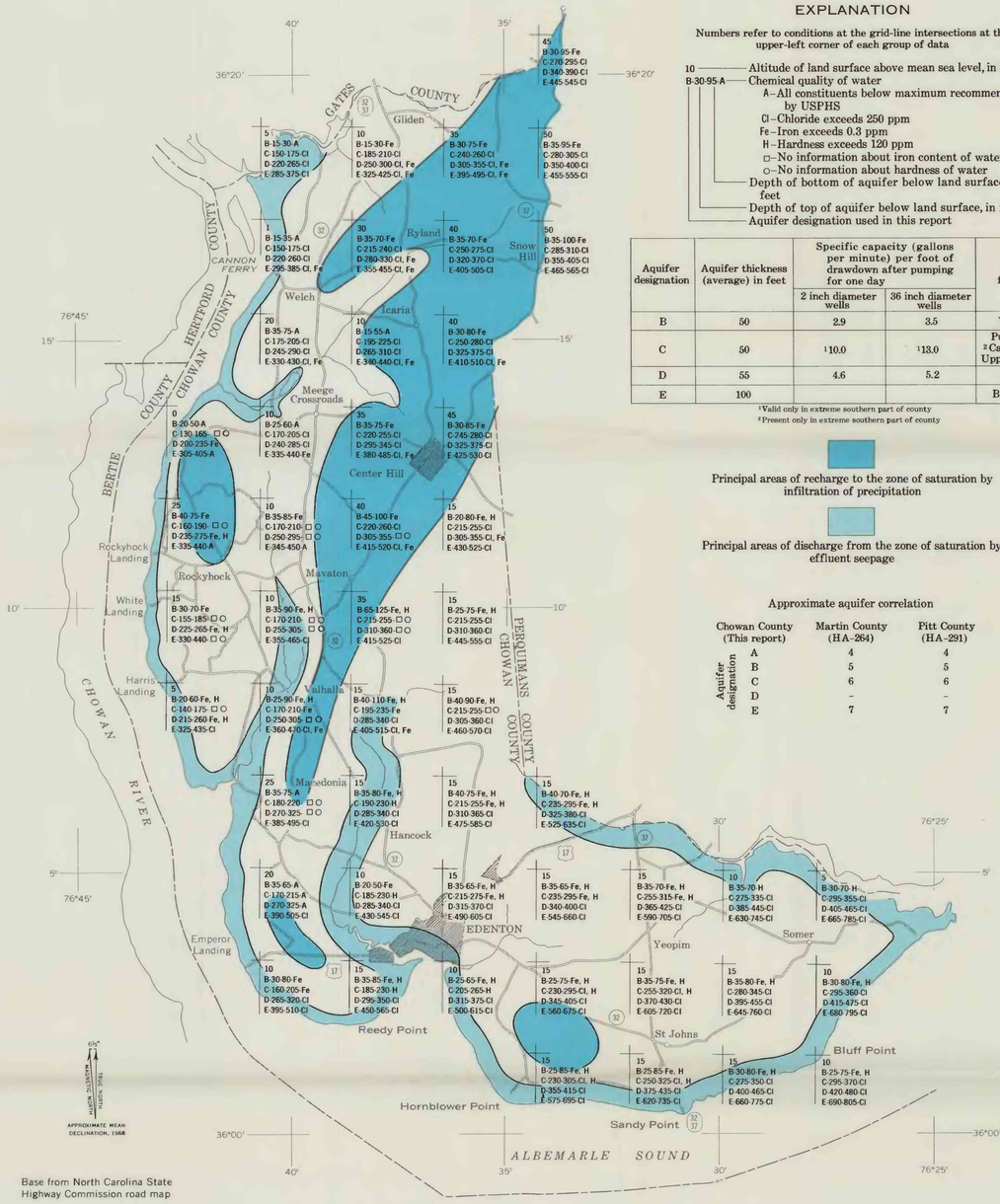
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
CHOWAN COUNTY BOARD OF COMMISSIONERS
AND THE
NORTH CAROLINA DEPARTMENT OF WATER RESOURCES

