ENVIRONMENTAL GEOLOGIC ATLAS OF COASTAL GEORGIA

GEOLOGIC ATLAS 5

Edited By

Madeleine F. Kellam

RESEARCH GEOLOGISTS

Martha M. Griffin
Vernon J. Henry
Paul F. Huddlestun
Madeleine F. Kellam
Bruce J. O'Connor
Mary Lynne Pate
Bruce O. Rado

PROJECT COORDINATORS

Martha M. Griffin, Madeleine F. Kellam and Bruce O. Rado

RESEARCH ASSISTANTS

Thomas M. Loretto
Denise McCarthy
Laura M. Smith

PUBLICATION COORDINATORS

Elisandra S. Black
Linda L. Stoutenburg

CARTOGRAPHERS

Madeleine F. Kellam
L. Jeane Smith

DEPARTMENT OF NATURAL RESOURCES

J. Leonard Ledbetter, Commissioner

ENVIRONMENTAL PROTECTION DIVISION

Harold F. Reheis, Assistant Director

GEORGIA GEOLOGIC SURVEY

William H. McLemore, State Geologist

Atlanta

1986

TOPOGRAPHY AND BATHYMETRY

EXPLANATION

40 — Topographic contour - Shows land surface elevation in feet. Datum is National Geodetic Vertical Datum of 1929. Contour interval 20 feet. Supplementary contour (dashed) at 5 feet.

30 — Bathymetric contour - Shows depth of water in feet. Datum is mean low water. Contour interval 6 feet.

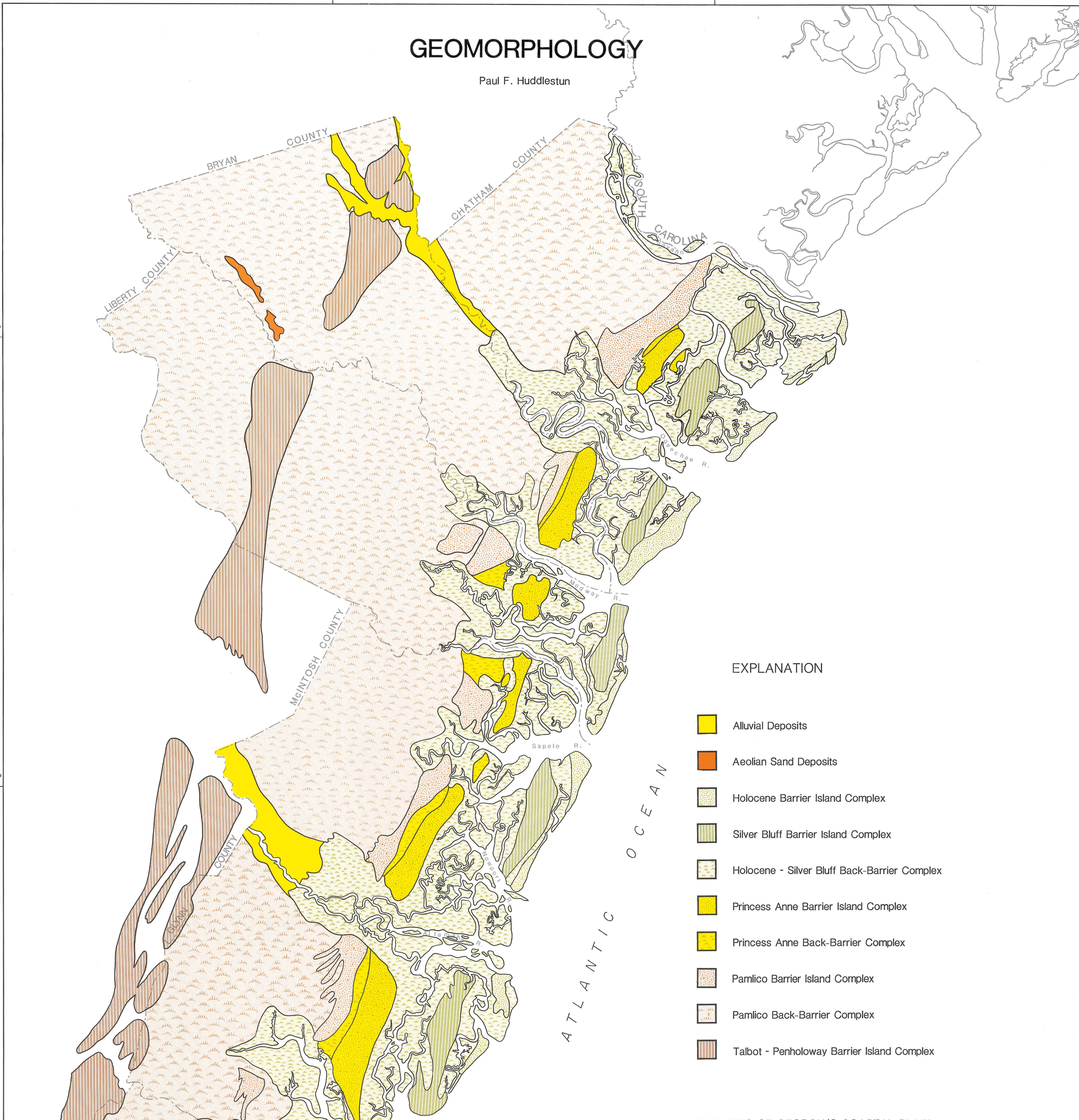
The relationship between the two datums is variable. This map is not intended for navigational use.

