NORTH CAROLINA

DEPARTMENT OF WATER RESOURCES

Harry E. Brown, Director

DIVISION OF GROUND WATER
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GROUND-WATER BULLETIN NUMBER 2

GEOLOGY AND GROUND WATER
IN THE
GOLDSBORO AREA, NORTH CAROLINA

By
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PREPARED COOPERATIVELY BY THE GEOLOGICAL SURVEY
UNITED STATES DEPARTMENT OF THE INTERIOR



RALEIGH

FOREWORD

This bulletin was prepared under a joint water resources investigation conducted by the State of North Carolina and the Geological Survey, United States Department of the Interior.

The report covers data collected in accordance with a cooperative program entered into between North Carolina Department of Conservation and Development and the Geological Survey, United States Department of the Interior.

The responsibilities for the water resources program, formerly vested in the Division of Water Resources, Inlets and Coastal Waterways, Department of Conservation and Development, were by action of the 1959 General Assembly transferred to the newly created Department of Water Resources, effective July 1, 1959.

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The Honorable Luther H. Hodges Governor of North Carolina Raleigh, North Carolina

Dear Governor Hodges:

I am pleased to submit Ground-Water Bulletin Number 2, "Geology and Ground Water in the Goldsboro Area, North Carolina".

This report gives the results of an investigation made by the U. S. Geological Survey, initiated in cooperation with the North Carolina Department of Conservation and Development and completed in cooperation with the North Carolina Department of Water Resources, as a part of the program of reconnaissance investigations to evaluate the ground-water resources of the State. The report presents the data collected and describes the general geological and ground-water conditions in Johnston, Sampson and Wayne Counties.

This report is a valuable contribution to the knowledge of the ground-water resources of the area. It will be available to all persons and agencies concerned with the development and conservation of those resources.

Respectfully submitted,

Harry Brown

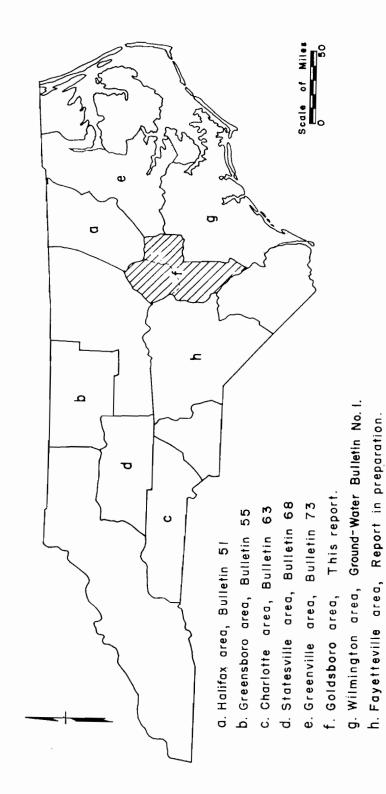
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INDEX MAP OF NORTH CAROLINA Showing areas covered by major ground-water investigations

Figure 1

GEOLOGY AND GROUND WATER IN THE GOLDSBORO AREA, NORTH CAROLINA

Ву

Richard D. Pusey

ABSTRACT

The Goldsboro area of this report includes Johnston, Sampson, and Wayne Counties, and covers 2,313 square miles. The area is in the central part of eastern North Carolina and had a total population of 179,953 according to the 1950 census.

Northern Johnston County is in the Piedmont province. The remaining area, in Johnston County and in Sampson and Wayne Counties, lies in the Coastal Plain province. The Piedmont province is separated from the Coastal Plain by the fall zone, an area of complex geologic structures and hydrologic conditions. The Piedmont has irregular topography and is underlain by granite, gneiss, schist, slate, and other crystalline rocks. East and south of the fall zone the sedimentary rocks which underlie the Coastal Plain thicken to the southeast over an irregular basement of rocks consisting largely of slate. The sediments also dip gently to the southeast 10 to 15 feet per mile, forming a monocline.

The oldest sedimentary rocks, of Late Cretaceous age, are exposed along the fall zone in its southern extension, largely in Johnston County. Younger sediments of Late Cretaceous age are exposed at progressively greater distances to the southeast, forming an offlap sequence. In Wayne and eastern Sampson Counties, Tertiary sediments have filled depressions in the underlying Cretaceous rocks. In all but the most elevated areas in the Piedmont, surficial sands of post-Miocene age cover the underlying formations.

In the crystalline rocks of the Piedmont province the average yield of wells is 5 to 20 gpm (gallons per minute). In the granites, where yields are low, the quality of the water is good, whereas in the slate and gneiss the yields are higher but the water generally contains excessive amounts of iron.

In the fall zone, ground-water conditions are complicated owing to the topography and structure. Here, water supplies are small and quality is poor. In the Coastal Plain, wells that penetrate both the Black Creek and Tuscaloosa formations may yield as much as 700 gpm in downdip areas; yields are less in updip areas.

The Peedee formation of Late Cretaceous age and the formations of Tertiary age because of their limited areal extent and thickness, furnish only small supplies of water in the area.

INTRODUCTION

Location and Extent of the Area

The area described in this report includes 2,313 square miles of central-eastern North Carolina that comprises Johnston, Sampson, and Wayne Counties (fig. 1). The area is in the Coastal Plain physiographic province except for the northwestern part of Johnston County, which is in the Piedmont physiographic province. The "fall line" which separates these two physiographic provinces passes through central Johnston County. The city of Goldsboro in Wayne County is the largest in the tri-county area.

The population of the area is increasing as a result of industrialization and the expansion of nearby military installations. The city of Goldsboro, centrally located in eastern North Carolina, is a marketing and distribution center for nearby rural areas.

Purpose and Scope

The purpose of the investigation was to determine the physical properties and areal extent of the water-bearing rocks in the three counties and to collect information about the amount and chemical quality of the ground water. A review was made of the available geologic and hydrologic literature on the area. This review was followed by an inventory of wells, collection of selected water samples for chemical analysis, and studies and analysis of all the data. The information was then arranged by counties in a report covering the entire area.

Cooperation and Direction

The investigation was made by the Ground Water Branch, U. S. Geological Survey, in cooperation with the Division of Mineral Resources, North Carolina Department of Conservation and Development.

The report was prepared under the general supervision of A. Sayre and P. E. LaMoreaux, former and present chiefs, Ground Wat Branch, U. S. Geological Survey, and of J. L. Stuckey, State Ge logist. Field investigations and preparation of the report we under the immediate supervision of P. M. Brown, District Geologi for the Ground Water Branch in North Carolina.

Previous Work

This is one of a series of reconnaissance reports (fig. 2) the describe the general ground-water conditions in selected areas the State. Previous information concerning the ground-water conditions in the Goldsboro area has been published in volume 3 of the North Carolina Geological and Economic Survey, entitled "The Coastal Plain of North Carolina" (Clark and others, 1912) and in Bull tin 72 of the North Carolina Department of Conservation and Development, entitled "Well Logs from the Coastal Plain of North Carolina" (Brown, 1958).

Acknowledgments

The writer wishes to acknowledge the assistance and cooperation of well owners, well drillers, superintendents of water system and other individuals who were of help in the collection of data

GEOGRAPHY

Area and Population

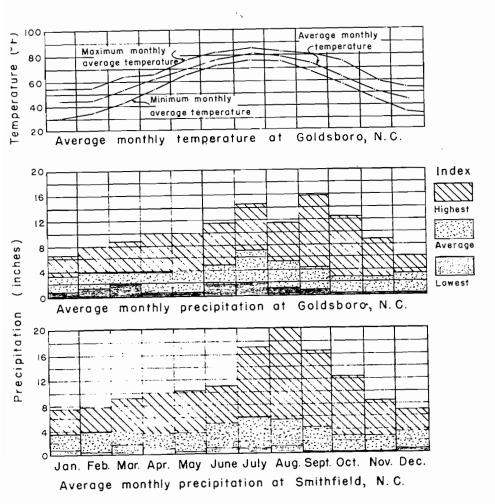
The Goldsboro area, consisting of Johnston, Sampson, and Way Counties, occupies 2,313 square miles in the central portion eastern North Carolina.

According to the 1950 census, the area had a total population of 179,953. The population is centered largely in and around 26 is corporated cities and towns in the area, of which the three courseats (Clinton Goldsboro, and Smithfield) are the largest.

Agriculture

Agriculture is the main source of income for more than 80 percent of the inhabitants. Tobacco, cotton, corn, poultry, and liv stock are the major farm products.

In the last several years, the expansion of the poultry indu



Climatic summary of the Goldsboro area

North Carolina

1887—1956

try and the practice of irrigation have resulted in increased demands for water.

Climate

The U. S. Weather Bureau maintains 6 stations in the Goldsbor area. The average yearly temperature in the area is $62^{\circ}F$. The average monthly temperatures recorded at Goldsboro for the 60-yea period 1897-1956 are given in figure 2. The temperatures recorde at 5 other stations in the area approximate those at Goldsboro an cover a period of 60 years from 1897 to 1957.

Precipitation graphs (fig. 2) show the long-term (60-year monthly precipitation averages for Goldsboro and Smithfield. The graphs show that the average monthly precipitation during the period of the records is quite similar at both stations, ever though the high and low averages vary somewhat. The average annual precipitation is approximately 48 inches at both stations. The precipitation is highest in July and lowest in December or January.

Physiography and Drainage

The area investigated lies in two major physiographic provinces. The northern half of Johnston County is in the Piedmont province, whereas the remainder of the area is in the Coastal Plain province. Local relief in the Piedmont province in the area ranges from less than 50 feet to as much as 200 feet and the elevation ranges from 150 to 400 feet above sea level. Relief in the Coastal Plain section of the area ranges from less than 20 feet to 100 feet and the elevation ranges from 70 to about 150 feet above sea level. The relief is greatest where the larger streams have cut down through post-Miocene terraces and exposed underlying formations of Cretaceous age, as in southern Wayne County and parts of Sampson County.

The area is drained by streams flowing southeastward. Tributary stream valleys have a parallel alignment except where topographic influence of terraces affect their courses. In southern Wayne County, Eccene sediments deposited in ancient stream valleys are more resistant to erosion than surrounding Cretaceous sediments and have influenced the drainage pattern by causing a deflection of the stream channels away from the more resistent sediments. The stream in the Piedmont province generally are incised in narrow valleys about 150 feet deep, whereas in the Coastal Plain province the larger streams tend to meander and the stream valleys are wider and

shallower. The gradient of the Neuse River in the Piedmont province is about 1.5 to 2.0 feet per mile and in the Coastal Plain province it is about 1.0 to 1.5 feet per mile.

GEOLOGY

The rocks of the Piedmont province are a complex of igneous and metamorphic types. The metamorphic rocks - slate, schist, and gneiss - are of both sedimentary and volcanic origin. The igneous rocks include granite, vein quartz associated with granite, aplite, and diorite. The granite occurs as a batholith that extends southward into the northwestern part of Johnston County: Both the aplite and the diorite occur in dikelike bodies. The aplite occurs near Princeton, Johnston County, and the diorite near Willow Springs, Johnston County.

Thin beds of Upper Cretaceous sediments crop out along the "fall zone" in Johnston and Wayne Counties. Overlying these Cretaceous rocks, the Tuscaloosa and Black Creek formations, are sediments of Eocene, Miocene, and post-Miocene age. The Castle Hayne limestone of Eocene age was deposited in a shallow sea that extended inland to the vicinity of Clayton, Johnston County. Erosional outliers of this formation lie unconformably on crystalline rocks in Johnston County and on sediments of Cretaceous age in Wayne County. Where Eocene sediments are absent, the Yorktown formation of late Miocene age may overlie the Cretaceous formations. Surficial deposits of sand, clay, and gravel blanket most of the area. These sediments are considered to be of post-Miocene age and are designated as such in this report. A generalized geologic cross section across the Goldsboro area is shown in figure 3. A geologic map of each county is included with the county description.

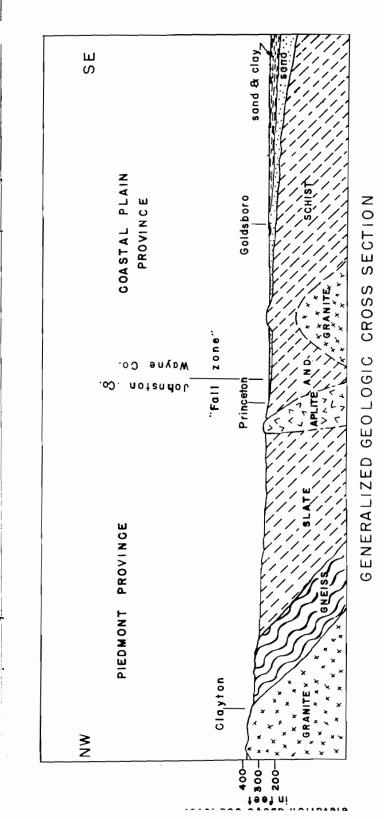
Principal Rock Units and Their Hydrologic Characteristics

Rocks of the Piedmont Province

Gneiss

<u>Mica Gneiss</u>

Mica gneiss of sedimentary and volcanic origin crops out in northern and central Johnston County. The rock is composed predominantly of feldspar, quartz, and mica. Although the gneiss generally lacks the schistose structure of the schist and slates that crop out to its southeast, there are all gradations between gneiss and



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GOLDSBORO

of the

schist, making it difficult to differentiate these rocks in the field.

The mica gneiss furnishes moderate supplies of water to domestic and municipal wells. The average depth of wells in this rock is about 125 feet and their average yield is 20 to 25 gpm. Most wells tapping this rock are 6 inches in diameter and are cased to less than 100 feet; the static water levels range from 10 to 30 feet below the land surface.

The chemical quality of water from the mica gneiss is suitable for most uses. The pH of the water is in the neutral to slightly acid range and the dissolved solids generally is less than 100 ppm (parts per million). Except for well 59 in Johnston County (p. 30) the water is also soft and is low in iron.

Hornblende gneiss

Hornblende gneiss, composed predominantly of hornblende and feldspar, crops out in a very small area north of Clayton in Johnston County. The rock is a metamorphosed intrusive body that is important only because of genetic relationships to other rock units in the area. No wells obtain water from this rock unit.

Kyanite gneiss

Kyanite gneiss, composed largely of quartz and the metamorphic mineral kyanite, crops out in a small area adjacent to U. S. Route 70 southwest of Wilson Mills in Johnston County (Stuckey, 1926, p. 661-674). No wells obtain water from this rock unit.

Mica Schist and Slate

The mica gneiss of northern and central Johnston County grades southward and eastward into a complex of mica schist and slate, formed from rocks probably of volcanic origin. The schist-slate complex covers a large area of Johnston County and underlies the Coastal Plain sediments in most of Wayne, Johnston, and Sampson Counties. No one rock term is applicable to these rocks of variable mineralogic composition, which grade from foliated, contorted schist in northern Johnston County to poorly foliated slate in the central part of the area.

The occurrence of ground water in the schist and slate of the Goldsboro area is similar to its occurrence in the mica gneiss. In

areas where the schist-slate complex crops out or is covered by a thin mantle of sediments, the average depth of wells is between 100 and 150 feet and the average yield about 15 gpm. Wells are generally 6 inches in diameter, are cased to depths of less than 80 feet, and have static water levels between 10 and 30 feet below the land surface.

