

#### INTRODUCTION

##### PURPOSE AND SCOPE

During the past 30 years large quantities of ground water have been withdrawn at Franklin, and a cone of depression has formed in the water level of the Lower Cretaceous aquifer. This cone extends westward to the Fall Line, coalesces to the north and east with other small cones caused by pumping, and reaches southward into North Carolina. The water-level decline has caused concern about future ground-water supplies.

This atlas presents the results of a field investigation of geology and hydrology and an interpretation of the aquifer systems in the Franklin area. The hydrology presented here has been used for other studies in progress by the U.S. Geological Survey, including the digital modeling of the Lower Cretaceous aquifer in the Franklin area and interpretation of the subsurface geology and hydrology of the southeastern Virginia Coastal Plain.

Fieldwork for the atlas was done from August 1968 through July 1972. Drill cuttings from several deep wells were collected and studied. Electric and gamma-ray logs were

made of these wells, and gamma-ray logs were also made of many other wells. Electric logs made by water-well drillers provided additional subsurface geologic information. Water-level recorders were installed on five wells to obtain continuous records of water-level changes. Synoptic water-level measurements were made during September 1970, December 1970, and December 1971. Water from selected wells was analyzed for various chemical constituents.

##### COOPERATION AND ACKNOWLEDGMENTS

This investigation was made by the U.S. Geological Survey in cooperation with the Virginia State Water Control Board, E. T. Jensen, Jr., Executive Secretary.

Acknowledgment is here given to the cooperation of officials of Union Camp Corp., Hercules, Inc., and the cities of Franklin and Norfolk for furnishing information on ground-water pumpage and water levels. Thanks are also given the following well-drilling companies for their help: Layne Atlantic Co., R. L. Magette Co., and Pittman Wood and Metal Co.

#### DESCRIPTION OF THE AREA

##### LOCATION AND EXTENT OF AREA

The Franklin study area (index map), of approximately 1,300 square miles, includes parts of the counties of Isle of Wight, Nansemond, Southampton, Surry, and Sussex, as well as the city of Franklin.

