These storm-tide stages were computed by FEMA (1988, 1988, and 1989), using the joint probability method and the FEMA storm surge model. Probability distributions were determined for five parameters: central pressure depression, radius of maximum winds, forward speed of the storm, shoreline-crossing point, and crossing angle. The frequency distribution of surge height was determined from a large number of storms modeled by using combinations of the five parameters and their associated total probabilities. Results were statistically combined with astronomical tide data and adjusted for wind and wave effects.

To compare historically recorded storm-tide stages at the Charleston Customs House Wharf gage with storm-tide stages during Hurricane Hugo and FEMA stage-frequency relations, a stage-frequency relation was derived by fitting logarithms of the recorded annual peak tidal stages for the period of record (1922–85) to a Pearson Type III distribution. This relation is included only for comparison and is not intended for use as an alternative approach for estimating hurricane storm-tide stage frequency of other sites. On the basis of this relation, the tidal storm-tide stage of 10.2 feet at the Customs House gage during Hurricane Hugo had a recurrence interval of about 200 years. A stage-frequency relation developed by Myers (1975) from data collected at this site during 1893–1958 indicated that a stage of 10.2 feet would have a recurrence interval of 150 years.

EFFECTS ON MORPHOLOGY OF THE COASTAL AREA

The effects of Hurricane Hugo on morphology varied along the coast. In general, beaches north of the eye were eroded as sand was moved from higher elevations of the beach. South of the eye, beach erosion was minimal except in the Folly Island area.

In the area from Garden City Beach to North Myrtle Beach, which was more than 100 mi north of the eye of the storm, the beach was only moderately affected by the passage of Hurricane Hugo. Large amounts of sand were redistributed from the southern tip of Garden City Beach to Myrtle Beach, but the intertidal area from Myrtle Beach to North Myrtle Beach was not substantially changed as a result of the storm.

From Winyah Bay to North Inlet, the slope of the beach remained about the same although the intertidal area moved landward 50 to 80 feet as a result of 1.5 to 2 feet of beach erosion. Sand was eroded from some beaches at elevation as high as 13 feet, which was about the elevations of the storm tide in the area.

Prior to Hurricane Hugo, parts of the low-lying barrier islands in the area from Charleston Harbor to Winyah Bay had a natural dune system, which restricted tidal flow to the inlets and river entrances. These dunes were overtopped, and in some cases, completely removed by the storm surge, and sediment was deposited in the marsh. Breaches were cut through the dunes in many parts of this area due to high-tidal velocities, especially near Cape Romain (fig. 2) (Stauble and others, 1991).

In the area between Sullivans Island and the Isle of Palms, overwashed sand was transported as far as 400 feet inland, (Stauble and others, 1991). Isle of Palms is a barrier island and has tidal inlets with large ebb-tidal deltas extending offshore. These ebb-tidal deltas helped to reduce damages from storm-tide surges by dissipating wave energy farther offshore.

Beach erosion has been an ongoing problem on Folly Island, primarily due to the construction of the Charleston Harbor jetties on the updrift side of the island in the late 1800's (Mark Hansen, Joan Pope, Julie Rosati, and Stephen Knowles, Department of the Army, Corps of Engineers, written commun., 1992). This erosion has led to the construction of bulkheads, revetments, and groins, all of which were severely damaged or destroyed by overwash during Hurricane Hugo. Damage was extensive throughout Folly Island, and several breaches were cut through the island by overwash (Stauble and others, 1991). Farther to the south, from Kiawah Island to Edisto Beach (fig. 4), beach erosion was minimal.

WATER-QUALITY EFFECTS

Hurricane Hugo caused substantial changes in water-quality characteristics of some streams in the coastal area. Strong winds blew large amounts of debris, ranging from building materials to natural vegetation, into watercourses and the high winds and tidal velocities caused resuspension of bottom sediments. The decay of the debris and oxidation of bottom materials greatly reduced dissolved-oxygen concentrations in many coastal streams. Dissolved-oxygen concentrations at selected sites on the Cooper, Pee Dee, and Waccamaw Rivers (fig. 3), are shown for 1988–89 in figure 11. This figure indicates that concentrations of dissolved oxygen in these rivers were substantially lower about 10 to 12 days after the passage of Hurricane Hugo than during the same period the previous year (1988).