The chemical quality of water from the schist-slate complex is not uniform. Iron generally exceeds the recommended maximum of 0.3 ppm (Public Health Service Drinking Water Standards, 1946), and domestic, industrial, and municipal supplies require treatment. The water is neutral to slightly acidic, the pH ranging from 7.0 to 5.7.

Granite

A large body of granite underlies the western and northern parts of Johnston County. Generally, the granite is weathered and is represented by a soft, friable, coarse-grained saprolite. In unweathered exposures the rock is a gray to pink medium-grained granite or granodiorite containing large amounts of biotite and lesser amounts of olivine. Locally, the granite is porphyritic and contains feldspar crystals up to an inch in length. Structural features such as jointing and exfoliation (fig. 4) are common.

Granite in the Goldsboro area generally is favorable for the development of small to moderate water supplies from fractures that extend to a depth of 200 to 250 feet. In addition, small yields may be obtained from the weathered granite (saprolite), although this material is very thin throughout most of the area. Most domestic wells tapping the granite are less than 80 feet deep; they yield as much as 20 gpm. Municipal wells at Clayton have an average depth of 250 feet and an average yield of 37 gpm. These wells obtain water from a highly fractured zone near the edge of the granite intrusive and have static water levels that are about 15 feet below the land surface.

Aplite

A dike-shaped body of aplite crops out and forms a ridge near Princeton, Johnston County. The ridge is about 1 mile wide and 6 miles long and trends N. 60°E. The white to pink aplite is a silica-rich rock containing small amounts of biotite and muscovite (fig. 5). In addition, it contains prominent phenocrysts of feld-spar along the contact zone with the bordering slates. The aplite



igure 5. Outcrop of pitted aplite which forms a ridge near Raines



Figure 4. Exfoliation in Granite on Rout N. C..42, 1 mile east of Dru Store, Johnston County.

cuts the slates, and its intrusion was probably concurrent with that of the granite in the area.

No ground-water supplies are obtained from the aplite in Johnston County. An examination of the aplite quarry near Princeton indicates that the rock is impervious and contains little or no water.

Diorite

Diorite occurs as narrow dikes in the area north of Willow Springs, Johnston County. The dark gray to black rock is medium to fine grained and is structurally and lithologically similar to diorite dikes that intrude sediments of Triassic age west of the Goldsboro area.

No ground-water supplies are obtained from diorite in the area of investigation.

Rocks of the Coastal Plain Province

Cretaceous system

Upper Cretaceous series

Tuscaloosa formation

The name Tuscaloosa was proposed by Smith and Johnson (1887, p. 95-116) for sediments of Cretaceous age exposed at Tuscaloosa, Ala., and was applied first to Cretaceous sediments in North Carolina by Cooke (1936, p. 19).

The Tuscaloosa formation in the Goldsboro area is composed of gray to white sand and gravel and lenses of clay. Quartz is the major constituent of the sand and gravel; feldspar ranges from 0 to 5 percent in most samples.

The formation contains no fossils in the area of investigation and the age assigned is based on fossiliferous material in the subsurface to the east of the Goldsboro area. In the present investigation, the Tuscaloosa was delineated on the basis of stratigraphic position and lithology. Where exposed the Tuscaloosa formation appears of continental origin. The sand is coarse, cross bedding is common, and clay beds are uncommon. Residual bands of iron oxide are common near the surface as a result of postdepositional leaching by circulating ground waters.

Locally, partially indurated basal conglomerates are present, as along the Neuse River south of Smithfield in Johnston County.

From the fall zone, where it overlies an irregular basement formed largely by slate, the Tuscaloosa thickens to the southeast. The formation dips southeastward at 12 to 15 feet per mile in the outcrop area and probably attains a thickness of about 250 feet in southern Sampson County.

The contact between the Tuscaloosa formation and the overlying Black Creek formation is represented by an undulating unconformity in the outcrop area. However, in the vicinity of Clinton, Sampson County, subsurface samples suggest an interfingering of the two formations in a transition zone about 100 feet thick. The apparent interfingering may have resulted from intermittent deposition in two adjacent basins separated by a narrow ridge of basement rock. In many wells a thin zone of siderite pellets marks the top of the Tuscaloosa formation. However, in well 57 in Sampson County (pl. 4) and wells 127 and 140 in Johnston County (pl. 2), the zone of siderite pellets occurs below the contact picked by the writer on the basis of lithology.

The Tuscaloosa is capable of yielding large supplies of ground water in Sampson County and southeastern Wayne County, where it attains its greatest thickness. In other areas, especially where the formation is less than 50 feet thick, it is capable of yielding only small to moderate domestic supplies.

Few wells tap the Tuscaloosa formation in Sampson County and southeastern Wayne County, because ground water is readily available in the overlying formations.

The quality of water in the Tuscaloosa formation is not uniform. In the area near the fall zone where water-table conditions exist, the water in the Tuscaloosa has a pH less than 7.0 and contains large amounts of iron. In the areas where artesian conditions exist, the water has a pH greater than 7.0 and is low in iron content.

Black Creek Formation

The name "Black Creek shale" was proposed by Sloan (1907, p. 12, 13, 14) for beds exposed along Black Creek in Florence and Darlington Counties, S. C.

The Black Creek formation consists of black or dark-gray thinly laminated clay and lenses of sand. It contains abundant mica and lignite, as well as iron sulfides in the form of marcasite or pyrite which occur as concretions, disseminated grains, or as a replacement mineral in lignitized wood fragments. The lower part of the formation contains minor amounts of glauconite and, occasionally Foraminifera.

Stephenson (1923, p. 10) proposed the name Snow Hill marl member for the upper 100 to 200 feet of the Black Creek formation. The Snow Hill marl member is composed of calcareous sand and clay containing abundant microfossils.

The Snow Hill marl member is correlated with the upper part of the Exogyra ponderosa zone of the Atlantic and Gulf Coastal Plain as shown by Stephenson (1923) and later substantiated by Brown (1957). The lower unnamed member of the Black Creek formation is correlated, therefore, with beds of Austin age, whereas the Snow Hill marl member is correlated with beds of Taylor age. The formation thickens toward the southeast in a downdip direction, individual beds having a dip of about 10 to 12 feet per mile.

The formation thickens from a featheredge along its western margin to about 200 feet at Clinton and probably is as thick as 400 feet near Ivanhoe. At Mount Olive in Wayne County it is 211 feet thick (Brown, 1958, p. 53).

The lower part of the Black Creek formation reflects both continental and marine deposition. However, deposition was chiefly in a nearshore continental environment in the area of investigation. The upper part of the Elack Creek formation, the Snow Hill mark member, was deposited in shallow marine waters.

Because of its wide extent and shallow depth and the presence of sand lenses, the Black Creek formation is the source of water for a large number of domestic and municipal wells in the Goldsbord area. The yield of wells tapping this formation ranges from 50 gpm from small-diameter screened wells to 500 gpm from large-diameter gravel-wall wells. The average specific capacity of the wells inventoried is about 5 gpm per foot of drawdown.

The water from the Black Creek formation is not of uniform chemical quality. Near its outcrop area the formation contains water of low pH that is high in iron. The lower part of the formation in Sampson County contains slightly alkaline water low in iron.

Peedee formation

The Peedee formation was named by Ruffin (1843, p. 6-7) for exposures of Cretaceous age in Florence and Horry Counties, S. C. Stephenson (in Clarke and others, 1912, p. 45) used the name Peedee for equivalent sediments in North Carolina.

The Peedee formation crops out in a roughly triangular area in southeastern Sampson County, where it attains a thickness of about 40 feet and overlies the Black Creek formation. According to LeGrand and Brown (1955, p. 8) there is no major hiatus between the Black Creek and Peedee formations.

The Peedee formation is composed of dark-gray to green even textured quartz sand containing glauconite, mica, and clay. In the Goldsboro area the formation is rather homogeneous and bedding is absent. No microfossils were recovered from well cuttings or from surface exposures of the Peedee formation, and its correlation is based on lithology and stratigraphic position. The Peedee exposed in the Goldsboro area represents the basal unit of the Peedee as recognized elsewhere in the State.

The formation is thin and therefore is not a major source of ground water in the Goldsboro area. Most wells tapping the Peedee formation in the area are dug or driven wells that yield 10 to 20 gpm.

The chemical quality of water from the formation is uniform. The water is alkaline, moderately hard, and low in iron.

Tertiary system

Eocene series

Castle Hayne limestone

Small isolated outcrops of the Castle Hayne limestone of Eocene age are found south of the Neuse River in Wayne County, at Newton Grove in Sampson County, and northwest of Clayton in Johnston County. Except for the deposit near Clayton, which rests upon granite, the limestone occupies depressions in the underlying Black Creek formation.

The lithology of the Castle Hayne limestone varies locally. Where N. C. Route lll crosses the Neuse River in Wayne County the $1\,\mathrm{M}$

formation occurs as two distinct lithologic units. A coarse, con glomeratic sandstone cemented by a limy matrix crops out and extends along the river for a mile. The sandstone contains phosphati pebbles, sharks' teeth, pelecypods, and fish vertebrae and is about 30 feet thick. Above the conglomeratic sandstone is a buff t greenish even-textured homogeneous marl which attains a thicknes of about 40 or 50 feet.

Three miles southwest of Mount Olive on the farm of Leo Flowers in Duplin County, east of the Goldsboro area, marl of Eocene age crops out that is similar lithologically to the material in the upper zone of the Castle Hayne at the Neuse River locality. The owner of the property reports that a well at the farm pene trated marl to a depth of more than 150 feet and that coarse material containing large shell fragments was present below the marl.

Well 6 (pl. 4) at Newton Grove penetrated buff to cream mar between depths of 13 and 138 feet. The upper 14 feet consisted o fine-grained marl containing abundant microfossils, whereas th lower 111 feet consisted of coarse shell marl containing no micro fossils. These intervals seem to represent two separate zones.

Exposures of the Castle Hayne limestone 3 miles north of Moun Olive and 2 miles east of Genoa in Wayne County represent a reef like deposit composed of siliceous sponges and sponge spicule partially cemented by silica in a matrix of buff to greenish clay This outcrop is the most extensive Eocene deposit in the area o investigation. Approximately 15 domestic wells obtain their wate supplies from this outlier.

A mile north of U. S. Route 70, on the Wake-Johnston Count line west of Clayton, are several slabs of sandstone of Eocene ag lying at the surface. No exposures of this material were observe in place. The material is a dense siliceous sandstone containin numerous fragments of gastropods and pelecypods, some of which have been removed by solution. The sandstone overlies granite and i some 200 feet higher than the exposures of Eocene materials i Wayne and Sampson Counties. According to Richards (1950) the deposits west of Clayton lack typical Castle Hayne species but never theless contain several middle Eocene species that probably can be correlated with the Claiborne (middle Eocene) deposits of the Gul Coast. Because of poor preservation of the fossils this outlie cannot be correlated with material of Eocene age to the east at the present time.

Wells obtain water from the Castle Hayne limestone near Newton Grove in Sampson County and 2 miles east of Genoa in Wayne County. Because of the small areal extent of the formation, wells are few and data are scanty. Generally, water from the formation is slightly alkaline, moderately hard, and low in iron.

Miocene series

Yorktown formation

The Yorktown formation, of late Miocene age, was named for exposures at Yorktown, Va., and the name was used first in North Carolina by Miller (in Clark and others, 1912). The Yorktown formation crops out discontinuously in northern Wayne County, where erosional remnants occur in depressions in the underlying Upper Cretaceous sediments.

The Yorktown formation extends into eastern Sampson County, where it includes the Duplin marl. The Duplin marl and the Yorktown formation are mapped as a single unit in this report as Mansfield (in Gardner, 1943, p. 11) considered the two to have been deposited contemporaneously, the differences in lithofacies and biofacies reflecting variations in water depth and temperature. The Duplin marl is a shallow-water facies of the Yorktown formation of downdip areas (LeGrand and Brown, 1955, p. 12).

The Yorktown formation consists of interbedded blue-gray sand and clay and layers of shell material. The Duplin marl consists of buff to tan sandy shell beds. The total thickness of the two formations is about 50 feet in the Goldsboro area, and they generally are covered by a mantle of post-Miocene sediments which may be as much as 30 feet thick.

The Miocene material in Wayne County appears to resemble closely the material in zone 2 (Gardner, 1943) of the Yorktown formation of Virginia. The Duplin marl in the Goldsboro area may be equivalent in age to or younger than the Yorktown formation.

The Yorktown formation furnishes water to a few wells in areas where it attains a thickness of 40 to 50 feet and shallower water-bearing sands are absent. Water from the formation is moderately to excessively hard and may contain excessive amounts of iron.

Quaternary system

Pleistocene and Recent Series

Post-Miocene deposits - undifferentiated

Interbedded gravel, sand, and clay of undetermined origin overlie both the Cretaceous and Tertiary deposits and the crystalline rocks of the Piedmont complex. These surficial deposits are difficult to differentiate from the underlying sediments, particularly where they overlie the Tuscaloosa and Black Creek formations.

The thickness of these deposits ranges from 1 to 50 feet an generally averages 25 feet in most areas. However, in the wester part of Sampson County, thicknesses of as much as 80 feet are no uncommon. In most places these sediments contain materials reworke from the underlying older strata. Zones of iron oxide occurring a their base were formed by leaching processes.

The post-Miocene sediments appear to have been deposited in fluviatile environment. Crossbedding and channeling indicate deposition by flowing water. According to previous authors these deposits are mainly of Pleistocene age and have been described a Pleistocene terrace deposits (Stephenson, p. 43, 1912, Pichards, p. 36, 1950). There is little evidence of terraces in the Goldsbor area; and, where features associated with terraces are present the are so obscure that recognition of any single terrace is discretionary. All the post-Miocene sediments are considered as on stratigraphic unit in this report. They attain their greates thickness in southeastern Wayne County, western Sampson County, and Johnston County.

Sand in these surficial deposits furnishes more water to well than any other rock unit in the Goldsboro area. Nearly all well tapping this material are bored or dug. The water occurs under water-table conditions, and water levels fluctuate seasonally. The permeability of the surficial deposits is high, and well yields to 50 gpm are common throughout the area. The water table this material represents a subdued expression of the overlying topography. Shallow wells may become dry during periods of drough but water levels recover rapidly after periods of normal rainfal

The chemical quality of water from the surficial material uniform. The water is soft, corrosive to metals, and contains su amounts of iron that will cause staining of plumbing fixtures a laundry.

GROUND-WATER HYDROLOGY

Hydrologic Cycle

The natural and continuous circulation of water between the atmosphere and the earth is called the "hydrologic cycle." Water in the form of rain or snow (precipitation) falls upon the surface of the earth. Part drains off directly into streams or lakes and eventually to the ocean. Part of the water is evaporated or is transpired by plants (evapotranspiration). In the Goldsboro area, a significant part of the precipitation infiltrates the soil cover into underlying rocks and reaches the zone of saturation. The water in the zone of saturation is called "ground water." After it reaches the zone of saturation it flows toward places where it discharges into streams or lakes or directly into the ocean, or where it comes near enough to the surface to be discharged by evapotranspiration.

Occurrence of Ground Water

Ground water occurs in the interstices, or void spaces, in consolidated rocks and unconsolidated sediments and soils. The interstices may be either primary or secondary. Primary interstices are those formed when the rock was deposited, such as pore spaces in sand and gravel. Secondary interstices are those formed after the rock was deposited, such as fractures and solution openings. In the unconsolidated sedimentary rocks in the Goldsboro area, most ground water occurs in primary interstices, whereas in the igneous, metamorphic, and consolidated sedimentary rocks most ground water occurs in secondary openings.

