U.S. Department of the Interior
U.S. Geological Survey

THE SANTEE RIVER BASIN-- FACTORS AFFECTING A MAJOR RESOURCE

BASIN SETTING

From its headwater streams in the Blue Ridge Mountains of North Carolina to the Atlantic Ocean in South Carolina, the Santee River flows 413 miles and drains approximately 16,800 square miles, making it the second largest river system on the east coast of the United States (fig. 1). The Santee River Basin has a humid subtropical climate with short, cool winters and long, hot summers. Precipitation ranges from a high of about 70 in/yr (inches per year) in the mountains to about 40 in/yr in the lower parts of the basin. The character of the river and its tributaries changes as it crosses three physiographic provinces on its way to the Atlantic Ocean. The headwaters of the river, in the Blue Ridge province, has swift and turbulent streams with bedrock bottoms and abundant rapids. Piedmont streams generally have sandy bottoms and slower flows than Blue Ridge streams. Coastal Plain streams generally have sandy or muddy bottoms, sluggish flows, and black water, a color produced by the presence of abundant organic matter.

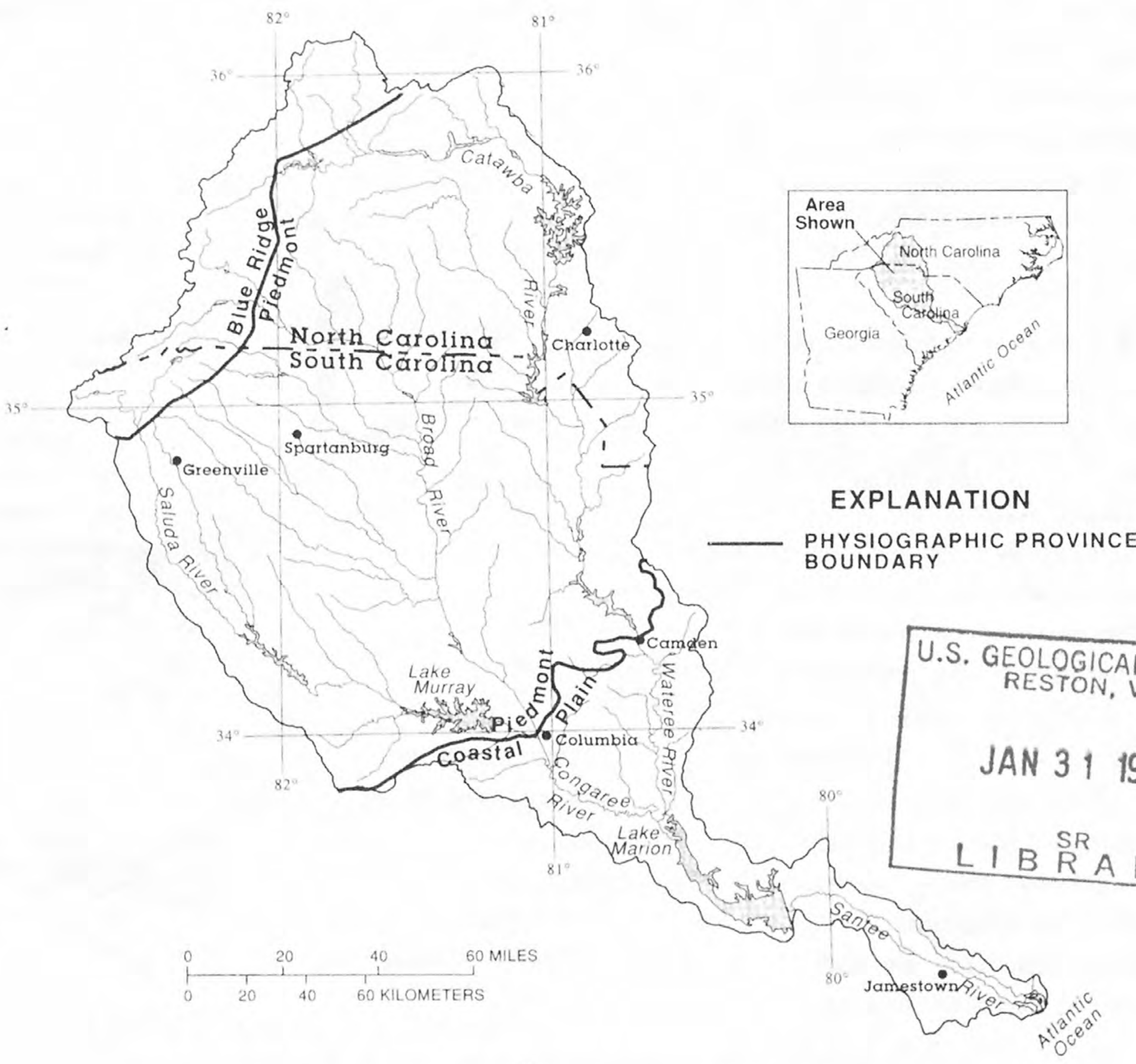

Figure 1. The Santee River Basin in North and South Carolina.