SUMMARY

Hurricane Hugo, which hit the South Carolina coast on September 22, 1989, was the most destructive hurricane to affect the state since records have been collected. Storm-tide stages for Hurricane Hugo at Charleston Harbor were estimated to have a recurrence interval of about 150 years. The hurricane caused damage estimated at $7 billion, and claimed the lives of at least 35 persons in South Carolina. Storm-tide stages were the highest ever recorded in South Carolina, more than 20 feet above sea level in some areas. Storm-tide stages caused extensive coastal flooding and beach erosion, and greatly reduced dissolved-oxygen concentrations in streams near the South Carolina coast.

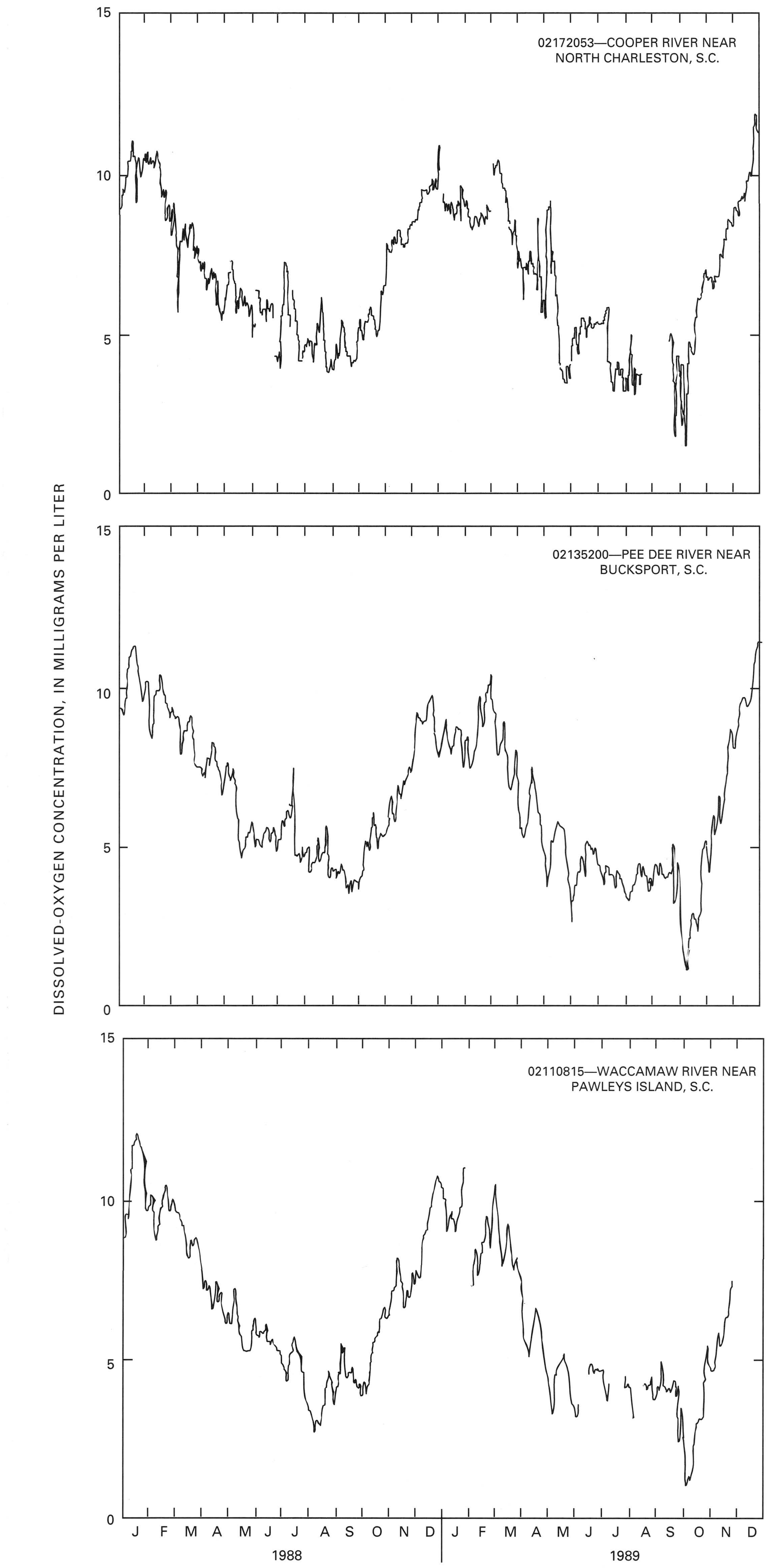

Figure 11. Dissolved-oxygen concentrations in the Cooper,Pee Dee, and Waccamaw Rivers, 1988-89.