A formation, group of formations, or part of a formation that is water bearing is called an aquifer (Meinzer, 1923, p. 30). Under water-table conditions the water is in equilibrium with atmospheric pressure and its upper surface, the water table, is the top of the zone of saturation. Under artesian conditions, water is confined under sufficient hydraulic pressure to cause it to rise above the level at which it is penetrated in a well. The imaginary surface that coincides with the static level of the water in an artesian aquifer is termed the piezometric surface.

In the Goldsboro area unconfined ground water is common in the igneous and metamorphic rocks of the Piedmont province and in the upper part of the Coastal Plain sediments. In the Coastal Plain province some of the water that percolates into the earth pene-

trates to some depth, the flow being controlled in part by the disof the formations and in part by localities of discharge such a streams that have cut into the aquifer. As it moves toward the southeast, the water passes into beds which are overlain and under lain by clay beds and is confined under artesian pressure. But water-table and artesian conditions are illustrated in figure 6

Water-3earing Properties of Rocks

The capacities of water-bearing units to store and transmit water are determined by the relationship between the porosity, the permeability, the specific yield, and the coefficient of transmit sibility of the aquifer.

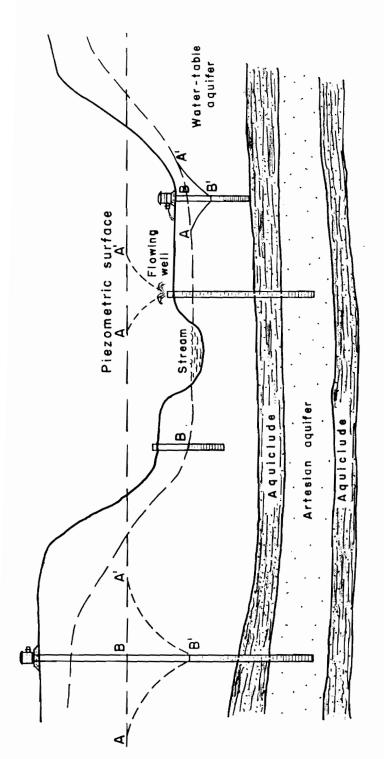
The porosity of a rock is the ratio of the volume of por spaces to the total volume of the solid material, generally expressed as a percentage. In unconsolidated sediments porosity is determined by the degree of assortment, shape, and arrangement of the individual grains, but not by their size. In igneous and metamorphic rocks, porosity is controlled largely by secondary opening formed as a result of cleavage or fracture. Sedimentary rocks generally have higher porosities than crystalline rocks.

Permeability is the measure of a rock's capacity to transmit water under pressure and is dependent upon the porosity of the rotogether with the size, shape, extent, and degree of interconnection of the rock's pore spaces.

The specific yield of a rock is the ratio of the volume of water that will drain from a rock by gravity to the total volume of the water-bearing rock, and is expressed as a percentage.

The coefficient of transmissibility is the product of the fie coefficient of permeability and the thickness of the water-beari formation. A thick formation will yield more water (in gallons poday) than a thin one of the same permeability.

In the present investigation the capacity of the formations store and transmit water was estimated chiefly from an examinati of well cuttings and from analyzing data pertaining to the perfor ance characteristics of wells. These estimates, while not defin tive, allow a comparison of the capacities for the storage at transmissions of water among the water-bearing formations in tarea.



Static water level water Drawdown Pumping ō AA'B' 88, മ്മ

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QUALITY OF WATER

Because of the increasing demand for potable water in the Goldsboro area, it is important to determine the chemical quality of water in the area as well as its quantity.

Ground water is an aqueous solution containing dissociated cations (postively charged particles) and anions (negatively charged particles) which combine to form salts upon evaporation of the water. The ionic constituents commonly reported in water analyses are those that have a direct bearing on the suitability of water for domestic, municipal, or industrial use. In this report the ionic constituents present in natural ground waters are reported quantitatively in parts per million.

The chemical composition of ground water changes from place to place and from formation to formation in the Goldsborp area. The water analyses, tabulated at the end of the individual county descriptions, were selected to show average and extreme values in various parts of the counties.

In 1946 the United States Public Health Service established chemical and physical specifications for drinking water used on interstate carriers. These specifications since have been adopted by the American Water Works Association and most municipalities as a standard for public water supplies and are as follows:

Iron and manganes	se together	ppm = 0).3
Magnesium		ppm = 125	í
Chloride		ppm = 250)
Sulfate		ppm = 250)
Fluoride		ppm = 1	5
Lead		ppm =	. 1
Color		units = 20)
Total solids		ppm = 1500)

 $^{^{1}}$ 1,000 ppm permitted if no other water is available.

COUNTY DESCRIPTIONS

Johnston County

(Area 795 square miles; 1950 population 65,906)

Johnston County lies in the northern part of the area of investigation. The county is bounded on the northwest by Wake County, on the northeast by Nash and Wilson Counties, on the southeast by Wayne County, and on the south and southwest by Harnett and Sampson Counties. Smithfield, the county seat, is the largest town in the county and the second largest in the Goldsboro area. Other incorporated towns include Benson, Clayton, Four Oaks, Kenly, Micro, Pine Level, Princeton, Selma, and Wilson Mills. The major industries include agriculture, textiles, lumber, and livestock.

The northern half of the county lies within the Piedmont province and the southern half within the Coastal Plain province. Elevations in the northern part of the county range from 250 to 400 feet above sea level and the upland surface slopes southeastward at about 10 feet per mile. Elevations in the southern part of the county range from 150 to 250 feet above sea level and the upland surface slopes southeastward at a rate of about 3 feet per mile. The major streams in the county flow toward the southeast and with their tributaries form a parallel drainage pattern. The stream gradients are gentle and the streams meander in the Coastal Plain.

Geology. -- The major crystalline-rock units exposed in the northern half of the county are granite, splite, mica gneiss, schist, and slate (pl. 1). The minor units are diorite, kyanite gneiss, and hornblende gneiss. A large body of granite, probably of Paleozoic age, has intruded a mica gneiss along the northwest border of the county. This granite, which is medium grained to porphyritic, is fairly resistant to erosion and forms an upland of knobby hills covered by a thin veneer of saprolite. East of the granite, the surface of a complex of mica gneiss, schist, and slate slopes toward the southeast at a rate of 10 feet per mile, and passes beneath Coastal Plain sediments in the southern part of the county. The complex is probably of early Paleozoic age. Although closely related both structurally and lithologically to the schist and slate, the gneiss lacks their foliation and, consequently, is less altered by weathering. North of Princeton a dikelike body of dense aplite intrudes the mica gneiss and forms a prominent ridge that strikes N. 60°E. Several diorite dikes, possibly of Triassic age, intrude the granite south of Clayton, and minor segregations 22

of kyanite gneiss and hornblende gneiss occur lo aly in the mic gneiss.

In the southern part of the county the Tuscaloosa formatic crops out along the fall line as a feather edge that extends in a east-west direction. The formation dips toward the southeast and locally attains a thickness of about 150 feet where it overlied depressions in the crystalline basement rock. Unconformably over lying the Tuscaloosa formation are sediments of the Black Cree formation. This formation, generally less than 40 feet thick, it composed of black micaceous clay containing lignitized wood fragments. Locally, marcasite and pyrite occur as concretions or as replacement of the wood.

A thin blanket of surficial sand, probably of post-Miocene as mantles the Cretaceous sediments throughout much of the county at the crystalline rocks along the fall zone. These surficial deposido not attain a thickness of more than 30 feet and are absent some areas.

<u>Ground water.</u> -- Except for public supply of Smithfield, a public and domestic water supplies in Johnston County are obtain from wells. Most domestic wells are dug or bored, whereas municip wells are drilled.

In the Piedmont, dug and bored wells generally less than feet deep obtain water from weathered crystalline rock or surfici sand. These wells yield 2 to 15 gpm. Drilled wells obtain wat from granite, mica gneiss, schist, and slate. The wells in t granite are less than 80 feet deep, and their average yield is lethan 20 gpm. Wells in the mica gneiss average about 125 feet depth and have average yields of 20 to 25 gpm. Wells in the schi and slate are comparable in depth to wells in the mica gneiss, a their average yield is 30 to 35 gpm.

Water from the granite, mica gneiss, and schist is suitable f most uses. Water from the slate is generally high in iron conte and may be corrosive.

In the Coastal Plain, domestic wells obtain water from to Tuscaloosa and Black Creek formations and surficial sands. The domestic wells range in depth from 10 to 175 feet and in yield from 10 to 90 gpm. The quality of the water from the Coastal Plain of posits in the county is variable but generally suitable for most uses except that objectionable quantities of iron occur in so places.

Municipal Supplies

There are 8 municipal water supplies in Johnston County, 7 of which use ground water. The following municipal supplies are listed alphabetically.

Benson

Benson has 7 wells in operation. All the wells are drilled, and each is screened in the Tuscaloosa formation or is cased to slate which is penetrated at an average depth of 200 feet. The wells, ranging in depths from 206 to 800 feet, have a total yield of 533 gpm. The water analyses show that the water is soft to moderately hard and tends to be alkaline. The iron concentration in water from some wells is greater than 0.3 ppm, however, the water is not treated. As of 1959 the static water levels in the town wells were about 159 to 170 feet below the land surface. There has been a continuous lowering of static water levels in the area as a result of pumping since the municipal well system was installed.

Storage is provided by two 100,000 gallon tanks, one elevated and the other underground. There are 1,000 to 1,100 service connections in Benson, and total daily usage in the town averages 250,000 gallons.

Clayton

Clayton obtains water from 9 wells which yield a total of 331 gpm when all are pumped. The wells range in depth from 184 to 520 feet, and each is cased to granite or fractured schist. The wells have an average yield of 37 gpm, which is high for this area. The water is of suitable quality for most uses and is not treated.

Storage is provided by 2 underground tanks having a total capacity of 350,000 gallons, and 1 elevated tank having a capacity of 15,000 gallons. The maximum capacity of the water system is about 250,000 gpd.

Four Oaks

Four Oaks has two wells, both of which were drilled recently. One is 100 feet deep and the other 120 feet deep. They were cased to basement rock at depths of 97 and 105 feet, respectively, and were screened opposite the overlying Tuscaloosa formation.

The bottom 60 feet of casing in both wells is in sand and clay 24

of the Tuscaloosa, which is overlain by surficial sand. The static water level was 40 feet below the land surface in both wells when they were drilled in 1957. The deeper well yields 60 gpm, whereas the shallow well yields 40 gpm. The water from both wells is very soft, high in iron content, and corrosive to metals.

Storage is provided by an elevated tank which has a capacity of 100,000 gallons and feeds directly into the water main. There are 360 service connections in Four Oaks and total usage averages 50,000 gpd. The water system has a capacity of 75,000 gpd.

<u>Kenly</u>

Kenly has 3 wells, 2 are 100 feet deep, and the other is 200 feet deep. The wells are cased to slate, which is reached at a depth of about 40 feet. The total yield of these wells is 360 gpm. The water is somewhat high in iron content but is not treated. There are no industrial users. There is an elevated tank having a capacity of 100,000 gallons. There are 400 service connections in Kenly and the total usage averages 100,000 gpd.

Pine Level

Pine Level has one well 200 feet deep, which was finished in slate and yields 100 gpm. Storage facilities include a settling tank having a capacity of 55,000 gallons and an elevated storage tank having a capacity of 75,000 gallons. There are 205 service connections in Pine Level and the total usage averages 20,000 to 30,000 gpd.

Princeton

Princeton has two drilled wells 237 and 145 feet deep, cased to 58 and 50 feet, respectively. The wells were drilled into slate and have yields of 80 and 70 gpm respectively at a drawdown of 20 feet. The water is slightly high in iron content and is moderately hard. Storage is provided by an elevated tank having a capacity of 75,000 gallons. There are 325 service connections in Princeton and the total usage averages 40,000 gpd.

Selma

Selma has four municipal wells having an average depth of 290 feet. The wells penetrate slate and are cased to depths of 21 to 117 feet. Each of the wells yields 300 gpm, and they are used one

at a time. The water contains an average of about 3.2 ppm of iron. The water is treated with chlorine and caustic soda to reduce the iron content. Storage is provided by an elevated storage tank of 100,000 gallon capacity. Selma has about 1,100 service connections and the total usage averages 350,000 gpd.

Smithfield

Smithfield obtains its water from the Neuse River. The system can pump 1,850 gpm into its various storage units. Storage facilities include a 100,000-gallon clear-water underground tank, a 50,000-gallon elevated wash-water storage tank, and a 100,000-gallon elevated drinking-water tank at the pumping station. There is an additional 100,000-gallon elevated drinking-water tank on the east side of town. Approximately 560,000 gpd is used and the demand has reached a maximum of 702,000 gpd. There are about 1,700 service connections in Smithfield, of which 15 percent are industrial.

TABLE 1. - RECORDS OF WELLS IN JOHNSTON COUNTY, N. C.

Well No.	Location	Омпет	Туре	Depth	Diam- eter	Depth of casing	Water- bearing material	Water level	Yield (gpm)	Draw- down	Remarks
1	1.2 mi. north	H. B. Creech	Drilled	124	9	45	Slate-		က	:	Analysis
2	Emit	Watkins Chapel-	op		9	1	op	Observar	:	:	Do
3	1.8 mi. SE of	P. Godwin	op	87	9	54	op	cion weil	20	!	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
4	5.7 mi. SE of	II. R. Johnson	op	125	9	80	op		10	-	Analysis
2	6.7 mi. South	Paul Dunn	op	62	9	92	op	-10	10		Water level
9	ot Emit	Dr. R. E. Earp-	op	133	9	113	Mica gneiss	-25	40		measured 1952 Water level measured
7	3.5 mi. East Archer's Lodge-	L. E. Prince	op	45	9	18	op	-18	9		1/29/55 Analysis. Water level
8	3.1 mi. SE of	Percy Flowers-	op	186	80	169	op	-10	12	1 1 3 1	Mater level
6	Archer's Lodge- 2.8 mi. east	L. G. Cappes	op	158	2	137	Granite-	-25	15	:	Water level
10	Archer's Lodge- 1.7 mi. NW of	M. G. Weathers-	op	140	9		Granite	1	2	;	measured 1951 Analysis
11	Archer's Lodge- 1,3 mi. West	David A. Pace	op	49	9	45	porpnyry Mica	-20	2	-	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
12	Archer's Lodge 2.5 mi. West	J. S. Vause	op	110	9	96	gneiss	:		:	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
13	Archer's Lodge-	Mrs	op	99	9	41	op	-25	1.0	;	Water level
14	Archer's Lodge- 3.3 mi. SW of Archer's Lodge-	D. R. Boyette	Drilled	51	9	45	Mica gneiss	-15	20		Measured 1992 Analysis. Water level
15	3.2 mi. NW of	J. G. Barbour	op	78	9	64	Granite-	-19	17	;	Mater level
16	Clayton 1,8 mi. West	C. H. Bedding-	do	124	6	100	do	-15	20		Water level