STREAMFLOW

The Santee River begins at the confluence of the Congaree and Wateree Rivers, south of Columbia, S.C. near the boundary of the Piedmont and Coastal Plain. On average, about 9,000 ft^3/s (cubic feet per second) and 6,000 ft^3/s flow into the Coastal Plain in the Congaree and Wateree Rivers, respectively. The flow in the Santee River near Jamestown, S.C., averaged 11,400 ft^3/s during 1987-91, and the highest and lowest daily mean flows were 89,500 ft^3/s and 460 ft^3/s, respectively. The average flow at Jamestown is lower than the combined flows of the Congaree and Wateree Rivers because some of the flow is diverted into the Cooper River Basin at Lake Marion.

The biggest recorded floods in the Santee Basin occurred prior to regulation by dams in 1908, 1916, and 1930. The highest streamflow recorded in the Santee Basin was 400,000 ft^3/s in the Wateree River near Camden, S.C., on July 18, 1916. Streamflow records collected in the Congaree River at Columbia, S.C., indicate that the magnitude of floods decreased significantly after the 1930's, largely because of the construction of reservoirs that control floodwaters on tributaries upstream. The flood plains of the Congaree and Wateree Rivers are inundated for several days at a time during floods that occur on an average of 3 to 4 times a year.

Major droughts in the Santee Basin occurred in the early 1940's, 1950's, and 1980's. The lowest streamflow recorded in the Congaree River at Columbia, S.C., was 662 ft^3/s on October 18, 1954.

SEASONAL FACTORS

In the Santee Basin, streamflow varies seasonally from high flows in the winter months, when evaporation and uptake by vegetation (evapotranspiration) are least, to low flows in the summer when evapotranspiration is greatest. During droughts, ground water can provide 100 percent of the water for streamflow. Ground water is replenished when precipitation falls on the land surface and soaks into the soil. When evapotranspiration is high, water is removed from the soil by plants and less ground water is available to supply streams, which results in low streamflows. During the winter months when evapotranspiration is low, a much larger amount of soil water reaches the water table, abundant ground water is then available to streams, and high streamflows result.

WETLAND FACTORS

Flood plains of rivers in coastal South Carolina are dominated by forested wetlands or swamps (fig. 2). The most common tree species

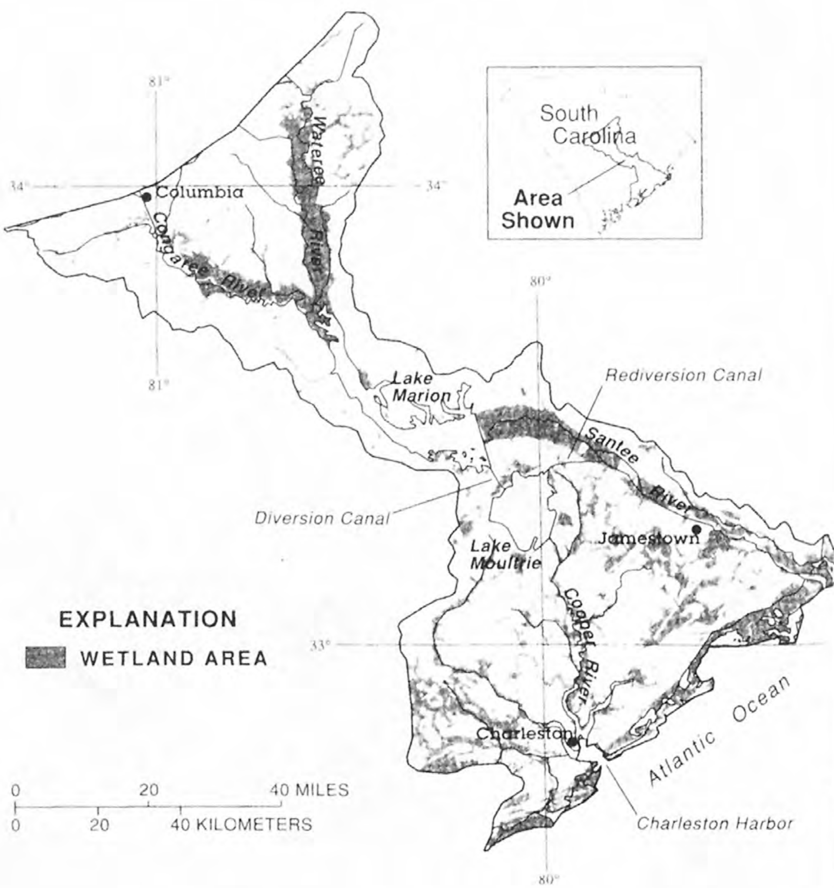

Figure 2. The Congaree, Wateree, and Santee Rivers in coastal South Carolina.

in the swamps are those that can withstand extended periods of flooding, such as cypress and tupelo. Forested wetlands have a pronounced effect on the flow of water in these rivers. During low flows, water is primarily contained within a few stream channels similar to flow in non-wetland areas. During high flows, however, water moves out of these stream channels and spreads out into forested and heavily vegetated areas. This has the effect of slowing down the water, decreasing the magnitude and frequency of floods, and increasing evapotranspiration.

