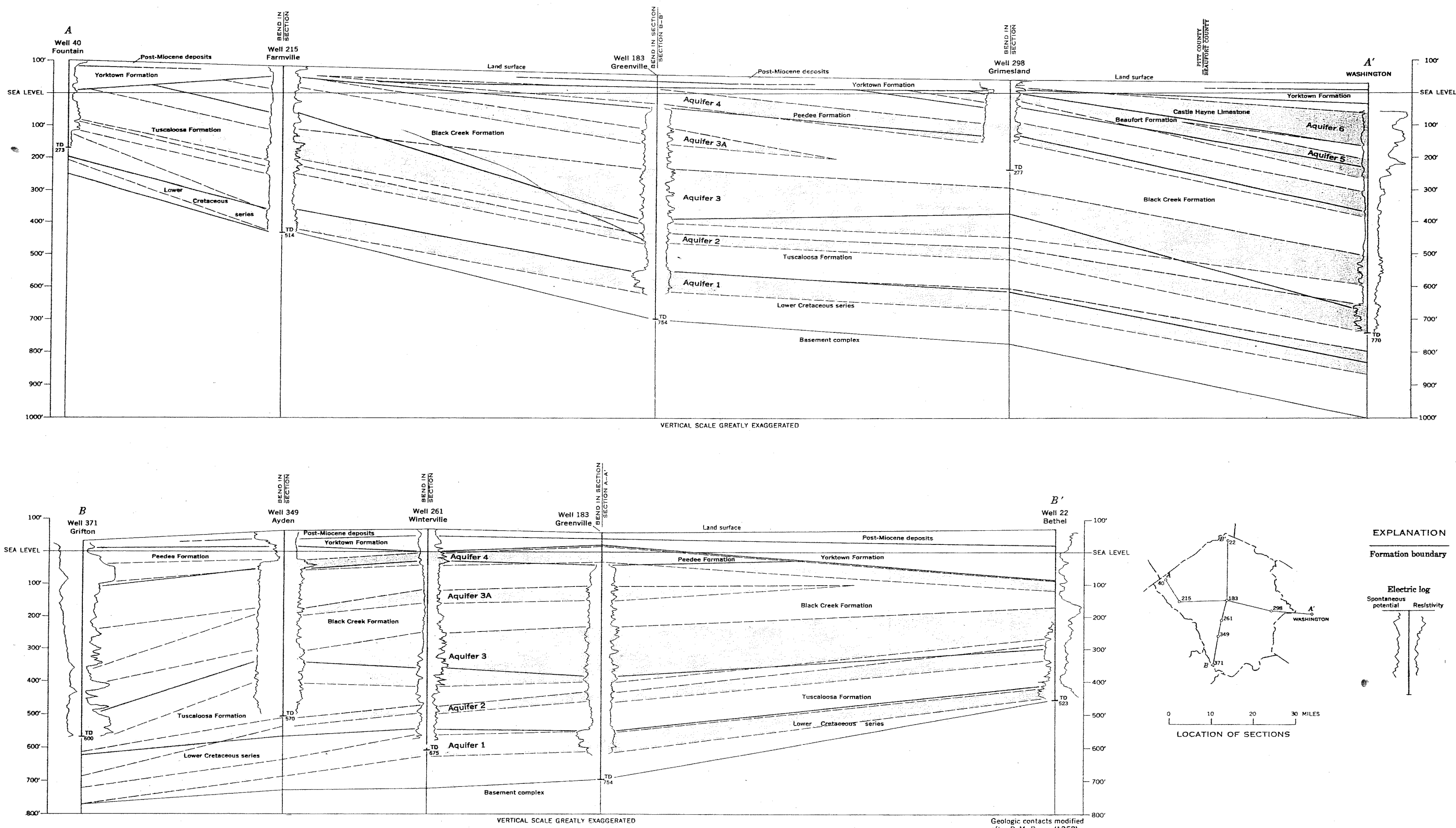
Well location Lat.	Well location Long	Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water: Iron	SO_4	Cl	Hardness	Sp.Cond.	Aquifer No.
352418N	0771336	1	403					26	23	1	T	7							7
352434N	0771312	1	404					16	13	1	T	0							7
352428N	0771300	1	405	C HARDY	P	P		20	17	1	T			7		0	2	1	7
353410N	0771322	1	406	J L EDWARDS	P	P		180	175	3	S				0	0	3		4
353436N	0771822	1	407	H G HARDEE	P	C		392	373	2	S		25	2	0	0	0	3	3
353116N	0772948	1	408	E K TYSON	P	P		135		2				3		1	4	3	3A
354800N	0772200	1	409	BETHEL	M			500?		10		37							1
354100N	0772000	1	410	J H CAREY	P			338		2	S	24	30						3
353700N	0773400	1	411	C CORBITT	P			242	230	2	S	40							3
353800N	0773300	1	412	G JEFFERSON	P			215	187		S	50							3
353400N	0772600	1	413	R ALLEN	P			351				55							3
354400N	0771900	1	414	M JARMON	P			240	228		S	40							3
353100N	0771900	1	415	J L ROUSE	P			408	393		S	53							3
353900N	0771400	1	416	H I FLEMING	P			245	237		S	25							3
353600N	0773600	1	417	H TYSON	P			237	227		S	40							3
354200N	0773100	1	418	D PITTMAN	P			234	224		S	36							3
353700N	0771800	1	419	J L HARRIS	P			199	189		S	25							3
353600N	0773500	1	420	ANN COX	P			236	226		S	45							3
353300N	0773000	1	421	H WRTHNGTN EST	P			135	125		S	25							3A
353500N	0773600	1	422	P JONES	P			243	233		S	40							3
353900N	0773600	1	423	G JEFFERSON	P			214	199		S	40							3
354100N	0772900	1	424	J E WATSON	P			276	263		S	26							2
353700N	0773300	1	425	R HEATH	P			264	249		S	42							3
354200N	0773400	1	426	W JOHNSON	P			325	305		S	38							1