Remarks	Water level measured 19: Abandoned	Amalysis	measured 1953 Analysis. Water level	measured 1953 Water level measured 8/26/58	Water level measured 9/17/53		Analysis. Water level measured	.11/21/56 Analysis Water level measured	1/21/52 Analysis
Draw- down	1 1 1		!	-		:	1	 	-
Yield (gpm)	100?	24 32 33 38 38 50 50 50	42	25	1 1 1 1	25	8	15	30
Water level	-5 -5 Observa-	5	-4.5	-20	-20		-40	-35	;
Water- bearing material	op	000000000000000000000000000000000000000	op	Slate-	Mica gneiss	op	op	Slate-	Mica gneiss
Depth of casing	833	206 30 206 30 35 100	52	96	74	120	107	80 114	:
Diam- eter	ω ω ω	8 10 12 10 10		9	9	9	9	99	9
Depth	360	325 210 2210 520 185 225 250 250	184	184	130	130	140	135	103
Туре	op	000000000000000000000000000000000000000	op	op	Drilled	op	op	op	op
Owner	Bartex Spinning Co Norwich Mills-	Town Welldododododo	p	J. A. Jones	F. W. Lee	Gillis Hood	I. R. Casey	H. M. Wilson H. E. Mitchner	George Black- man
Location	Clayton	Claytondodododo	op	2.7 mi. South of Clayton	2.8 mi. SE of Clayton	3.9 mi. South	of Clayton 3.6 mi. SW of Wilson Mills	Wilson Mills	3.7 mi. NW of Selma
Well No.	17	2224 2222 2234 255 255 255 255	27	28	29	30	31	33	34

	Water level	measured 1954 Analysis	Analysis. Water level	measured 7/2/56 Analysis	1	Abandoned	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Analysis.	measured	Analysis		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Analysis. Water level	measured 1953	Water level	10/14/54 Water level measured	9/1/5/ Analysis.
-	1 1	-	!	!	-		-	-					1 1 1		-	!	
!	1 5 25	10	8	10	2	1	6.	200		90		-	4	2	10	10	4.5
	-15	1	-30	1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	₩.					-25		-25	-15	-16
op	op	Sand	Slate-	op	op	op	Slate-	qo		op	00		op	op	op	op	op
73	62 50	80	45	20	06	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	35	40		1 1	70	ř	96	40	0.2	91	09
9	9	9	9	9	9	1 1 1	9	8		. 00	999	0	9	9	9	9	9.
100	147 57	26	100	69	105		82	200		90-1002	103	671	113	20	80	115	06
op	op	op	op	op	op	op	Drilled	op			- op		op	op	op	op	op
J. Tom Scott	op	Mrs. Luther	B. B. Phillips	D. E. Stancil-	Mrs. D. L.	A. G. Lee	Mrs. G. I.	Town of Kenly-				Hunter	F. L. Langley	Mrs. R. G.	Forest Gurley-	J. W. Boyette-	O. L. Boyette-
35 4.3 mi. North of Selma	op	5.5 mi. North		4.6 mi. North	4.3 mi. NW of	3.9 mi. NW of	Jo ₩	Kenly		op			3.1 mi. East of Kenly	3.6 mi. SE of	4.3 ml. South of Kenly	4.4 mi. South of Kenly	4.8 mi. South of Kenly
35	36	38	39	40	41	42	43	44		45	47	2	49	20	51	52	53

Remarks	Analysis Water level measured	Water level measured 9/2/52 Analysis	Analysis	Analysis. Water level measured	10/2/31 Analysis	Water level measured 4/26/49	Water level measured 10/19/54	Water level measured 7/58		Analysis. Water level measured	6/14/54 Analysis 	
Draw- down			}	:	-	:	1	1	!	22		
Yield (gpm)	4	12	10	35	15	7	4.5	1	25	80	70	-
Water level		-20		-20		-35	-30	12,+14	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	-50	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
Water- bearing material	-Aplite-	Slate-	Slate-	op	op	op	op	Sand	-Aplite-	op	op	
Depth of casing	25	35	0.2	109	127	140	27	20	20	. 28	20	
Diam- eter	9	9. 9	9	9	9	9	9	24	S	8	84	
Depth	149	92	108	132	150	155	09	20	53	237	145	-
Туре	op	do Drilled	op	op	op	op	op	Dng	Drilled	0 p	op	
Owner	Kyle Boyette R. B. Mozingo-	Harvey C. Little W. C. Daniels-	Ivey Edgerton-	W. C. Fitz- gerald	B. E. Lancas-	ter Dr. M. Hinnant	D. F. Peedin	O. L. Boyette-	op	Town of Princeton	Princeton School	
Location	5.4 mi. South ofKenly 4.3 mi. NE of Princeton	3.3 mi. SW of Kenly	Kenly3.4 mi. SW of	Kenly 1.6 mi. North of Micro	2.9 mi. NE of	Selma	3.5 mi North of Princeton	2.3 mi. NW of	0.9 mi. North	oi Frinceton	op	
Well No.	54	56	58	59	0.9	61	62	63	64	65	99	

Abandoned	Water level	measured		Abandoned			Water level	measured 5/52 Analysis Analysis. Water level	measured 1953 Analysis. Water level	measured 1951		Water level measured	10/1/58	Abandoned	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Water level measured 2/58
-	:	-	!	1	:	-57	-80		0	!		t 1 1	-	-	:	:	
33	7	30	100		300	300	300	300	2		-	208	.653	:	:	20	80
!	-10	1	1	1	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		-10	-25	-12	1		-10		1		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	-25
Slate-	op	Slate-	op	op	op	op	op	op	op	Sand	op	Slate-	op	op	op	Slate-	op
140	44	14	1	145	09	21 54	117	99	53		!	32	41	1 1 1	1	96.5	40
9	9	9	9	8	8	89	8	9	4	9	9	9	9	9	8	9	4
165	92	58	200	550	305	300 150	300	275 235	89	1	85	148	99	!	250	159	45
op	op	Drilled	op	op	op	op	op	op	op	op	op	op	op	op	op	Drilled	op
H. H. Olive	G. Jack	Mrs. Mary H.	Town of Pine	Pepsi Cola	Town of	Griggs Equip-	Town of	N. C. State Hwy. Comm.	Е. Н. Lamm	J. E. Woodall-	W. R. Hill	Shelton Lewis-	Circle Court	Circle Drive-	Burlington	Smithfield	_
6.3 mi. SW of	4.0 mi. West	Pine Level	op	Selma	op	op	op	2.7 mi. NW of Selma	1.0 mi. SW of Selma	4.0 mi. SE of	3.5 mi. SE of	Smithfield	1.2 mi. NE of	qo	Smithfield	Smithfield	1.8 mi. SW of Smithfield
89	69	20	7.1	72	73	74	92	77	46	80	81	82	83	8 4	85	98	87

1.7 mi. NW of

Crossroads----

0.8 mi. South

of Johnson

rneernade

121

Roy Strickland

Jr. - - - - - -

Church----

Fellowship

--do---

--Dug--

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34

---do---

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			TABLE 1	RECORDS	OF WELLS	Th Jours	TON COUNTY	- Continue	ea		
Well No.	Location	Owner	Туре	Depth	Diam- eter	Depth of casing	Water- bearing material	Water level	Yield (gpm)	Draw- down	Remarks
88	2.8 mi. SW of Smithfield	Carolina	do	197	8	31	do		40		
89	do	Packing Co	do	176	8	38	do		30		
90	3.3 mi. SW of Smithfield	C. Benson	do	60	4	50	do	-25	10		Water level measured 1948
91	do	Walt Lassiter-	do	60	. 4	50	do	-25	10		Water level measured 11/2/47
92	do	C. R. Cable	do	73	4	50	do	-30	12		Analysis
93	3.7 mi. SW of Smithfield	D. I. Penny	do	53	6	25	do	-18	25		Water level measured 1953
94	2.4 mi. East of Four Oaks	Piney Grove	Dug	22	24	22	Sand	-18.2			
95	1.4 mi. NE of	Arthur N.	Drilled	110	4	95	do		4		Analysis
96	Four Oaks Four Oaks	West, Jr Town of Four Oaks	do	100	8	97	do	-42	40		Analysis. Water level measured
97	do	Esso Station	do	142	6	111	Sand and slate	-60	25	-30	9/30/57 Water level measured 11/1/41
98	do	Town of Four Oaks	do	120	8	105	do	41.6	40	-46.2	Analysis. Water level measured 9/30/57
99	do	Joe Austin	do	145	6	105	do		9		
100	2.5 mi. North of Four Oaks	J. A. Olive	Drilled	155	6	94	Sand and slate		10		
101	4.6 mi. West of Smithfield-	A. T. Coates	do	155	6	140	Slate-		10		Abandoned
102	4.3 mi. West	Pisgah Church-	do	150	6	95	do		10		
103	of Smithfield- 0.5 mi. West of Smithfield-	Noah Williams-	do	258	6	176	do		10		

15

measured

10/6/58 Analysis. Water level

140 Smithfield---105 2.0 mi. West Mrs. W. A. 40 --do---6 12 --Slate-20 Ferrell---of Smithfield-Mrs. Pauline Millis-----2.4 mi. West 106 --do---69 6 22 ---do---20 of Smithfield-2.5 mi. West of Smithfield-107 J. T. Ogburn----do---60 5 ---do---10 ----108 2.6 mi. West J. M. Ogburn----do---67 5 42 ---do---5 Analysis of Smithfield 109 3.2 mi. NW of D. G. Gower---80 --do---6 75 ---do---Smithfield----110 ----do--------do------do---187 6 32 ---do---4.6 mi. West Short Journey 111 --do---117 6 94 ---do---20 ---of Smithfield-School----112 6.5 mi. West Elizabeth --do---100 4 Mica of Smithfield-Church - - gneiss--113 6.4 mi. West J. llubert --do---90 6 71 ---do---12 Analysis of Smithfield-Dickerson----114 6.3 mi. West ---do----125 6 --do---40 ---do----20 20 Water level of Smithfieldmeasured 12/1/52 115 1.6 mi. NE of Rachel Barbour --do---125 6 119 ---do----40 10 Analysis. Willow Springs Water level measured 7/55 Willow Springs Jesse Sherrill 93 116 Drilled 6 79 30 Granite -10 Water level porphyry measured 10/10/44 117 1.7 mi. SW of Garland --do---73 5 45 Mica -14 30 Analysis. Drug Store----Sherrill----Water level gneiss-measured 8/58 A. Taylor----1.9 mi. SW of 110 5 118 --do------do---Drug Store----119 3.6 mi. SW of Plainview --do---26 24 26 --Slate-Water level -15 -Low-Johnson Cross-Church---measured roads-----11/6/58 1.3 mi. West A. M. Jones, 120 29.5 29.5 --Sand--Water level --do---24 - 6.2 ---of Johnson

6

---do---

TABLE 1. - RECORDS OF WELLS IN JOHNSTON COUNTY - Continued

₩ell No.	Location	Owner	Туре	Depth	Diam- eter	Depth of casing	Water- bearing material	Water level	Yield (gpm)	Draw- down	Remarks
122	3.8 mi. South	Mrs. L. Parrish	Drilled	157	6		do		10		Analysis
123	Crossroads 3.3 mi. SE of Johnson Cross-	Johnston Memorial	Dug		36		do	-14.3			Analysis. Water level
124	roads 4.1 mi. NW of Benson	Church H. A. Penny	-Bored-	38	24	38	do	-15			measured 3/10/59 Analysis. Water level measured
125	Benson	Town of Benson	Drilled	206	8	185	Sand	-33	2.5	-106	11/6/58 Water_level measured 1955
126	do	do	do	700	10 to 8	200	do	-198	300		Analysis.
127 128	do	do		702 800	10 to 8 10 to 8	270 259	Slate- Sand	-201	40 13	-302	measured 1957 Analysis Analysis. Water level measured
129	do	do	do	550	10	212	Sand and		60	-350	8/20/57
130	do	do	do	717	10 to 8	240	Sand	-171	125		Analysis. Water level
131	do	do	do	500	10 to 8		Sand and slate	-215	45	- 50	measured 1948 Analysis. Water level measured 1955
132 133	2.3 mi. SE of	do Waldo McLamb		375 243	8 4	241 165	Sand	Observa-	50 10		Analysis Abandoned
134	Benson	do	Dug	30	36	30	do	tion well - 20			Analysis. Water level measured 9/16/58
									6	•	

135 3.6 mi. SE of A. D. Raynor --Drilled 47 45 ---do---8 ------4 Benson-----Miss Bessie 4.7 mi. East 136 --do---178 6 166 ---do---- 45 15 Water level of Benson----Tart----measured 11/23/56 137 5.1 mi. SE of Harvey A. Tart Drilled 172 6 167 --Sand--- 20 10 Analysis. Benson-----Water level measured 6/7/55 E. G. Clifton-138 Peacock's --do---173 6 ---do---90 Analysis Crossroad ----139 -----do-----Johnson's --do---275 6 ---do---Grocery-140 1.3 mi. North Almeta --do---205 6 186 ---do---- 50 10 Analysis. of McCoy-----Water level Johnsonmeasured 10/10/58 4.4 mi. East Randall -Bored-27 24 - 3.6 141 27 ---do-------Water level of McCoy----Chapel--measured 10/10/58 Water level 0.8 mi. West of Stricklands New Hope --Dug--35 36 35 142 ---do---- 15 Church---measured 10/9/58. Crossroad----Abandoned 1.0 mi. North of Stricklands 200 143 Rufus Drilled 6 184 ---do---------20 Abandoned Sanders----Crossroad-----280 0.5 mi. East Mrs. John J. --do---6 ---do--- $2\frac{1}{2}$ Analysis of Harper----Langston----

TABLE 2. - CHEMICAL ANALYSES OF GROUND WATER FROM JOHNSTON COUNTY

(Numbers at heads of columns correspond to well numbers in table of well data)

Well number	1	2	4	7	10	14	19	21
Silica (SiO ₂)	13	15	25	33	44	20	38	33
Iron (Fe), total	. 69	. 60	. 09	. 15	. 35	. 18	. 58	. 05
Calcium (Ca)	2.0	4.0	4.4	10	2.3	4.0	9.0	8.0
Magnesium (Mg)	3.4	3.9	4.5	4.4	. 3	2.0	1.1	1.0
Sodium and potassium (Na+K)	2.0	5.2	3.3	7.2	6.8	7.6	10	11
Bicarbonate (HCO ₃)	26	34	40	63	21	17	54	44
Sulfate (SO,)	. 3	1.3	. 4	1.2	. 2	. 1	1.0	4.0
Chloride (Cl)	2.0	3.8	4.6	1.3	4.0	4.0	2.6	4.5
Fluoride (F)	. 0	. 0	. 0	.1	. 0	. 0	.1	. 1
Nitrate (NO ₂)	. 3	.1	.7	.3	. 9	18	. 0	1.7
Phosphate (PO ₄)	.0	.1	. 0	.1	. 3	. 1		
Dissolved solids	45	51	63	98	70	69	90	89
Hardness as CaCO ₃	20	26	30	43	7	19	27	24
pH	6.6	6.9	6.5	6.4	6.6	6.9	6.4	6.6
Water-bearing material	Slate	Slate	Slate	Gneiss	Granite	Gneiss	Granite	Granite
Date of collection	12-8-58	8-4-58	9-22-58	12-9-58	9-22-58	12-8-58	5-20-48	5-20-48

Analyzed by the Quality of Water Branch, U. S. Geological Survey.