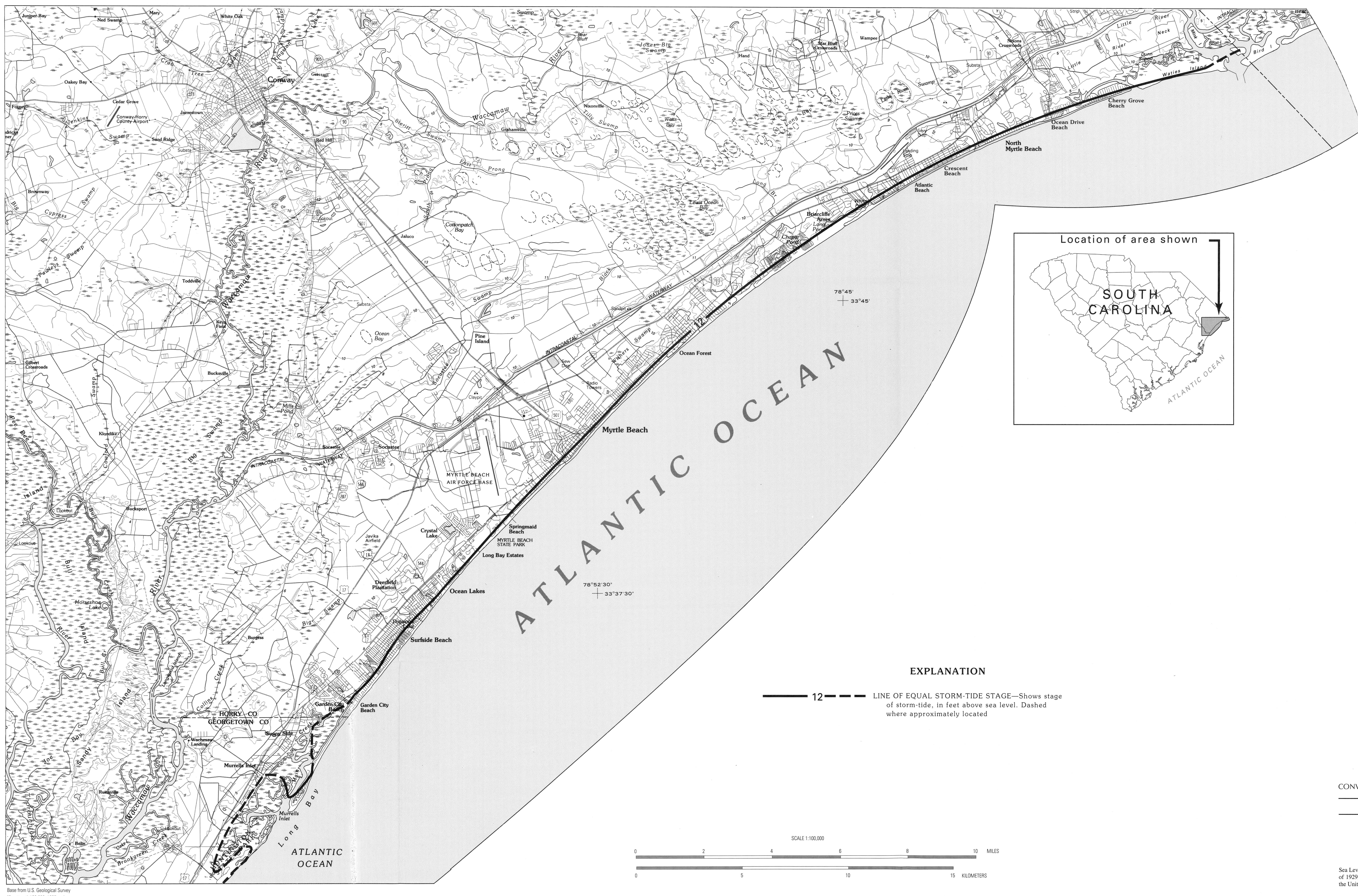

Figure 6. Storm-tide stages from Murrells Inlet to Little River Inlet.

CONVERSION FACTORS AND VERTICAL DATUM

Multiply inch-pound unit	by	To obtain metric unit
inch (in.)	2.54	centimeter
foot	0.3048	meter
mile (mi)	1.609	kilometer
miles per hour (mi/h)	1.609	kilometer per hour

Sea Level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 [NGVD of 1929]—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

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