Table 5.--Records of wells in Pitt County, N. C.--Continued

Well location		Sequence No.	Well No.	Owner	Ownership	QW analysis	Log data	Depth (feet)	Depth cased (feet)	Diameter (in)	Finish	Water level (feet below MP)	Yield (gpm)	Quality of water					Aquifer No.
Lat	Long													Iron	SO_4	Cl	Hardness	Sp.Cond.	
354200N	0773300	1	427	L N DUKE	P			239	229		S	30							2
353500N	0773400	1	428	FORMICA FLKBD	P			239	225		S	37							3
353400N	0773100	1	429	W ERVIN	P			313	293		S	40							3
354100N	0773600	1	430	R D JEFFERSON	P			190	175		S	45							3
354300N	0773200	1	431	C H TYRE	P			230	219		S	50							2
353700N	0773700	1	432	J E BYNUM	P			193	172		S	45							3
353700N	0771900	1	433	N HOPKINS	P			327	315		S	15							3
354000N	0773800	1	434	A MOORE	P			198	183		S	45							2,3
353900N	0773900	1	435	B LANG	P			212	199		S	45							2,3

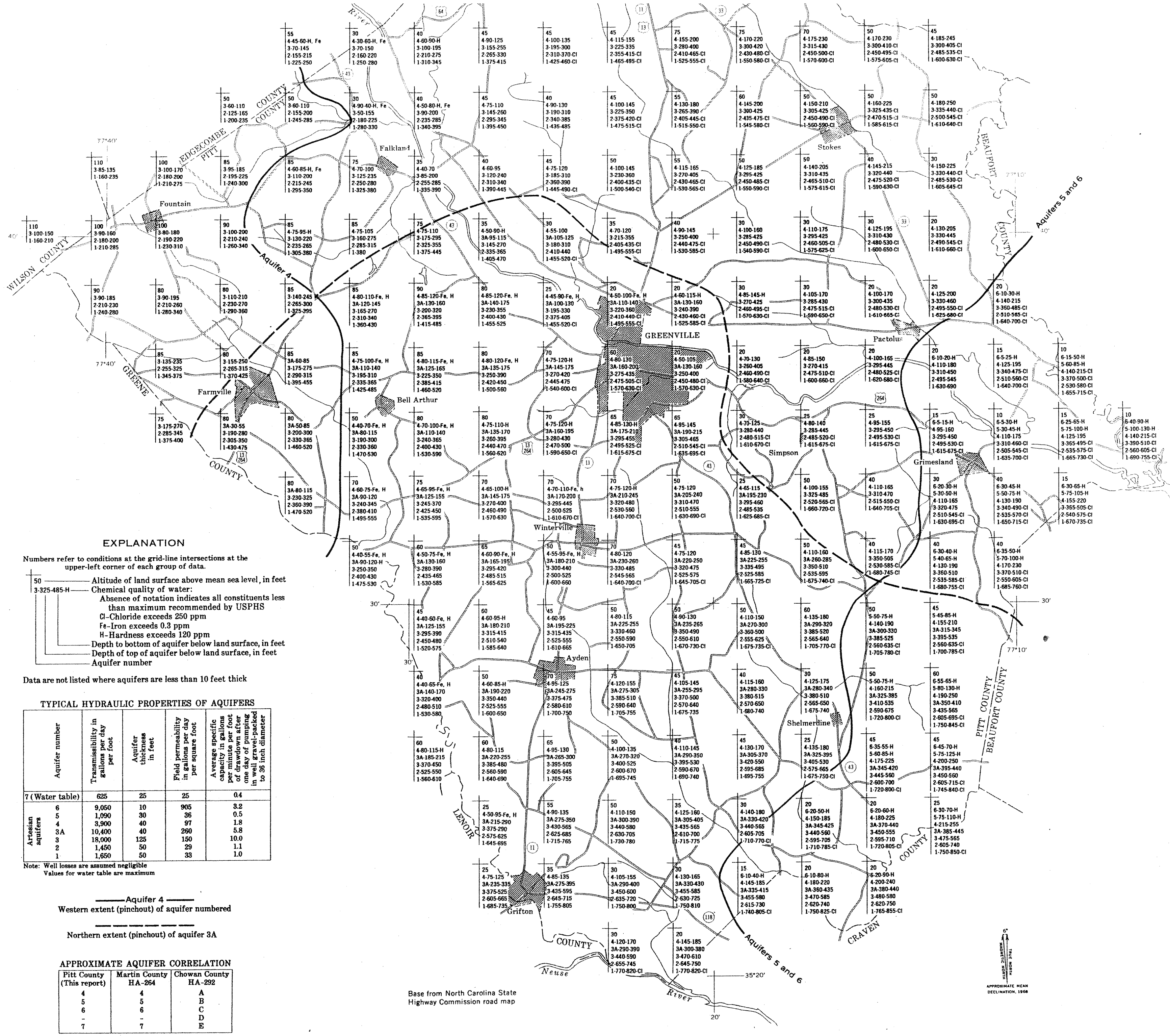
Explanation of Quality of Water Code

Constituent	Range (mg/l)	Code Number	Constituent	Range (mg/l)	Code Number	Constituent	Range (micromhos)	Code Number
Iron	0.00-0.05	0	Chloride	0-10	0	Sp. Cond.	0-50	0
Do	0.06-0.1	1	Do	11-25	1	Do	51-150	1
Do	0.11-0.30	2	Do	26-100	2	Do	151-300	2
Do	0.31-0.50	3	Do	101-250	3	Do	301-500	3
Do	0.51-1.0	4	Do	251-500	4	Do	501-1,000	4
Do	1.1 -3.0	5	Do	501-1,000	5	Do	1,001-2,000	5
Do	3.1 -5.0	6	Do	1,001-2,000	6	Do	2,001-5,000	6
Do	5.1 -10	7	Do	2,001-5,000	7	Do	5,001-10,000	7
Do	11 -15	8	Do	5,001-20,000	8	Do	10,000-20,000	8
Do	more than 15	9	Do	more than 20,000	9	Do	more than 20,000	9
Sulfate	0-10	0	Hardness	0-10	0			
Do	11-25	1	Do	11-20	1			
Do	26-50	2	Do	21-50	2			
Do	51-100	3	Do	51-100	3			
Do	101-150	4	Do	101-150	4			
Do	151-200	5	Do	151-200	5			
Do	201-250	6	Do	201-300	6			