TABLE 2. - CHEMICAL ANALYSES OF GROUND WATER FROM JOHNSTON COUNTY - Continued (Numbers at heads of columns correspond to well numbers in table of well data)

Parts per million

Well number	22	23	24	25	26	27	31	32
Silica (SiO ₂)	35	.33	30	27	31	32	50	33
Iron (Fe), total	. 05	. 04	1.1	. 05	.04	. 02	3.9	. 09
Calcium (Ca)	16	8.4	12	20	21	18	4.4	4.0
Magnesium (Mg)	6.6	. 7	4.5	2.0	7.9	5.4	2.6	3.4
Sodium and potassium (Na +K)	14	14	12	23	8.7	10	9.7	8.6
Bicarbonate (HCO ₃)	61	48	63	72	110	72	3 3	36
Sulfate (SO ₄)	2.2	4.3	7.7	11	1.3	4.9	9.0	4.2
Chloride (C1)	19	5.9	9.0	20	4.4	6.8	4.3	4.0
Fluoride (F)	. 1	.1	. 1	. 0	. 0	. 1	. 0	. 0
Nitrate (NO ₃)	16	2.3	2.6	12	3.0	12	. 3	2.1
Phosphate (PO ₄)	.1				.1	. 1	. 0	. 0
Dissolved solids	149	94 .	113	158	131	126	9.7	78
Hardness as CaCO3	67	24	48	58	86	67	22	25
pII	7.4	6.8	6.6	6.6	7.8	7.5	6.7	7.0
	Granite	Granite	Granite	Granite	Granite	Granite	Gneiss	Slate
Date of collection	3-28-58	5-20-48	4-23-54	5-20-48	3-28-58	9-22-58	9-22-58	12-9-58

TABLE 2. - CHEMICAL ANALYSES OF GROUND WATER FROM JOHNSTON COUNTY - Continued (Numbers at heads of columns correspond to well numbers in table of well data)

Well number	34	38	39	40	44	45	49	53
Silica (Si0 ₉)	22	27	15	43	22	12	29	8.0
Iron (Fe), total	.01	.12	. 07	4.0	.77	. 49	. 32	. 06
Calcium (Ca)	32	1.1	2.9	2.0	9.8	8.7	2.0	6.0
Magnesium (Mg)	3.4	. 4	5.8	2.7	2.8	13	2.7	3.2
Sodium and potassium (Na + K)	6.2	4.2	11	8.0	13	33	5.9	4.8
Bicarbonate (HCO ₃)	104	12	18	32	58	20	28	9
Sulfate (SO ₄)	13	.3	. 2	2.7	4.6	6.4	. 5	18
Chloride (Cl)	2.8	3.2	20	3.0	6.5	72	2.5	44
Fluoride (F)	.1	.0	. 0	.0	.1	. 1	. 0	. 5
Nitrate (NO ₃)	.0	.3	14	.0	2.4	27	1.4	41
Phosphate (PO ₄)	.0	.0	. 2	. 0			.1	3.1
Dissolved solids	136	44	86	78	91	194	61	181
Hardness as CaCO3	94	5	31	- 16	36	75	16	28
pH	7.0	6.4	6.3	6.1	6.9	5.9	6.7	5.6
Water-bearing material	Gneiss	Sand	Slate	Slate	Slate	Slate	Slate	Slate
Date of collection	12-8-58	9-22-58	12-9-58	12-18-58	5-27-54	11-4-47	12-8-58	9-19-58

Analyzed by the Quality of Water Branch, U. S. Geological Survey.

TABLE 2. - CHEMICAL ANALYSES OF GROUND WATER FROM JOHNSTON COUNTY - Continued (Numbers at heads of columns correspond to well numbers in table of well data)

Parts per million

Well number	54	57	58	59	60	65	66	77
Silica (SiO ₂)	52	12	15	40	13	33	32	28
Iron (Fe), total	1,7	. 02	. 08	12	. 30	. 55	. 21	1.1
Calcium (Ca)	14	1.4	2.4	5.9	6.4	23	2 4	18
Magnesium (Mg)	1.4	1.1	2.4	2.1	3.4	4.7	4.5	3.2
Sodium and potassium (Na+K)	11	2.7	3.1	9.1	2.6	8.6	20	13
Bicarbonate (HCO ₃)	53	11	16	38	39	97	123	65
Sulfate (SO ₄)	11	. 1	. 8	8.0	· . 5	11	13	27
Chloride (Cl)	3.5	2.5	3.0	4.1	3.5	2.5	4.6	3.0
Fluoride (F)	. 0	.1	. 0	.1	. 0	. 2	.1	. 1
Nitrate (NO ₃)	. 6	1.8	2.0	. 3	. 7	. 4	. 0	. 9
Phosphate (PO ₄)	. 3	/1	. 1	. 0	. 0			
Dissolved solids	126	28	38	90	58	139	159	130
Hardness as CaCO3	41	8	16	24	30	77	78	59
pH	7.0	6.0	6.0	6.5	6.6	7.6	7.8	6.8
Water-bearing material	Aplite	Aplite	Slate	Slate	Slate	Aplite	Aplite	Slate
Date of collection	9-24-58	12-19-58	12-8-58	9-22-58	10-1-58	6-7-54	1 - 5 - 48	9-23-54

TABLE 2. - CHEMICAL ANALYSES OF GROUND WATER FROM JOHNSTON COUNTY - Continued (Numbers at heads of columns correspond to well numbers in table of well data)

Well number	78	79	92	95	96	98	108	113
Silica (SiO ₂)	29	40	38	20	10	9.8	32	32
Iron (Fe), total	1.0	1.8	. 67	. 59	2.8	1.7	3.4	1.4
Calcium (Ca)	7.2	16	11	14	2.1	1.2	3.2	4.6
Magnesium (Mg)	3.8	5.1	5.1	12	. 5	. 4	3.4	5.0
Sodium and potassium (Na+K)	8.8	13	6.2	26	6.3	4.8	8.5	10
Bicarbonate (HCO3)	33	106	69	157	1	4	42	35
Sulfate (S0 ₄)	17	. 7	2.6	1.8	1.9	. 1	4.5	10
Chloride (Cl)	5.2	4.5	2.8	2.2	5.0	4.0	2.0	10
Fluoride (F)	. 2	. 2	.1	. 1	. 0	. 0	. 0	. 2
Nitrate (NO ₃)	.1	. 3	. 4	. 2	12	7.4	. 0	. 1
Phosphate (PO ₄)		.0	. 0	. 1	. 0	. 0	. 0	. 2
Dissolved solids	88	135	102	164	42	3 5	75	91
Hardness as CaCO3	34	63	49	85	7	5	23	34
pII	7.0	7.2	6.9	8.2	4.7	5.2	7.0	6.3
Water-bearing material	Slate	Slate	Slate	Sand	Sand	Sand & Slate	Slate	Gneiss
Date of collection	4-21-50	9-24-58	9-16-58	11-7-58	6-25-58	6-25-58	12-10-58	12-10-58

Analyzed by the Quality of Water Branch, U. S. Geological Survey.

TABLE 2. - CHEMICAL ANALYSES OF GROUND WATER FROM JOHNSTON COUNTY - Continued (Numbers at heads of columns correspond to well numbers in table of well data)

Parts per million

Parts per million												
Well number	115	117	121	122	123	124	126	127				
Silica (SiO ₂)	34	31	7.1	32	8.2	6.6	19	14				
Iron (Fe), total	.26	1.2	.04	1.6	.32	. 19	. 06	2.8				
Calcium (Ca)	11	6.5	1.6	19	2.4	11	16	14				
Magnesium (Mg)	5.1	3.4	. 5	5.4	2.8	1.4	6.9	8.0				
Sodium and potassium (Na+K)	7.4	9.9	10	9.7	8.8	14	33	26				
Bicarbonate (HCO ₃)	48	46	1	96	6	31	134	130				
Sulfate (SO ₄)	.3	4.0	. 2	3.0	. 2	. 1	7.3	3.4				
Chloride (Cl)	7.1	5.5	8.5	2.0	8.5	12	11	7.9				
Fluoride (F)	. 0	.1	. 0	. 1	.1	. 1	.1	.1				
Nitrate (NO ₃)	18	.1	18	.1	19	22	. 2	. 2				
Phosphate (PO ₄)	. 0	. 4	.0	.0	. 1	. 0	. 0	. 0				
Dissolved solids	106	90	51	126	66	86	163	138				
Hardness as CaCO3	50	31	6	70	17	32	68	67				
pII	6.6	6.7	4.9	7.5	6.3	7.4	7.7	7.7				
Water-bearing material	Gneiss	Gneiss	Sand	Sand	Sand	Sand	Sand	Slate				
Date of collection	9-22-58	11-6-58	9-17-58	11-6-58	12-10-58	12-10-58	3-21-58	3-21-58				

TABLE 2. - CHEMICAL ANALYSES OF GROUND WATER FROM JOHNSTON COUNTY - Continued (Numbers at heads of columns correspond to well numbers in table of well data)

Well number	128	130	131	132	134	137	138	140
Silica (SiO ₂)	11	14	17	19	5.1	42	17	16
Iron (Fe), total		. 00	.77	. 89	. 03	.34	. 09	.11
Calcium (Ca)	13	14	21	11	1.6	2.0	2.7	7.7
Magnesium (Mg)	5.6	6.7	10	7.5	1.5	2.7	2.3	6.8
Sodium and potassium (Na + K)	49	29	32	29	9.8	9.0	59	5,9
Bicarbonate (HCO ₃)	130	128	124	129	12	38	148	176
Sulfate (SO ₄)		9.1	46	2.1	. 3	1.1	3.9	8.8
Chloride (C1)		8.2	10	8.5	9.9	2.5	8.3	7.7
Fluoride (F)	.1	. 1	. 1	.1	. 1	. 4	. 4	. 5
Nitrate (NO ₃)	. 0	. 0	. 2	. 3	11	.1	. 7	. 3
Phosphate (PO ₄)			. 0	.1	. 0	. 4	. 3	. 0
Dissolved solids	l	144	209	146	49	79	177	200
Hardness as CaCO3	56	62	94	59	11	17	16	47
pH		7.6	7.4	7.8	6.4	6.4	7.8	7.8
Water-bearing material	Sand	Sand	Sand & Slate	Sand	Sand	Sand	Sand	Sand
Date of collection	4-23-54	4-23-54	3-21-58	3-21-58	9-16-58	9-17-58		12-10-58

Analyzed by the Quality of Water Branch, U. S. Geological Survey.

TABLE 2. - CHEMICAL ANALYSES OF GROUND WATER FROM JOHNSTON COUNTY - Continued (Numbers at heads of columns correspond to well numbers in table of well data)

Parts per million

		Parts per million
Well number	144	
Silica (SiO ₂)	10	
Iron (Fe), total	.33	
Calcium (Ca)	5.2	
Magnesium (Mg)	1.0	
Sodium and potassium (Na+K)	142	
Bicarbonate (HCO3)	334	
Sulfate (S0 ₄)	16	
Chloride (Cl)	17	
Fluoride (F)	1.1	
Nitrate (NO ₃)		
Phosphate (PO ₄)	. 0	
Dissolved solids	359	
Hardness as CaCO3	17	
рН	7.8	
Water-bearing material	Sand	
Date of collection	10-1-58	

Sampson County

(Area 963 square miles; 1950 population 49.780)

Sampson County lies in the southern part of the Goldsboro area. It is triangular in shape with the apex at the south. The county is bounded on the north by Wayne, Johnston, and Harnett Counties, on the east by Duplin and Pender Counties, and on the west by Cumberland and Bladen Counties. Clinton, the county seat, is the largest town in the county. Other incorporated towns include Autryville, Garland, Harrells, Newton Grove, Parkersburg, Roseboro, Salemburg, and Turkey.

Sampson County is in the Coastal Plain province. The topography is flat to gently rolling and the upland surface slopes gently toward the southeast. The flat to gently-rolling surface is dissected by streams whose valleys are about 80 feet deep in areas of maximum relief.

Geology. -- Most of the county is covered by sand and clay that is designated as post-Miocene undifferentiated in this report. In the western part of the county this surficial material is as much as 80 feet thick, whereas in other parts of the county it is no more than 30 or 40 feet thick. In the major stream valleys this surficial material has been eroded away and older formations are exposed.

Marls of Miocene and Eocene age crop out in scattered outliers throughout the county. The Duplin marl of Miocene age attains a maximum thickness of about 20 feet locally north, east, and south of Clinton. The marl, composed of thin shell beds and clays, contain a macrofossil assemblege similar to that occurring at Natural Well in Duplin County (Gardner, 1943, p. 18-19). A large outlier of the Castle Hayne limestone of Eocene age occurs at Newton Grove. At this locality the formation is 125 feet thick and is lower topographically than the surrounding Cretaceous sediments. The limestone at Newton Grove is similar, lithologically, to Eocene deposits in adjacent Wayne and Duplin Counties and is correlated on the basis of lithology and the occurrence of Eocene ostracode.

Sediments of Late Cretaceous age - the Peedee, Black Creek, and Tuscaloosa formations underlie the Quaternary and Tertiary sediments. The Peedee formation, composed of gray to green calcareous sand and clay containing glauconite, occurs as a thin wedge-shaped deposit in the southeastern corner of the county. The formation thickens from a feather edge along its western margin to as much as 20 or 30 feet along the eastern border of the county.

Underlying the Peedee formation is the Black Creek formation which is composed of gray to black micaceous sand and clay. The formation is 30 to 50 feet thick in the northwestern part of the county and 300 to 400 feet thick in the southeastern part of the county. Well cuttings from well 57 at Clinton (page 50) suggest to the writer that in this area the Black Creek formation interfingers with the Tuscaloosa formation.

The Tuscaloosa formation, composed of pink to red sand and clay, is the basal sedimentary unit in the county and lies upon an irregular crystalline basement complex. The formation has been penetrated in only a few places in the county and little information is available as to its maximum thickness. It is estimated to be about 250 feet thick at Ivanhoe and more than 100 feet thick at Clinton and along the northern edge of the county. Correlation of the Tuscaloosa formation is based on lithology and stratigraphic position.

Ground water. -- All water supplies in the county are obtained from wells. Most domestic wells are dug or bored and obtain water from the surficial sand which supplies water to about 75 percent of the people in the county. The water from the surficial sand is soft, corrosive to metals, and high in iron content.

Municipal wells obtain water from the Black Creek and Tuscaloosa formations. The Black Creek formation is the source of water for wells of moderate depth. Wells shallower than 100 to 200 feet yield from 5 to 100 gpm, whereas wells deeper than 200 feet may yield as much as 500 gpm. Locally, water from the Black Creek formation may contain excessive amounts of iron and hydrogen sulfide and therefore is of poor chemical quality.

The Tuscaloosa formation is the source of water for many deep wells in the county but is not used to a great extent because of its great depth below land surface which makes the cost of drilling wells prohibitive for small domestic supplies. Wells at Clinton, the East Carolina Indian School, Hobbton, and Roseboro obtain water from the Tuscaloosa formation. Water from the Tuscaloosa formation is soft to moderately hard, generally low in iron content and slightly alkaline.

The Miocene and Eocene outliers are of only local significance as aquifers. Analyses of water from these formations show moderate hardness, low iron content and pH ranges from 7.0 to 7.8.

No wells in Sampson County obtain water from the basement rock as adequate supplies are available from overlying sediments.

Municipal Supplies

There are three municipal supplies in Sampson County, all of which use ground water. The following municipal supplies are listed alphabetically.