HYDROLOGIC INVESTIGATIONS
ATLAS HA-292

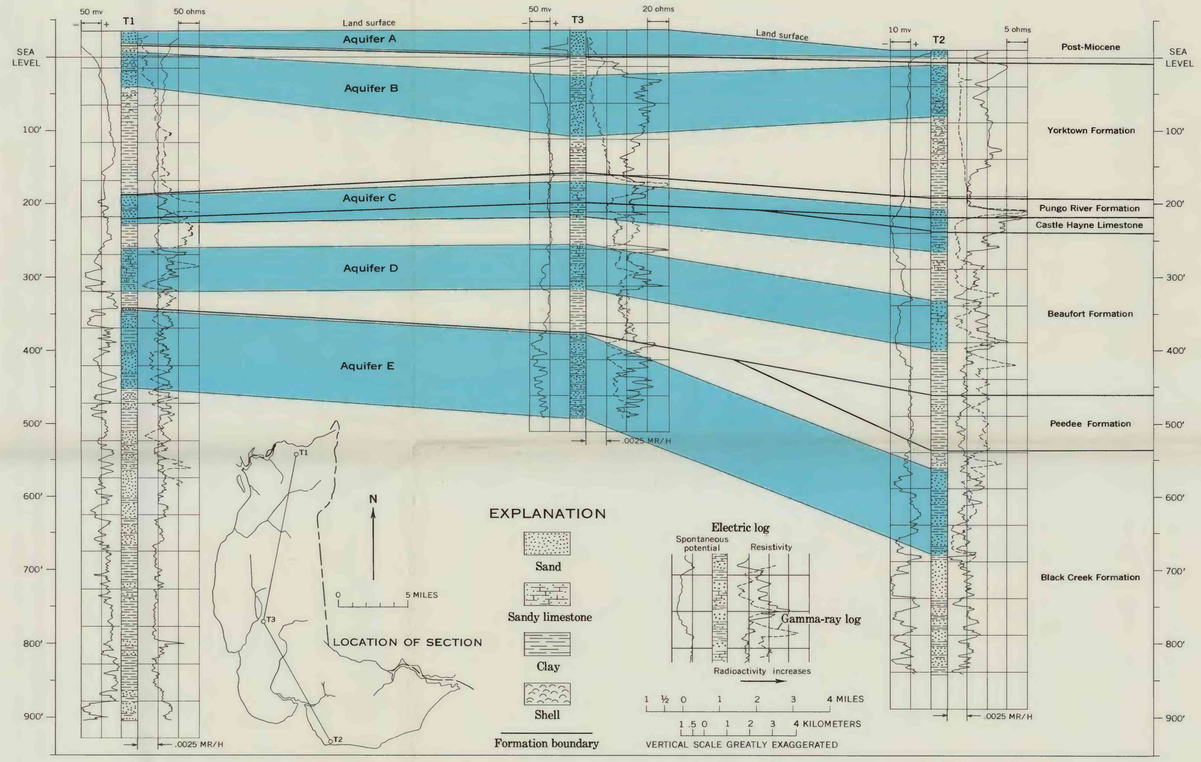


MAP SHOWING AQUIFER CHARACTERISTICS AND AREAS OF RECHARGE TO AND DISCHARGE FROM THE ZONE OF SATURATION

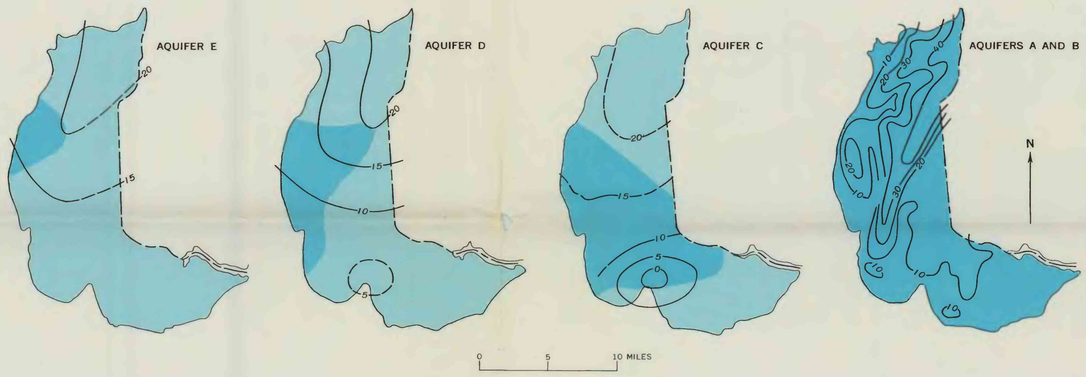
SCALE 1:125 000

Aquifer designation	Aquifer thickness (average) in feet	Specific capacity (gallons per minute) per foot of drawdown after pumping for one day		Geologic formation
		2 inch diameter wells	36 inch diameter wells	
B	50	2.9	3.5	Yorktown
C	50	[1]10.0	[1]13.0	Pungo River [2]Castle Hayne Upper Beaufort
D	55	4.6	5.2	Beaufort
E	100			Black Creek