RESERVOIR FACTORS

The biggest effect of reservoirs on river flows is to reduce high flows and increase low flows. Reservoirs can store large amounts of water to reduce flooding downstream, and during droughts, water stored in reservoirs can be discharged to maintain a minimum flow. If the reservoir is used for power generation, flows often do not follow natural seasonal patterns but reflect the demands of consumers for electricity. Although power companies are required to maintain minimum flows to prevent the degradation of aquatic habitats, the rapid alteration of high- and low-flow conditions for power generation can adversely affect stream morphology, which can affect aquatic wildlife.

The construction of reservoirs such as Lakes Marion and Moultrie has altered the hydrology of the lower Santee River Basin. Lake Moultrie is located in the Cooper River Basin, but its primary inflow is diverted water from the Santee River Basin. The diversion was made in 1942 to generate electric power (fig. 2). However, problems arose soon after the project was completed. The water from the Santee River carried a much heavier load of sediment than had originally been carried by the Cooper River, and this sediment settled out in the Cooper River and Charleston Harbor. The cost of dredging the harbor soared after the diversion. To solve this problem, a canal was dug in 1986 from Lake Moultrie to the Santee River to redivert much of the flow back to the Santee River.

WATER QUALITY AND LAND USE

Many water-quality problems are a direct result of land-use practices within the river basin. Based on data from the 1970's, 64 percent of the Santee Basin is forested, 25 percent is used for agriculture, and 8 percent is urbanized.

AGRICULTURAL FACTORS

Modern agriculture uses chemicals, such as insecticides, herbicides, and fungicides to promote high crop yields. By their nature, these chemicals are toxic to plants and animals, and excessive use can result in degradation of biological habitats in streams and rivers. Fertilizers too, can affect reservoirs and streams when used in excess. These plant nutrients stimulate the growth of algae and can produce huge increases in algal populations. The eventual death and decomposition of the algae reduces the quantity of dissolved oxygen in the water and adversely affects fish and other aquatic animals. Sediment eroded during tillage of soil enters streams and increases turbidity in surface water, which in turn increases the cost of treatment for public consumption and industrial use, deposits silt in reservoirs, covers fish spawning beds, and causes aesthetic problems.

URBAN FACTORS

Many land-use practices in urban areas have similar effects on water quality as those in agricultural areas. Pesticides and fertilizers are used on lawns, parks, and golf courses. Sewage treatment plants discharge large quantities of nutrients to streams. Grading for highway and construction projects can produce large quantities of sediment that washes into streams. In addition, synthetic organic chemicals, many of which are toxic, are concentrated in urban areas and can enter streams through leaking tanks, spills, and discharges.

RESERVOIR FACTORS

Reservoirs have a significant effect on water quality, because most of the sediment carried by the streams settles out in reservoirs. This has a two-fold effect--it reduces the amount of sediment carried by the rivers downstream from a reservoir, which in turn reduces the quantity of contaminants, such as metals, synthetic organic chemicals, and phosphorus that are commonly attached to the sediment. Within reservoirs, water tends to be stored for long periods of time, allowing algae to proliferate and dissolved oxygen to decrease. In most cases, low concentrations of dissolved oxygen are a natural condition for reservoirs in the Santee Basin. Natural wetland systems, such as the forested wetlands in the Congaree Swamp National Monument and Francis Marion National Forest, affect water quality much like the reservoirs. Water flows slowly through the wetlands allowing sediment, and the chemicals attached to the sediment, to settle out.

IMPORTANCE OF THIS RESOURCE

In 1990, about 3 million people relied on the water resources of the Santee River Basin. The majority of the population lived in the upper part of the basin in the Charlotte, N.C., and Greenville-Spartanburg, S.C., metropolitan areas. Columbia, S.C., is the only major urban center in the lower part of the basin. Many of the industries in the basin rely on water for processing and waste removal and include paper, textiles, and chemicals. All of the urban areas in the basin use surface water for their public-water supplies. In 1990, total basin withdrawals of surface water totaled 5.8 Bgal/d (billion gallons per day). Thermoelectric use accounted for 5.2 Bgal/d; industrial use, 350 Mgal/d (million gallons per day); municipal use, 280 Mgal/d; and agricultural use, 25 Mgal/d. About 3 percent of these withdrawals were for consumptive uses. Instream use by hydroelectric plants was 43 Bgal/d in 1990.

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