Clinton

Clinton has three wells in operation. All the wells are drilled multiple-screen wells, and have an average depth of about 400 feet. They obtain water from the Black Creek or Tuscaloosa formations. Well 57 (p. 50), screened in sands of the Tuscaloosa formation was tested in March 1959 for a period of 30 days at a continuous pumping rate of 400 gpm. The static water level at the start of the test was 65 feet below land surface and the drawdown at the end of 30 days of pumping was 155 feet. The drawdown was stabilized at 155 feet during the last 14 days of the pump test.

Storage is provided by 3 elevated tanks and 1 underground tank having a total storage capacity of 575,000 gallons. There are about 2,100 service connections in Clinton, and total daily usage in the town averages about 500,000 gallons.

Garland

Garland has one gravel wall well, 348 feet deep, that taps the Black Creek formation. The well was tested at 450 gpm; when drilled, the static water level was 62.73 feet below land surface.

Storage is provided by one elevated tank with a capacity of 125,000 gallons. There are about 200 service connections in Garland and the daily usage in the town is about 60,000 gallons.

Roseboro

Roseboro has two "gravel-wall" wells in operation which tap the Black Creek and Tuscaloosa formations. Both wells were drilled to basement (350 feet) and finished at a depth of 340 feet. The combined yield of both wells is 800 gpm.

Storage consists of one elevated tank with a capacity of 100,000 gallons. There are about 375 service connections in Roseboro and the daily usage in town is about 250,000 gallons.

TABLE 3. - RECORDS OF WELLS IN SAMPSON COUNTY, N. C.

Remarks	Analysis			Analysis. Water level	7-30-58 Analysis. Water level measured	1-7-55 Analysis. Water level	October 1958		Analysis. Water level measured	8-1-53 Water level measured	2-15-56 Analysis. Water level
Draw- down	An	:		An	7 An Wa	Va Wa	00	- - -	An	8- #8-	An
Yield [[gpm] c	:				50			28	10	25	- 02
Water			1	89	-14	-10			-27	-12	92-
Water- bearing material	Sand	op	op	op	op	Lime- stone	Sand	op	op	op	Sand
Depth of casing	26	28	22.	17	112	26	26	74	96	32	290
Diam- eter	9	9	24	2	4	4	9	9	4	9	9
Depth	30	30	22	17	116	109	30	18	100	37	300
Туре	Drilled	op	-Bored-	Driven-	Drilled	op	op	op	op	op	Drilled
Owner	Plainview School	Mingo High School	Mount Carmel Church	L. J. Tur- lington	E. K. Bass	William & Mary Motel	Newton Grove	Holy Redeemer	Church	Hobbton School	Hobbton School Drilled
Location		:	Crossroads 3.5 mi. north of West's	Crossroads West's Cross- roads	4.6 mi. east of West's Crossroads	Newton Grove	op	op	2.7 mi. SE of Newton Grove	Hobbton	Hobbton
Well No.	1	2	8	4	2	9	2	8	6	10	11

Well No.	Location	Owner	Туре	Depth	Diam- eter	Depth of casing	Water- bearing material	Water level	Yield (gpm)	Draw- down	Remarks
12	2.7 mi. east	Goshen Church-	Driven-	19	1½	19	do	-8			Water level
13 14	of Hobbton Suttontown 2.1 mi. SE of Suttontown	W. B. Sutton II. C. Murphy	Drilled do	154 153	6 4	150	do	-20	60 90		measured 1955 Analysis Analysis. Water level
15	4.1 mi. SE of Suttontown	Henry Vann	do- 	240	10	240	do	-42	500		measured 1953 Water level measured 1955
16	2.9 mi. SE of Suttontown	Piney Grove	do	68	6		do				Analysis
17	4.7 mi. north of Turkey	Gordon McClenney	Dug	14	36	14	do	-5			Water level measured
18	4.5 ml. east of Kenner	Hargrove School	Drilled	124	6	117	do	-30	50		7-31-58 Water level measured
19	Keener	B. E. Lockamy-	do	44	4	40	do	-12	10		1-29-57 Water level
20	Beaman's Cross- road	Henry Vann	-Bored-	20	24	20	do	-8			measured 1954 Water level measured
21	0.8 mi. SW of Beaman's	Otis Strick- land	Drilled	117	6	113	do		12		June 1958
22	Crossroad 2.1 mi. SE of Beaman's Crossroad	Eastern Caro- lina Indian lligh School	do	318	6	299	do	-74	35		Analysis. Water level measured
23	Kitty Fork	J. F. Ellis	Drilled	241	10	228	Sand	-41	300	· 	May 1958 Water level
24	4.0 mi. west of Beaman's	D. C. Spell	Driven-	22	1½	22	do				measured 1955
25	Crossroad 5.4 mi. east of Clement	A. K. Hall	Dug	18	36	18	qó	-2			Water level measured 7-28-58

26	1.9 mi. north	J. T. Hayes	-Bored-	22	24	20.5	do	-8			Water level measured 1956
27	Clement	Ivey Autry	Dug	25	20	25	do	-15			Water level measured
28	4.9 mi. NE of Autryville	J. W. Reaves	Drilled	35	5	33	do				7-28-58 Analysis
29	4.0 mi. east of Autryville-	Ed Sessoms	Driven-	75	1½	75	do		1		
30 31	Salemburg	Robie Butler	do Drilled	45 58	1½ 6	45 55	do	-15	10		Water level measured
32	Salemburg	Salemburg Manufacturing	do	75	6	41	do	-15	4		9-20-56 Water level measured 11-23-55
33	do	Salemburg School	do	87	4		do		15		
34	do	Edwards Military	do	137.5	6	133	do		60		
35	0.8 mi. SE of	Institute W. J. Freeman,	do	110	4	105	do		25		
36	Salemburg 2.0 mi. west of Roseboro	Jr K. Lucas	Drilled	121	4	117	Sand	-2.5			Analysis. Water level measured
37	1.9 mi. west	B. Lucas	Driven-	35	1½	35	do	-10	8-10		Nov. 1958 Water level measured 1956
38	Roseboro	Town of Roseboro	Drilled	470	18	338	do	-72	500		Analysis. Water level measured 1955
39	do	do	do	400	10		do		300		Analysis. Water level
40	0.7 mi. south	Roseboro Spinning Co	-Bored-	60	24	60	do	-16			measured 19 Water level measured 1957
41 42	0.8 mi. south	Roseboro	do	30 38	24 24	30 38	do	-15 -15			do
43	of Roseboro 0.9 mi. south of Roseboro	Spinning Co	do	65	24	65	do	-15			

Well No.	Location	Owner	Туре	Depth	Diam- eter	Depth of casing	Water- bearing material	Water level	Yield (gpm)	Draw- down	Remarks
44	4.4 mi. west of Clinton	Anson Cannady-	Drilled	85	2	80	do	-18	5		Water level measured 1953
45	do	do	do	80	2	75	do	-10			Not in use Water level measured 1953
46	4.5 mi. west of Clinton	Arthur Cannady	-Bored-	21	. 24	21	do	-8.15			Water level measured
47	3.9 mi. north of Clinton	Bert Lee	do	42	24	42	Marl	-6.5			9-18-58 Water level measured
48	1.6 mi. NW of Clinton	Sampson County	Drilled	119	4	111	Sand	-40	20		9-1758 Water level measured 1-8-57
49	1.4 mi. NW of	Telephone Co. Prison Camp	do	144	4	109	do		14		Analysis
50	Clinton l.l mi. north of Clinton	R. A. McCullen	do	120	8	110	do	-23	125		Water level measured 1-27-54
51 52	Clinton	Ilenry Vann City of Clinton	do	380 435	24 to 8 10	385	do	-,36	560		Water level
53 54		do	do	385 265	8 24	385	do	-40	500		Water level measured
55	1.8 mi. NE of Clinton	J. C. Woody	do	118	4	114	do	-25	15		March 1948 Water level measured
56	Clinton		do	527	10 to 8		do		650		4-9-58 Analysis
57	do	Clinton	do	386	10.		do	-67	400	155	Water level measured March 1959

58 l	1.5 mi. west	Adams, Johnson	do	88	4		do	-30	10		Water level measured 1956
59	of Clinton 3.0 mi. north	& McOueen, Inc.	Driven-		2		do	+4.52	3		Analysis. Water level
	of Turkey								l		measured 3-4-59
60	0.6 mi. north	E. E. Seay	Drilled	45	4	45	Sand				Analysis
61	of Turkey 0.5 mi. SW of	Turkey School-	do	250	6		do				
62	Turkey 2.3 mi. SW of		Driven-	?	2	?	do		3		Analysis
63	Turkey 5.9 mi. SW of	D. Underwood	-Bored-	58	24	58	do	-15			Water level
	Clinton				1%	13	do	-8			June 1958 Water level
64	5.6 mi. SE of Roseboro	Fred Summons	Driven-	13	מז	13	11140-11				measured 7-29-58
65		I. K. Carter	Drilled	160	4		do				Analysis
66	Garland	do	-Bored-	40	24	40	go	-15	5		Analysis. Water level
							}				measured 7-17-58
67			Drilled	282	6	259	do	-36	40		Water level
	of Taylor's Bridge	Bridge School-				 	do		4.6		11-30-53 Flows
68	0.9 mi. north of Taylor's	N. C. Park Service							4.0		1
69	Bridge	do			24	85	do	-10	3		Analysis.
70	2.2 mi. SE of Taylor's	Howard Merritt	-Bored-	85	24			10			Water level measured 1957
71	Bridge 1.0 mi. NW of	Lemon Nance	Drilled	82	4	80	do	-38	5		Analysis.
	Garland			}	{	}					measured 12-10-53
72	Garland		Drilled	189	6	185 348	Sand	-10 -62,73	35 450		Analysis.
73	do	Town of Garland	do	348	12	340		-02.73	*50		Water level
_											3-30-55

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Well No.	Location	Owner	Туре	Depth	Diam- eter	Depth of casing	Water- bearing material	Water level	Yield (gpm)	Draw- down	Remarks
74	1.6 mi. west of Clear Run	Clear Fun School	do	63	6	59	do	-8	50		Analysis. Water level measured
75	Harrells	Preston Ward	do	160	4	152	do	-22	17		1-9-57 Analysis. Water level measured 1946
76	do	Franklin Harrell School	do	250	6		do				
77	2.8 mi. east of Harrells		Driven-	85	1½	85	do	-2			Analysis. Water level
78	Harrells	A. P. Shaw	do	57	4	53	do	-25	15		measured 1946 Water level measured
79	1.0 mi. SW of Harrells	Keathern Church	do	89	4		do	-60	8		8-24-54 Water level
80	do	Bland High	do	92	6		do		25		measured 1953
81	1.7 mi. SW of Harrells	SchoolA. A. Maynard-	Drilled	45	4	40	do	-8	10		Water level
82	1.9 mi. south of Harrells	Mrs. Inez Devane	Drilled	75	4	71	Sand	26	10		8-25-54 Analysis. Water level measured
. 83	0.4 mi. north of Ivanhoe	E. H. Brown	do	45	4	41	do		10		11-14-54
84	0.2 mi. NW of Ivanhoe	Brown Lumber	do	47	4		do		19		
85 86	1.0 mi. south	Royal Church	do Driven	50 12	3 1½	12	do	-6			Water level measured 1954
87	1.2 mi. south	Public Supply-	do	180	6-4	180	do		3		Analysis
88	of Ivanhoe 1.8 mi. SE of Ivanhoe	P. L. Brown	Drilled	95	4	91	do		18		Analysis

TABLE 4. - CHEMICAL ANALYSES OF GROUND WATER FROM SAMPSON COUNTY

(Numbers at heads of columns correspond
to well numbers in table of well data)

Well number	1	4	5	6	9	11	13	14
Silica (SiO ₂)	6.7	12	64	23	84	20	17	35
Iron (Fe), total	. 0	4.3	. 09	.01	. 60	.00	15	06
Calcium (Ca)	1.2	. 8	1.2	55	3.5	10	5.5	22
Magnesium (Mg)	. 5	. 2	. 5	5.7	1.7	3.4	1.6	5.0
Sodium and potassium (Na + K)	3.3	2.9	46	4.3	18	59	10	8.7
Bicarbonate (HCO ₃)	4	7	101	186	45	178	16	102
Sulfate (SO ₄)	. 2	.2	. 5	6.9	4.4	1.6	2.5	.1
Chloride (C1)	4.7	3.0	3.8	3.3	2.5	12	19	3.7
Fluoride (F)	. 1	.0	. 4	. 2	. 4	. 4	. 0	. 2
Nitrate (NO ₃)	5.1	.0	. 2	.3	. 0	. 3	. 4	. 4
Phosphate (PO ₄)	. 0	.1	10	.2	7.5	. 9	. 0	. 9
Dissolved solids	35	. 24	182	201	144	198	65	123
Hardness as CaCO ₃	5 5	3	5	160	16	41	20	74
pll	5.5	5.6	6.8	7.4	6.6	7.1	6.4	7.8
Water-bearing material	Sand	Sand	Sand	Lime- stone	Sand	Sand	Sand	Sand
Date of collection	9-18-58	9-3-58	12-30-58	12-30-58	9-3-58	9-17-58	9-17-58	12-30-58

TABLE 4. - CHEMICAL ANALYSES OF GROUND WATER FROM SAMPSON COUNTY - Continued

(Numbers at heads of columns correspond
to well numbers in table of well data)

Well number	16	22	28	36	38	39	49	56
Silica (SiO ₂)	35	18	13	33	10	8.3	31	32
Iron (Fe), total	.00	.06	13	1.4	. 09	3.9	. 27	, 6.6
Calcium (Ca)	38	.8	.7	. 8	5.0	4.6	9.8	19
Magnesium (Mg)	1.2	1.5	. 3	.6	3.1	3.2	1.9	4.2
Sodium and potassium (Na+K)	3.0	168	5.5	32	285	260	8.4	9.5
Bicarbonate (HCO3)	110	343	7	77	429	402	48	86
Sulfate (SO _A)	7.7	13	3.0	3.4	52	45	58	5.7
Chloride (Cl)	4.5	53	4.5	3.0	165	146	3.4	4.7
Fluoride (F)	.1	1.0	. 0	1.0	. 3	. 4	.1	. 1
Nitrate (NO ₃)	. 6	.3	. 0	. 5	. 1	. 2	. 0	. 2
Phosphate (PO ₄)	. 2	. 2	. 0	4.6	. 5	. 4		1.4
Dissolved solids	156	432	30	120	7 47	694	85	117
Hardness as CaCO3	100	8	3	5	25	25	32	65
рН	7.1	8.2	6.4	7.8	8.0	8.6	6.9	7.1
Water-bearing material	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
Date of collection	9-16-58	12-30-58	8-6-58	10-17-58	4-15-58	4-15-58	3-26-50	5-27-58

Analyzed by the Quality of Water Branch, U. S. Geological Survey.