[1]Valid only in extreme southern part of county
[2]Present only in extreme southern part of county



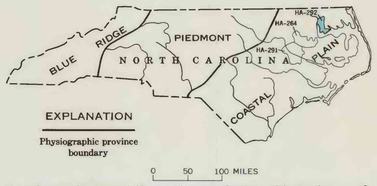
SECTION SHOWING CORRELATION OF GEOLOGIC FORMATIONS AND AQUIFERS



MAPS SHOWING CHLORIDE CONTENT OF GROUND WATER AND PIEZOMETRIC CONTOURS OF THE AQUIFERS

INTRODUCTION

Chowan County is located in the northeastern part of the Coastal Plain province of North Carolina and includes an area of about 180 square miles (see map below).



Map showing location of Chowan County, physiographic provinces, and published reports

The county is in the humid subtropical climatic belt of the eastern United States. Average annual temperature is about 61° F. and average annual precipitation is approximately 50 inches. Topography is relatively flat in the southern and eastern part, and rolling in the northern and western part of the area. Altitudes range from near sea level at the streams, river, and sound to about 50 feet above sea level at the northeastern boundaries of the county. About 12,000 people live in the area. Forty percent of the population is urban and 60 percent is rural. The economy of the county is predominantly agricultural.

GEOLOGY

About 2,000 feet of sediments, composed of unconsolidated to partially consolidated sand, silt, clay, limestone, and shell layers, occur between basement rock and land surface in the area. These rocks are part of the Coastal Plain sediments which dip generally eastward, and thicken from the western edge of the Coastal Plain to about 10,000 feet at Cape Hatteras. The penetrated sediments in Chowan County range from Cretaceous (Black Creek Formation) to post-Miocene in age.

GROUND WATER

All sediments between land surface and the upper part of the Black Creek Formation contain fresh water in at least part of the area and can be divided into five aquifers (Aquifers A, B, C, D, and E). These five aquifers are composed of permeable sand, shell, and limestone beds and will transmit water readily to wells. The aquifers are separated by four silt and clay aquicludes that retard the flow of water from one aquifer to another (see section).

Aquifer E is composed of interbedded fine- to medium-grained quartz sand, and shell and clay layers. The top of this water-bearing zone occurs at about 320 feet below land surface, and the bottom occurs at about 420 feet below land surface in the western part of the county. These depths increase about 25 feet per mile toward the east. Ground water in Aquifer E is under artesian conditions. Drilled screened wells are used to recover water from Aquifer E. Measured yields from wells screened in this zone are exceptionally low (1 to 5 gpm (gallons per minute)) for the texture of the sands in this aquifer. The yields probably would have been higher had electric and/or gamma-ray logs been used to determine the depth for screen settings during well construction. Where the water from this aquifer contains less than 250 ppm (parts per million) chloride, other dissolved constituents are usually below the maximum concentrations recommended by the U.S. Public Health Service.

Aquifer D is composed of interbedded fine- to medium-grained quartz sand, glauconite, and glauconitic and sandy limestone. The top of Aquifer D occurs at about 220 feet below land surface and the bottom occurs at about 270 feet below land surface in the western part of the area, and these depths increase about 12 feet per mile toward the east. Drilled open-end and screened wells are used to recover water from this zone. Water contained by Aquifer D is under artesian conditions. The specific capacity of properly constructed wells screening the full thickness of Aquifer D is about 5 gpm per foot of drawdown. Concentrations of chloride in water from this aquifer are below 250 ppm only in the central and western part of the county. Locally, the water is very hard, contains more than 0.3 ppm iron, and more than 1.5 ppm fluoride.