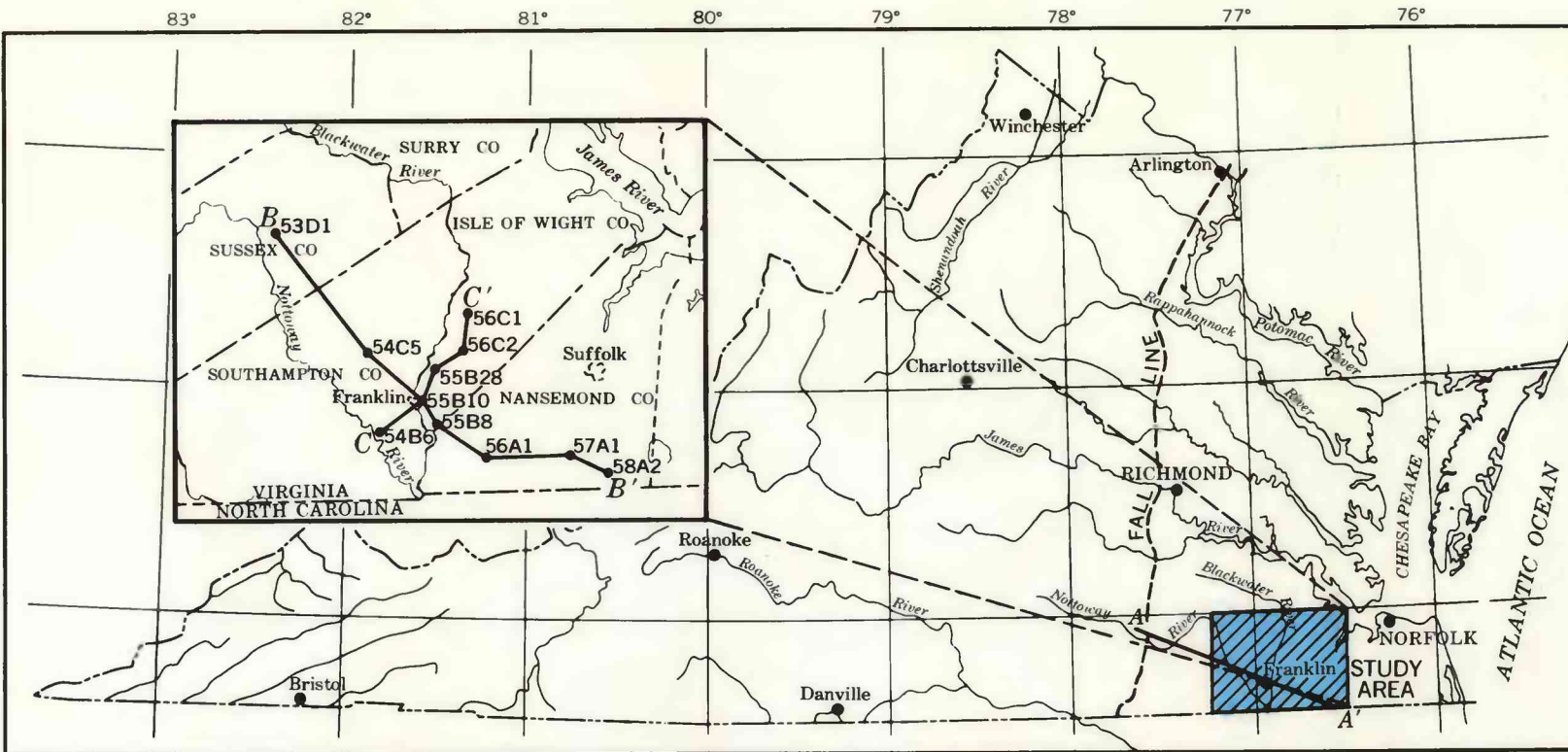
##### GEOLOGIC SETTING

The Franklin area is entirely within the Virginia Coastal Plain and is underlain by unconsolidated sediments, which, in turn, rest on a massive body of hard rock called the basement complex. In this atlas, rocks of Triassic age or older are considered to be basement.

The names, age relationships, and general nature of the sequence of rock and sediments are given in the lithologic table. The diagrammatic section A-A' illustrates how the

Lower Cretaceous sediments, which constitute the principal aquifer, are confined below by the basement complex and above by the younger sediments, collectively called here "post-Lower Cretaceous confining beds." The section also illustrates how the basement complex, at the surface in the Piedmont province, extends eastward beneath the sediments that overlap it in a feathered edge along the Fall Line.

The sediments consist of alternating beds of various mixtures of clay, silt, sand, and gravel that generally thicken eastward, as a wedge, and extend eastward to the Continental Shelf (geologic sections B-B' and C-C'). At well 53D1 near the western edge of the area, the top of the basement complex lies at a depth of 530 feet (-410 ms). At well 58A2 near Dismal Swamp, Triassic basement rock is at a depth of 1,874 feet (-1,818 ms).