TABLE 4. - CHEMICAL ANALYSES OF GROUND WATER FROM SAMPSON COUNTY - Continued (Numbers at heads of columns correspond to well numbers in table of well data)

Parts per million

Well number	59	60	62	65	66	70	71	73
Silica (SiO ₂)	19	9.4	23	18	5.4	7.6	16	33
Iron (Fe), total	1.3	.05	3.3	18	. 61	.56	. 05	3.1
Calcium (Ca)	39	38	2.1	2.0	13	5.7	3.6	9.1
Magnesium (Mg)	2.4	1.5	.9	1.2	1.7	1.2	2.4	2.9
Sodium and potassium (Na+K)	4.5	3.1	5.0	4.5	6.9	2.5	3.9	20
Bicarbonate (HCO3)	125	74	6	16		22	27	74
Sulfate (SO _A)	6.0	30	7.3	2.7	5.4	. 6	2.1	1.0
Chloride (C1)	3.0	12	4.0	2.6	2.9	3.0	2.5	5.1
Fluoride (F)	. 2	. 2	.1	.0	. 0	. 1	.1	. 2
Nitrate (NO ₃)	. 2	. 0	. 0	.0	16	. 1	.1	. 5
Phosphate (PO ₄)	.1	. 2	. 2	.1	. 0	. 5	. 0	3.4
Dissolved solids	140	136	47	40	67	41	47	118
Hardness as CaCO3	108	102	9 .	10	39	20	21	3.5
он при	7.7	7.4	6.1	6.0	9.8	6.2	6.5	7.3
Water-bearing material	Sand	Sand	Sand	Sand	Sand	Sand	Sand	Sand
Date of collection	12-15-58	9-19-58	8-4-58	9-3-58	9-3-58	12-30-58	12-30-58	5-27-58

- Continued CHEMICAL ANALYSES OF GROUND WATER FROM SAMPSON COUNTY (Numbers at heads of columns correspond to well numbers in table of well data) 4. TABLE

		Par	Parts per million	ion			
Well number	74	7.5	77	82	87	88	
(Si0) soilis	7 1	9.5	93.	17	10	0.0	
Iron (Fe), total	00.	.07	.38	00.	90.	. 15	
Calcium (Ca)	1.2	34	47	55	26	.2	
Magnesium (Mg)	1.2	3.9	2.4	1.9	12	.1	•
Sodium and potassium (Na+K)	2.9	8.9	9.9	3.7	29	104	
Bicarbonate (IKO ₂)	2	140	163	178	302	279	
Sulfate (SO,)	2.8	7.	3.1	.2	6.	٠.	
Chloride (CI)	3.5	4.0	4.0	4.5	5.5	3.0	
Fluoride (F)	.2	.1	.1	e.	. 2	.2	
Nitrate (NO ₂)	1.1	.1	0.	1.	.2	.2	
Phosphate $(\tilde{P}0_A)$	0.	.5	.1		.1	. 2	
Dissolved solids	26	145	177	171	272	273	
Hardness as CaCO ₃	6	103	129	146	117	1	
Hd	5.4	7.1	7.2	7.1	8.2	7.6	
Water-bearing material	Sand	Sand	Sand	Sand	Sand	Sand	
Date of collection	9-18-58	9-18-58	9-18-58	9-17-58	8-6-58	12-18-58	

Survey. Geological Ś \Box Branch, Water Quality Analyzed by the

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Wayne County

(Area 555 square miles; 1950 population 64,267)

Wayne County is in the northern part of the Goldsboro area and occupies about one-fourth of the area described in this report. The county is bounded on the north by Wilson County, on the east by Lenoir and Duplin Counties, on the south by Sampson County, and on the west by Johnston County. Goldsboro, the county seat, is the largest city in the county. There are 6 other incorporated towns: Dudley, Eureka, Fremont, Mount Olive, Pikeville, and Seven Springs. In addition, Seymour Johnson Air Force Base, adjacent to Goldsboro, is a large population center.

Wayne County lies in the Coastal Plain province. The upland surface is flat and slopes toward the southeast. Maximum relief in the county occurs in and adjacent to the stream valleys of the major rivers, which flow in a southeasterly direction down the dip of the geologic formations in the area. At the Cliffs State Park the relief is about 100 feet adjacent to the Neuse River. The larger streams in the county have developed flat, wide, flood plains characterized by a meandering drainage pattern.

Geology. -- Surficial sand of post Miocene age covers the upland areas of the county. This surficial material is about 80 feet thick in the vicinity of Seven Springs and less than 40 feet thick elsewhere in the county.

Underlying the surficial sand is the Yorktown formation of late Miocene age. This formation, which is composed of gray massive marine clays interbedded with thin shell beds, occurs in northern Wayne County as a thin discontinuous sheet deposit. The southern margin of the outcrop area follows the Little River in a southeast direction from the Johnston County line to Goldsboro, from which point the border extends east-northeast into Greene County. In northern Wayne County the formation attains a maximum thickness of about 60 feet. North of Grantham a small outlier of the Yorktown formation has been penetrated in several auger holes. Depending upon its location within the county the formation lies unconformably on Cretaceous formations or basement rock.

The Castle Hayne limestone of Eocene age occurs as scattered outliers in the southern part of Wayne County. The lithology and the thickness of this unit varies from place to place. At the bridge where N. C. Route 111 crosses the Neuse River there are tw

distinct lithologic units within the Castle Hayne formation. The lower unit, about 30 feet thick and exposed at the water's edge, is a yellow conglomeritic marl containing abundant phosphate and quartz pebbles, sharks teeth and fish vertebrae. The upper unit, about 40 feet, is a greenish-yellow, fine to medium-grained marl that exhibits a very even texture in contrast to the lower unit. Near Mount Olive an outlier, composed of buff-colored siliceous sponges and sponge spicules in a limy matrix, is correlated with the Castle Hayne limestone. Additional outliers of Eocene material occur sporadically along the course of the Neuse River in the central part of the county.

Underlying the Castle Hayne limestone and younger formations is the Black Creek formation of Late Cretaceous age. This formation crops out in the southern part of the county and occurs in the subsurface throughout most of the county. The inner margin of the formation strikes northeast through Adamsville and south of Goldsboro to Genoa. West of Genoa the strike of the formation swings westward to Cox Mill. The Black Creek formation thickens toward the southeast, attaining a thickness of about 65 feet at Grantham, of about 200 feet at Mount Olive, and of about 250 feet at Seven Springs. In the southern part of the county, thin shell beds that occur near the top of the formation are correlated with the Snow Hill marl member of the Black Creek formation.

Underlying the Black Creek formation is the Tuscaloosa formation composed of gray to red interbedded sand and clay. The inner margin of the Tuscaloosa formation lies northwest of Goldsboro, and in the subsurface extends northward through Fremont into Wilson County. This formation is the basal sedimentary formation in Wayne County and occurs in all but the northwestern corner of the county. The formation is 80 to 100 feet thick at Mount Olive and is about 200 feet thick at Seven Springs. Correlation of the Tuscaloosa formation is based on lithology and stratigraphic position.

The basement rock in Wayne County is chiefly slate. The basement surface is uneven and slopes to the southeast.

Ground water. -- Except for the municipal supply in Goldsboro, all municipal and domestic water supplies in Wayne County are obtained from wells. Surficial sand supplies water to domestic wells in the area south of the Neuse River. The yield of wells tapping this material does not exceed 10 gpm. The water is soft but commonly is corrosive to metals, and contains objectionable amounts of iron.

Shallow wells, up to 60 feet deep, obtain water from the Yorktown formation in the northern part of the county. The yield of wells tapping the Yorktown formation is variable but rarely exceeds 25 gpm. Water from the Yorktown formation is suitable for domestic purposes but may be moderately hard.

The Castle Hayne limestone furnishes water to a few wells, 40 to 50 feet deep, in the area 2.5 miles east of Genoa. These wells yield less than $10~{\rm gpm}$.

The Black Creek formation furnishes water to wells in the southern and southeastern sections of the county. Wells in the Black Creek formation generally are less than 150 feet. Domestic wells developed in this formation yield less than 25 gpm.

The water from the Black Creek formation generally is corrosive and may contain an objectionable iron content.

The Tuscaloosa formation is tapped by municipal wells in the central part of the county. In the northwestern part of the county the formation is thin and furnishes little water. In the southeastern part of the county the depth of the formation has prevented its use as an aquifer. Water from the Tuscaloosa formation in Wayne County may be moderately hard but it is otherwise suitable for most domestic purposes.

Basement rocks, chiefly slate, that underlie the sediments in the county are tapped infrequently as a source of supply. The yield of individual wells in basement rock is small and the water generally has a high iron content.

Municipal Supplies

There are 5 municipal water supplies in Wayne County, 4 of which use ground water. In addition, Seymour Johnson Air Force Base, adjacent to Goldsboro, uses large quantities of ground water and is included in the description of municipal water supplies. The following supply systems are listed alphabetically.

Eureka

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Eureka has one well in operation. In addition many home owners have private shallow wells. The town well is 305 feet deep and yields 55 gpm. Storage consists of an elevated tank, with a capacity of 20,000 gallons. There are 70 service connections in Eureka

and the daily usage in the town is about 10,000 gallons.

Fremont

Fremont has three wells in operation that obtain water from the slate and overlying sediments. The three wells range in depth from 250 to 596 feet and have a combined yield of 264 gpm.

Storage consists of one elevated tank with a capacity of 100,000 gallons. There are about 400 service connections in Fremont and the daily usage in the town is about 165,000 gallons.

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Goldsboro

Goldsboro obtains all its water from the Little River. In order to furnish water for the average daily consumption of 1,700,000 gallons, at least 1,200 gpm have to be pumped continuously for 24 hours. A maximum daily consumption of 3,000,000 gallons is often reached during the summer. Storage consists of three tanks with a combined capacity of 2,700,000 gallons. The water system supplies approximately 7,500 users; 10 to 15 percent of the water is used by industry. The water is treated.

Mount Olive

Mount Olive uses four wells that obtain water from the Black Creek and Tuscaloosa formations. The wells are from 135 to 282 feet deep and have a combined yield of 1,200 gpm. Storage consists of 2 elevated tanks and 3 underground storage tanks that have a total capacity of 520,000 gallons. There are about 1,200 service connections in Mount Olive and the daily usage in the town is about 400,000 gallons.

<u>Pikeville</u>

Pikeville has three wells that have a combined yield of 190 gpm. Only one well, 97 feet deep and cased to 93 feet which yields 80 gpm, is currently in operation. Storage consists of one elevated tank with a capacity of 75,000 gallons. There are about 175 service connections in Pikeville and the daily usage in the town is about 25,000 gallons.

Seymour Johnson Air Force Base

Extensive test drilling has been done in the search for additional water supplies of suitable quality for Seymour Johnson Air 60

Force Base. At present, the main well field is located at the southern corner of the base adjacent to the Neuse River where nine wells have been drilled. Five of these are used as supply wells and four have been abandoned because of excessive iron content of the water. The wells were drilled into the basement rock but are cased only to the top of the basement rock at depths of from 150 to 190 feet. Water is obtained from both the Black Creek and Tuscaloosa formations. The average yield of each of the supply wells is about 375 gpm.

Storage at the Air Base consists of four tanks with a combined capacity of 2,000,000 gallons. Data are not available for water consumption at the base.

Well No.	Location	Owner	Туре	Depth	Diam- eter	Depth of casing	Water- bearing material	Water level	Yield (gpm)	Draw- down	Remarks
1	5.6 mi. west	Bobert Waddell	Drilled	48	6		Slate				
2	5.3 mi. west of Fremont	A. W. Aycock	do	112	6	60	Sand	-12	10		Analysis. Water level measured
3	2.3 mi. west	Wayne Hooks	do	175	. 6	80	Slate		1/2		10-4-49 Abandoned
4	0.8 mi. west	C. !looks	do	75	6		Sand				Analysis
5	of Fremont Fremont	Town of Fremont	do	250	8	40	Slate	- 40	120		Water level measured 10-18-57
-	do	do	do	596	10	112	do		80		Analysis
7	do	do	do	250	8		do		64		
8	2.0 mi. NE of Fremont	Isaac Dees	do	213	6	167	do				Analysis
9	2.3 mi. east of Fremont	James A. Davis	do	64	6	62	Sand				Do
10	2.6 mi. SE of Fremont	Norwayne School	do	148	6	91	do	-1	15		Water level measured 7-24-57
11	Eureka	Town of Eureka	Drilled	305	6	165	Sand		55		
$\overline{12}$	do	Eureka School-	do	325	6		do				Analysis
13	1.6 mi. west	Mark K. Jones-	do	120	4	104	Slate		5		Do
14	of Nahunta 2.9 mi. SW of Nahunta	Clarence Bunn-	do	82	6	70	do	-13	9		Do Water level
, ,				200							measured 12-8-53
15	3.4 mi. west of Pikeville	W. A. Taylor	do	200	4	41	do		5		
16	Pikeville	Town of Pikeville	do	97 :	8	93	Sand		80		Analysis

		Pikeville Training	do	75 :	6	67	do		20	
- 1		School	do	210	6	150	Slate	-25	15	 Water level measured 4-18-56
19	1.2 mi. north	MI 3. 0. II.	do	140	4	98	do			
20	of Rosewood	MOZINGO	do	122	6	98	do		5	 Analysis
21	2.4 mi. west of Belfast	State Forest	do	60	6	55	Sand		15	
22	2.3 mi. west	Nursery	do	40	6	38	do			
23	of Belfast 2.1 mi. west of Belfast	State Forest	Drilled	110	6	65	Sand		10	 Analysis
24	0.8 mi. north	Nursery John Whitman	do	160	4		do			
25	0.4 mi. north	R. E. McNerney	do	182	4	165	Slate	-35	2.5	
26	of Belfast 0.4 mi. south	T. A. Loving	do	75	6	71	Sand		20	
27	of Belfast 0.5 mi. south	Codo	do	43	6	42	do		15	
28	of Belfast 0.4 mi. south of Belfast	Mrs. A. M. Shevard	do	110	6	73	do	-18	10	 Water level measured 5-13-55
29	1.0 mi. west	City of	do	110	8	110	do		100 _	
30	of Goldsboro 1.6 mi. north of Goldsboro	Goldsboro L. E. Warrick-	do	72	4	68	do	-4	5	 Water level measured 11-14-55
31	1.5 mi. north	O. A. Williams	do	108	6	105	do		5	
32	of Goldsboro 1.3 mi. north	W. E. Plummer-	do	68	4	64	do		8	
33	of Goldsboro 1.5 mi. SW of	N. C. Hide Co.	do	246	8		Slate		105	
34	Goldsboro	Jack Wright	do	75	6	71	Sand	-18	15	 Water level measured 6-25-54

Well No.	Location	Owner	Туре	Depth	Diam- eter	Depth of casing	Water- bearing material	Water level	Yield (gpm)	Draw- down	Remarks
35	Goldsboro	Dewey Bros	do	49	6	25	do	-25			Water level measured 6-15-43
. 36	do	ESSO Station	do	98	. 6		do				Analysis
37	Goldsboro	Goldsboro Iron and Metal Co.	Drilled	246	6	141	Sand		105.		
38	do	Edwards' Young	do	100	6	97	do		15		
39	do	Mens Shop Heilig and Myers	do	127	6	125	do	-33	56		Water level measured 10-14-57
4 0	do	Pepsi Cola Bottling Co	do	100	6	90	do		30		
41 42	do	B. C. Allen Ben R. Lewis	do	99 86	4 4	31 82	do	-35	10 15		Water level
43	do	Charles E. Croom	do	65	4	61	do	-4	10		7-21-53 Water level measured 7-15-55
44	0.4 mi. south of Adamsville-	Dr. W. Trachtenburg	do	55	4	51	do	-20	12		Water level measured 7-18-56
45	Adamsville	State Highway Maintenance yard	do	113	6	108	do		18		Analysis
4 6	do	E. H. Robbins-	do	207	6	202	do	-4 5 ·	60		Water level measured
47	2.0 mi. NE of Adamsville	Paul Best	do	90	6	85	do	-15	20		1-8-55 Analysis. Water level measured 8-12-53