Aquifer C is composed of sandy-shell limestone, glauconitic sand, sandy limestone and phosphatic sand. The top of this water-bearing zone occurs at about 150 feet below land surface, and the bottom occurs at about 190 feet below land surface in the western part of the county. Depths to the top and bottom increase about 10 feet per mile toward the east. The water in Aquifer C is under artesian conditions. Drilled open-end, naturally developed screened wells, and gravel-packed wells are used to recover water from this zone. In the southern part of the county the specific capacity of gravel-packed and naturally developed wells screening the full thickness of Aquifer C is about 10 gpm per foot of drawdown. The specific capacities of wells screening this aquifer in the central and northern part of the area will be much less because the Castle Hayne Limestone is absent and the general lithic texture of the aquifer is much finer in these areas (see section). Water from Aquifer C is very hard in the vicinity of Edenton. Where hardness is below 180 ppm, concentrations of dissolved iron generally exceed 0.3 ppm. Concentrations of chloride in this water exceed 250 ppm in the northern half and the southeastern part of the county.

Aquifer B is composed of fine- to coarse-grained quartz sand and shell beds. The top of this zone occurs at approximately 30 feet below land surface and the bottom occurs at about 80 feet below land surface. Water in Aquifer B is generally under semiartesian conditions. Bored, driven, and drilled naturally developed and gravel-packed wells are used to recover water from this aquifer. The specific capacity of properly constructed wells screening the full thickness of this aquifer is about 3 gpm per foot of water-level drawdown in the wells. Concentrations of iron in water from this zone are generally above 0.3 ppm, and the water is usually very hard in the southern and southeastern part of the county.

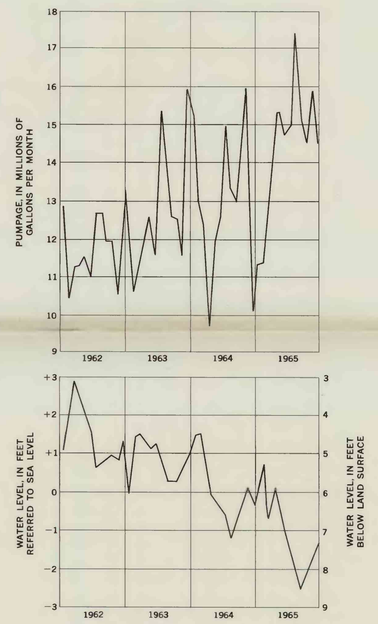
Aquifer A is composed of very fine- to medium-grained quartz sand that occurs between land surface and about 25 feet below land surface. The top and bottom of this aquifer at any one place is marked by the water table and the deepest occurrence of the surficial sand, respectively. Ground water in Aquifer A is under non-artesian or water-table conditions. Yields from dug, bored, and driven wells screened in this aquifer are usually less than 10 gpm. Water from this zone generally contains more than 0.3 ppm iron, but other dissolved mineral constituents are usually below the maximums recommended by the U.S. Public Health Service.

The depths to the aquifers, average water-yielding capacities, approximate thickness of the aquifers in Chowan County, and the general areas where concentrations of chloride, iron, and hardness-causing constituents in water from the aquifers are above or below 250 ppm, 0.3 ppm, and 120 ppm, respectively are shown on the aquifer characteristics map.

All the aquifers in the county are recharged by local precipitation. More recharge occurs during the winter and early spring months than in any other time of the year. Water levels generally rise during this period. Most of the ground-water recharge occurs in the elevated topographic areas in the county where the piezometric surfaces and the water table are high. The water moves away from these recharge areas towards areas of natural and artificial discharge where the piezometric surfaces and the water table are low. Discharge usually exceeds recharge in the late spring, summer, and early fall months, because of high evapotranspiration rates. Therefore water levels are generally lowest during this time of year.

The distribution of chloride concentrations in water in Aquifers C, D, and E (maps showing chloride content) was established before the present drainage system was developed, when major recharge was occuring west of Chowan County. Since the development of the present drainage system, major recharge to the artesian aquifers in the county has occured in the northern and northeastern part of the area (map showing areas of recharge and discharge), and water containing high concentrations of chloride is now being diluted and flushed from the north toward the east, south, and west.

Concentrated and increasing pumpage in the Edenton area (see graphs below) has developed a rather extensive cone of depression in the piezometric surfaces of Aquifer C, the major artesian aquifer in the southern part of Chowan County. This cone is expanding, and will continue to expand as long as pumping increases, and has already intercepted areas southwest, south, and southeast of Edenton where the water in Aquifer C contains excessive concentrations of chloride.



Graphs showing pumpage from municipal wells and monthly mean water-levels in an observation well screened in Aquifer C at Edenton

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GROUND-WATER RESOURCES OF CHOWAN COUNTY, NORTH CAROLINA

By
O. B. Lloyd, Jr.

1968

For sale by U.S. Geological Survey, price 50 cents