Do	251-500	7	Do	301-500	7			
Do	501-1,000	8	Do	501-1,000	8			
Do	more than 1,000	9	Do	more than 1,000	9			



SECTIONS SHOWING CORRELATION OF GEOLOGIC FORMATIONS AND AQUIFERS

MAP 1



EXPLANATION

Numbers refer to conditions at the grid-line intersections at the upper-left corner of each group of data.

50 — Altitude of land surface above mean sea level, in feet

3-325-485-H — Chemical quality of water:

Absence of notation indicates all constituents less than maximum recommended by USPHS

Cl–Chloride exceeds 250 ppm

Fe–Iron exceeds 0.3 ppm

H–Hardness exceeds 120 ppm

Depth to bottom of aquifer below land surface, in feet

Depth of top of aquifer below land surface, in feet

Aquifer number

Data are not listed where aquifers are less than 10 feet thick

TYPICAL HYDRAULIC PROPERTIES OF AQUIFERS

	Aquifer number	Transmissibility in gallons per day per foot	Aquifer thickness in feet	Field permeability in gallons per day per square foot	Average specific capacity in gallons per minute per foot of drawdown after one day of pumping in well gravel-packed to 36 inch diameter
	7 (Water table)	625	25	25	0.4
Artesian aquifers	6	9,050	10	905	3.2
	5	1,090	30	36	0.5
	4	3,900	40	97	1.8
	3A	10,400	40	260	5.8
	3	18,000	125	150	10.0
	2	1,450	50	29	1.1
	1	1,650	50	33	1.0

Note: Well losses are assumed negligible
Values for water table are maximum

——Aquifer 4——
Western extent (pinchout) of aquifer numbered

— — — — —
Northern extent (pinchout) of aquifer 3A

APPROXIMATE AQUIFER CORRELATION

Pitt County (This report)	Martin County HA-264	Chowan County HA-292
4	4	A
5	5	B
6	6	C
-	-	D
7	7	E

Base from North Carolina State Highway Commission road map

MAP SHOWING AQUIFER CHARACTERISTICS

M