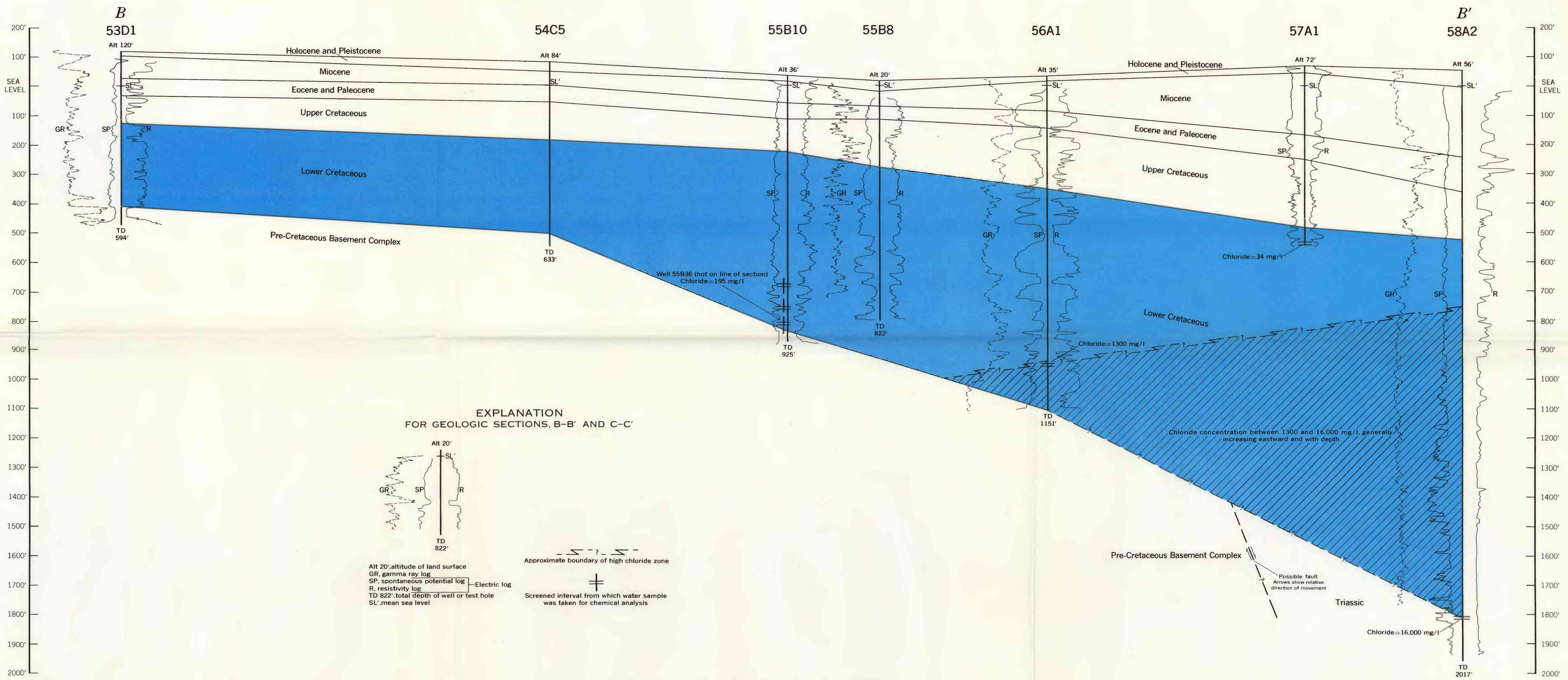
INDEX MAP SHOWING LOCATION OF FRANKLIN STUDY AREA, DIAGRAMMATIC SECTION A-A' AND GEOLOGIC SECTIONS B-B' AND C-C'

#### POST-LOWER CRETACEOUS AQUIFERS

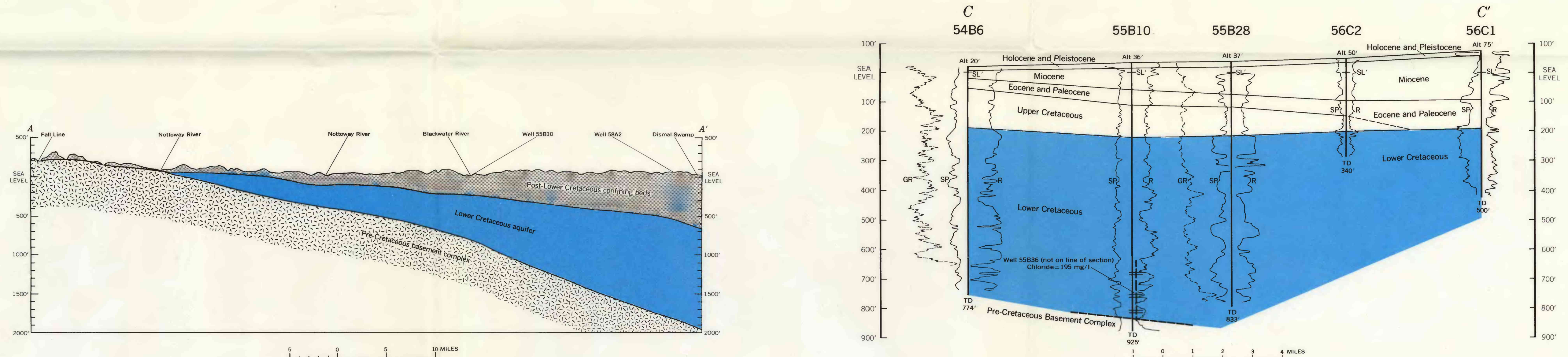
There are five aquifer systems in the Franklin area (lithologic table). Individual aquifers are separated by beds of fine-grained sediments, which act as confining layers. The water in the Pleistocene sand is generally under water-table conditions, whereas that in the other aquifers is confined under artesian pressure. The deepest aquifer, the Lower Cretaceous, is the major water-bearing unit and is the main subject of this atlas.