				202	6	96 l	do		30		
48	1.9 mi. west of New Hope	Central School		101	}		Sand	-11			Analysis.
49	Sevmour John-	U. S. Air Force	Drilled	200	10		Dana			}	Water level measured
\	son Air Force Base	do	do	176	10		do	-16.5			8-27-58 Analysis. Water level measured
51	do	do	do	168	10		do				8-29-58 Analysis. Test well. Water level
	-do	do	do	165	8	151	do	-20	120		measured
52	do	do	do	150	8	105	do	-9	3 2 5	56	June 1942 Water level measured 6-19-42
54	do	do	do	189	8	145	do	-10.7	400		Analysis. Water level measured
55	do	do	do	171	8	164	do	-16.5	300		6-2-42 Analysis. Water level measured
56	do	do	do	180	8	156	do	-11	720		June 42 Analysis. Water level measured June 1942
57	do	do	do	191.1			do	1	400		Analysis. Test Well. Analysis
58 59	Seymour John-	U. S. Alr	Drilled	125	8	97	do Sand		400		Water level measured June 1942
60	son Air Force Base	-		118	8	93	do	-15	450		Water level measured 7-10-42
61	do	do	do	115	8	91	do	-15	450		Water level measured
_									ł	1	7-18-42

TABLE 5. - RECORDS OF WELLS IN WAYNE COUNTY - Continued

Well No.	Location	Owner	Туре	Depth	Diam- eter	Depth of casing	Water- bearing material	Water level	Yield (gpm)	Draw- down	Pemarks
62	4.0 mi. south of Adamsville-	County Homes	do	228	8	174	do	-20	150		Water level
63	3.7 mi. SE of Adamsville	Tommie B. Powell	do	65	4	61	do	-10	10		3-19-57 Analysis. Water level measured
64	0.9 mi. SW of Stevens Mill	Charlie Blackman	do	122	4	83	Slate-	-30	10		6-20-56 Water level measured 12-10-54
65 66 67	Stevens Milldo 1.0 mi. east of Stevens	C. W. Warrick- Raymond Ricks- L. V. Williams	do do	135 70 70	6 6 4	45 12 35	do Sand do	-15	7 8 6		Analysis Water level measured 10-2-52
68	3.6 mi. NE of Grantham	Alvin Williams	do	142	4	42	Slate-	-9	2		Water level measured 12-17-54
69	1.4 mi. west of Genoa	Rodney Scott	do	66	4	62	Sand		10		12-11-54
70	2.3 mi. west of Genoa	Ralph E. Jinnette	do	87	4	85	do				Analysis
71	1.5 mi. NE of	A. D. Britt	Drilled	81	4	75.5	Sand		15		
72 73	Grantham 0.7 mi. west of Grantham	Albert Dunbar- Dr. L. A. Warrick	do	80 104	4 4	76 99	do				Analysis
74 75	Grantham 1.7 mi. east of Grantham	R. E. Hood Jean L. Hood	do	98 91	4 4	96 87	do		10 8.5		
76	3.2 mi. east of Grantham	G. S. Overman-	do	107	4 .	105	~do				
77	3.8 mi. east of Grantham	A. F. Scott	do	71	4	69	do		5		

78	4.0 mi. east of Grantham	do	do	71	4	69	do	-18	20		Water level measured 4-9-56
79	1.8 mi. north	Brogden School	do	77	6	73	do	-34	15		Water level measured 1-21-55
80	2.0 mi. east	Berry Mitchell	do	103	4	101	Lime- stone		5		Analysis
81	of Genoa 2.1 mi. east	Zeb. Mitchell-	do	70	4	68	do		10		
82 83	of Genoa do 2.5 mi. east	do erbert	do	70 68	4 4	68 66	do Sand		8		
84 85	of Genoa do 2.3 mi. east	Mitchell do W. P. Hatsell-	do	81 74	4 4	79 72	do <u>-</u> -		8		
86	of Genoa 2.6 mi. east	do	do	69	4	67	do		10		
87	of Genoa 3.0 mi. east	J. A. Strader-	do	85	4	83	do		8		
88	of Genoa 4.0 mi. SW of	Eureka Church-	Drilled		6		Sand		5		Analysis
89	Grantham 2.5 mi. east	F. L. Odom	do	106	4	101	do	-30			Water level measured
90	of Dobersville 4.8 mi. west of Mount Olive	Henry J. Hood-	do	138	4	135	do	-30	15		12-16-52 Analysis Water level measured
			,	22		77	do				10-8-53 Analysis
91	3.0 mi. NW of Mount Olive	Jake Sinten	1	77 95	4	93	do		3		Do
92	of Dudley	Coy Smith	do	86	4 4	41	do		5		
93	1.5 mi. NW of Mount Olive	D. M. May	1			67	do	-35	5		
94		B. M. Martin		67	4		do		10		measured 1953
95 96	do	Jack Barfield-	do	84 174	10	80 174	do		100		
97		Olive	do	170	10	150	do		160		Analysis

						_					
Well No.	Location	Owner	Type	Depth	Diam- eter	Depth of casing	Water- bearing material	Water level	Yield (gpm)	Draw- down	Remarks
98 99 100	do	do do Mount Olive Ice Co	do do	135 282 185	10 12 8	75 282 175	do do		90 800 150		Do
101	do	Mount Olive	do	185 -	· 8	172	do		85		
102	do	Dr. W. H. Crumpler	do	115	6	111	do		25		
103	Mount Olive	Town of Mount Olive	Drilled	134	6	130	Sand	-6	30		Analysis. Water level measured
104	1.0 mi. north of Indian	Diamond Poultry Co	do	170	4	130	do				7-15-57 Analysis
105	Springs 2.9 mi. NW of Seven Springs-	Royle Kornegay	do	87	4	83	do	-34	10		Water level measured 4-6-55
106	2.2 mi. NW of Seven Springs-	Cliffs of the Neuse State	do	87	6	78	do		60	 	Analysis
107	do	do	do	104	6	96	do	-95			Water level measured 10-30-58
108	2.9 mi. west of Seven	Mrs. P. E. Garris	do	86	4	84	do		5		10-30-36
109	Springs	L. B. Outlaw	do	92	4	88	do	-54	15		Water level measured 2-13-56
110 111	2.3 mi. west of Seven Springs	L. J. Outlaw	do	115 78	6 4	110 76	do		10 5		Analysis

112	2.2 mi. west	E. I. Wiggins-	do	58	4	53	do		7	
113	of Seven Springs 2.6 mi. west	L. B. Outlaw	do	83	4	81	do		5	
114	of Seven Springs l.l mi. west of Seven	H. Frank Phillips	do	91	4	89	do		10	 Analysis
115	Springs Seven Springs-	Seven Springs	do	304	6	194	do		12	
116	3.0 mi. SW of	School Mrs. J.	Drilled	63	4	60	Sand		5	
117	Seven Springs- 4.3 mi. SW of	Raiford Berry L. Price	do	92	4	90	do	-35	6	 Water level measured
118	Seven Springs- 3.3 mi. south of Seven Springs	L. L. Herring-	do	94	4	90	do	-31	12	 6-1-53 Analysis

TABLE 6. - CHEMICAL ANALYSES OF GROUND WATER FROM WAYNE COUNTY

(Numbers at heads of columns correspond to well numbers in table of well data)

Parts per million

			to per mir					_
Well number	2	4	6	8	9	12	13	14
Silica (SiO ₂)	22	40	16	7.1	13	13	30	19
Iron (Fe), total	. 12	1.7	. 24	.04	9.2	. 07	5.4	. 44
Calcium (Ca)	11	3.6	55	3.2	5.6	11	15	28
Magnesium (Mg)	3.4	1.2	21	3.2	1.9	4.3	1.4	7.8
Sodium and potassium (Na+K)	8.9	4.8	134	103	4.8	106	8.7	3 4
Bicarbonate (HCO ₃)	37	22	37	236	16	253	7.5	171
Sulfate (SO ₄)	3.9	3.9	110	9.9	7.1	16	. 2	19
Chloride (Cl)	8.5	5.5	170	5.0	6.0	34	2.5	10
Fluoride (F)	. 0	. 2	.1	. 2	. 1	. 2	. 2	. 3
Nitrate (NO ₃)	17	1.1	. 6	. 8	. 1	. 4	.1	. 1
Phosphate (POA)	. 1	.0		.1	.1	. 1	. 0	. 5
Dissolved solids	93	66	603	262	47 .	311	95	198
Hardness as CaCO3	42	14	224	21	22	44	44	103
plI	6.4	5.7	7.5	8.6	6.6	8.3	7.3	8.2
Water-bearing material	Sand	Sand	Slate	Slate	Sand	Sand	Slate	Slate
Date of collection	9-23-58	7-30-57	11-27-51	8-4-58	12-16-58	9-23-58	12-16-58	12-16-58

Analyzed by the Quality of Water Branch, U. S. Geological Survey.

TABLE 6. - CHEMICAL ANALYSES OF GROUND WATER FROM WAYNE COUNTY - Continued

(Numbers at heads of columns correspond
to well numbers in table of well data)

Parts per million

Well number	16	20	23	28	36	4.5	47	49
Silica (SiO ₂)	13	10	15	25	8	24	13	11
Iron (Fe), total	1.4	. 60	2.2	1.1	. 18	. 32	4.7	.01
Calcium (Ca)	3.4	64	4.0	27	22	15	6.0	24
Magnesium (Mg)	1.5	9.2	1.5	1.7	9.0	2.8	1.0	7.2
Sodium and potassium (Na + K)	3.6	19	6.8	5.8	15	8.6	5.4	68
Bicarbonate (HCO3)	12	260	10	88	129	65	16	197
Sulfate (SO ₄)	6.7	16	6.8	2.5	4.0	9.5	7.2	42
Chloride (Cl)	3.8	4.0	2.5	3.5	6.0	3.0	2.8	24
Fluoride (F)	.1	. 2	. 0	. 4	. 1	. 1	. 4	. 2
Nitrate (NO ₃)	. 2	. 2	. 3	. 1	. 5	.1	. 2	. 1
Phosphate (PO ₄)		1.5	5.0	4.1	. 0		3.5	. 2
Dissolved solids	41	255	58	121	125	95	60	272
Hardness as CaCO3	15	199	17	74	94	49	20	94
pH	5.6	8.1	6.9	6.9	7.1	7.1	6.3	8.4
Water-bearing material	Sand	Slate	Sand	Sand	Sand	Sand	Sand	Sand
Date of collection	10-19-53	9-24-58	12-16-58	12-16-58	12-17-58	4-20-50	12-17-58	8 - 29 - 58

Analyzed by the Quality of Water Branch, U. S. Geological Survey.

TABLE 6. - CHEMICAL ANALYSES OF GROUND WATER FROM WAYNE COUNTY - Continued (Numbers at heads of columns correspond to well numbers in table of well data)

Parts per million

Well number	56	57	58	61	63	65	70	71
Silica (SiO ₂)	22	16	18	18	25	9.1	22	12
Iron (Fe), total	. 27	3.8	4.5	.73	1.9	1.8	1.9	. 52
Calcium (Ca)	11	14	7.0	4.8	4.2	14	7.9	3.2
Magnesium (Mg)	2.9	4.4	2.8	1.9	1.1	4.1	1.3	.7
Sodium and potassium (Na +K)	12	6.0	9.8	6.8	7.5	5.6	4.0	- 4.7
Bicarbonate (HCO ₃)	45	6	0	11	28	30	24	2
Sulfate (SO ₄)	17	50	40	15	. 5	9.5	8.5	15
Chloride (Cl)	7.5	3.0	60	9.0	4.5	8.0	2.0	3.5
Fluoride (F)	. 2	. 0	.1	. 2	. 2	.1	. 6	. 0
Nitrate (NO ₃)	. 5	1.6	. 0	1.2	.1	23	.1	. 4
Phosphate (PO ₄)	.3	.0		.5	1.3	.0	3.4	.0
Dissolved solids	94	109	91	63	56 .	90	65	42
Hardness as CaCO3	40	54	29	20	16	52	25	12
pH	6.1	5.5	4.7	5.6	7.1-	6.3	6.4	5.1
Water-bearing material	Sand	Sand	Sand	Sand	Sand	Slate	Sand	Sand
Date of collection	7-17-57	10-9-57	11-26-47	7 - 17 - 57	12-16-58	9-24-58	12-16-58	

Analyzed by the Quality of Water Branch, U. S. Geological Survey.

TABLE 6. - CHEMICAL ANALYSES OF GROUND WATER FROM WAYNE COUNTY - Continued (Numbers at heads of columns correspond to well numbers in table of well data)

Parts per million

Well number	71	73	80	88	90	91	92	96
Silica (SiO ₂)	12	32	41	5.8	44	26	11	34
Iron (Fe), total	.52	. 33	.12	. 42	. 56	3.7	18	1.2
Calcium (Ca)	3.2	8.4	38	. 8	10	17	2.2	4.3
Magnesium (Mg)	.7	1.9	7.1	3.4	2.6	1.9	. 7	1.0
Sodium and potassium (Na+K)	4.7	7.2	12	7.0	8.9	3.9	3.3	11
Bicarbonate (HCO ₃)	2	36	153	6	59	55	14	31
Sulfate (SO ₄)	15	2.8	7.8	.1	. 8	4.3	. 3	5.8
Chloride (Cl)	3.5	3.0	4.6	6.0	3.8	4.0	2.0	3.6
Fluoride (F)	.0	. 2	. 1	.1	. 2	. 2	. 1	. 8
Nitrate (NO ₂)	. 4	. 1	. 4	20	. 3	. 2	. 2	. 1
Phosphate (PO ₄)	. 0	4.1	. 0	. 0	1.6	. 4	.1	
Dissolved solids	42	78	186	51	101	88	32	83
Hardness as CaCO3	12	29	125	16	36	50	8	15
pll	5.1	6.5	7.1	6.3	6.9	6.8	6.0	5.8
Water-bearing material	Sand	Sand	Lime- stone	Sand	Sand	Sand	Sand	Sand
Date of collection		12-17-58		12-17-58	9-23-58	8-5-58	12-17-58	12-2-46

- CHEMICAL ANALYSES OF GROUND WATER FROM WAYNE COUNTY - Continued of columns correspond in table of well data) (Numbers at heads to well numbers i

Silica (Si0 ₂)	97 99 32 .74 9 7.0 0 1.6 5 5.1 32 .9 8 4.0 4 .1 0 .1 	104 21 3.6 2.2 1.6 4.4 17 3.8 2.0 .1 .0 .0 49 .1 .0 .0 .1 .0 .1 .0 .0 .1 .0 .0 .0 .0 .0 .0 .0 .0 .0 .0	106 0 0 1.0	110 4.7 .44 3.2 2.9 2.7 20 2.4 4.8 .1 2.2 .0 .42 .0	114 2.3 2.2 3.5 3.5 3.5 3.5 3.5 3.5 3.5 8 8 8 8 8 8 8 8	118 16 .46 38 1.7 5.3 110 12 3.0 .1 .1 .1 .1 .132 102 7.3 Sand
Date of collection 12-2-46	46 8-21-53	12-17-58	1958	8-4-58	9-23-58	12-17-58

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
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
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