Generalized lithologic and water-bearing properties of the geologic units

System	Series and aquifer	Generalized lithology	Water-bearing properties
Quaternary	Holocene and Pleistocene	Surficial terrace deposits consisting of sand and clay. Alluvial deposits along streams and swamps.	Yields water for domestic and small industrial wells in Pleistocene terrace sand beds. Water is soft and low in mineral content, but may contain excessive iron (more than 0.3 mg/l).
	Miocene	Blue and gray clay; sandy clay containing abundant shells; minor sand beds, mostly in lower part.	A minor aquifer in Surry and Isle of Wight Counties. Generally yields little water because of low permeability. Sand beds not persistent; yield poor and variable, commonly less than 10 gpm. Water is a hard calcium bicarbonate type; objectionable iron often present.
Tertiary	Eocene and Paleocene	Glaucous quartz sand and glauconitic clay to clayey sand; indurated shell and limestone layers common; subordinate blue or gray silty clay, with little glauconite; coarse sand and gravel often present at base.	Sand and limestone beds yield moderate supplies to wells, mostly in western part of area. Reported yields as much as 200 gpm. Water is generally a soft sodium bicarbonate type, generally of good quality; may have objectionable odor and color.
	Upper Cretaceous	Alternating beds of fine to medium quartz sand, silt, and silty or sandy clay; slightly glauconitic; a thick red to brown or gray clay locally; coarse sand and gravel beds sometimes present.	Important aquifer for domestic wells and small municipal and industrial wells. Reported yields as much as 300 gpm. Water is a soft sodium bicarbonate type and of good quality.
Cretaceous	Lower Cretaceous	Interbedded arkosic sand, clay, and sandy clay. Sand, white to gray, fine to coarse gravel; beds 30-40 feet thick common, locally as much as 100 feet. Clay beds are of many different colors and become more compact with depth. Individual beds vary in thickness and composition laterally and may pinch out in short distances. Plant remains common.	Major artesian aquifer for municipal and industrial supplies. Reported yields from single sand beds as much as 700 gpm. Multiscreened wells, as at Franklin, yield 2,500 gpm or more. Water is a very soft sodium bicarbonate type and excellent for most purposes; unsuitable for some industries because of high sodium and bicarbonate; high in chloride locally in southeast corner of area.
	Precambrian, Paleozoic, and Triassic	Basement complex of Precambrian and Paleozoic igneous and metamorphic rocks and Triassic indurated sedimentary rocks; includes granite, andesite, gneiss, red and green shale.	Not used as aquifer in area. Water in the fractured and weathered zone. Serves as bottom confining layer for Lower Cretaceous aquifer.



GEOLOGIC SECTION B-B', SHOWING CORRELATION OF GEOLOGIC FORMATIONS BETWEEN WELLS



GEOLOGIC SECTION C-C', SHOWING CORRELATION OF GEOLOGIC FORMATIONS BETWEEN WELLS

## GROUND-WATER CONDITIONS IN THE FRANKLIN AREA, SOUTHEASTERN VIRGINIA

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