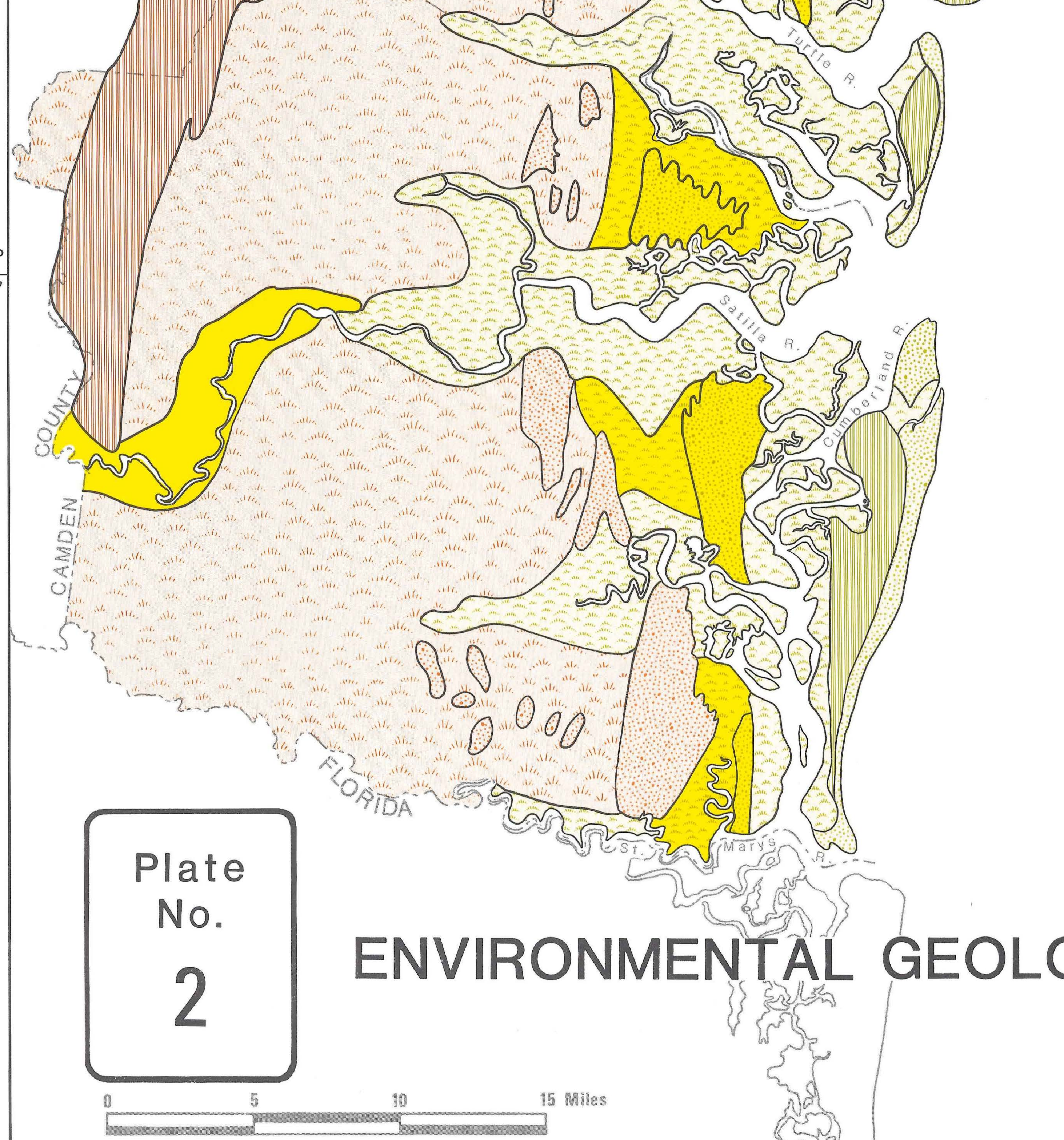
Plate No. 1

ENVIRONMENTAL GEOLOGIC ATLAS OF COASTAL GEORGIA

GEOMORPHOLOGY

Paul F. Huddlestun





BARRIER ISLAND COMPLEXES OF GEORGIA'S COASTAL PLAIN

The coastal counties of Georgia contain numerous marine terraces, many of which contain low elongated ridges that parallel the present coastline. These ridges, and the flat terrain that separates them, are thought to be relict barrier island and back-barrier complexes similar to those presently found along Georgia's coast. The ridges formed as barrier islands at relative sea level still-stands during the Pleistocene Epoch, when sea level worldwide was higher. Changes in mean sea level (MSL) throughout the Pleistocene created a series of barrier island complexes, now preserved as eroded ridges, which decrease in age with decreasing elevation. Most of the barrier islands of Georgia's present-day coast are composed of relict Pleistocene beach/dune deposits of the Silver Bluff complex, fronted by beach/dune deposits of the Recent, or Holocene, sea level rise.

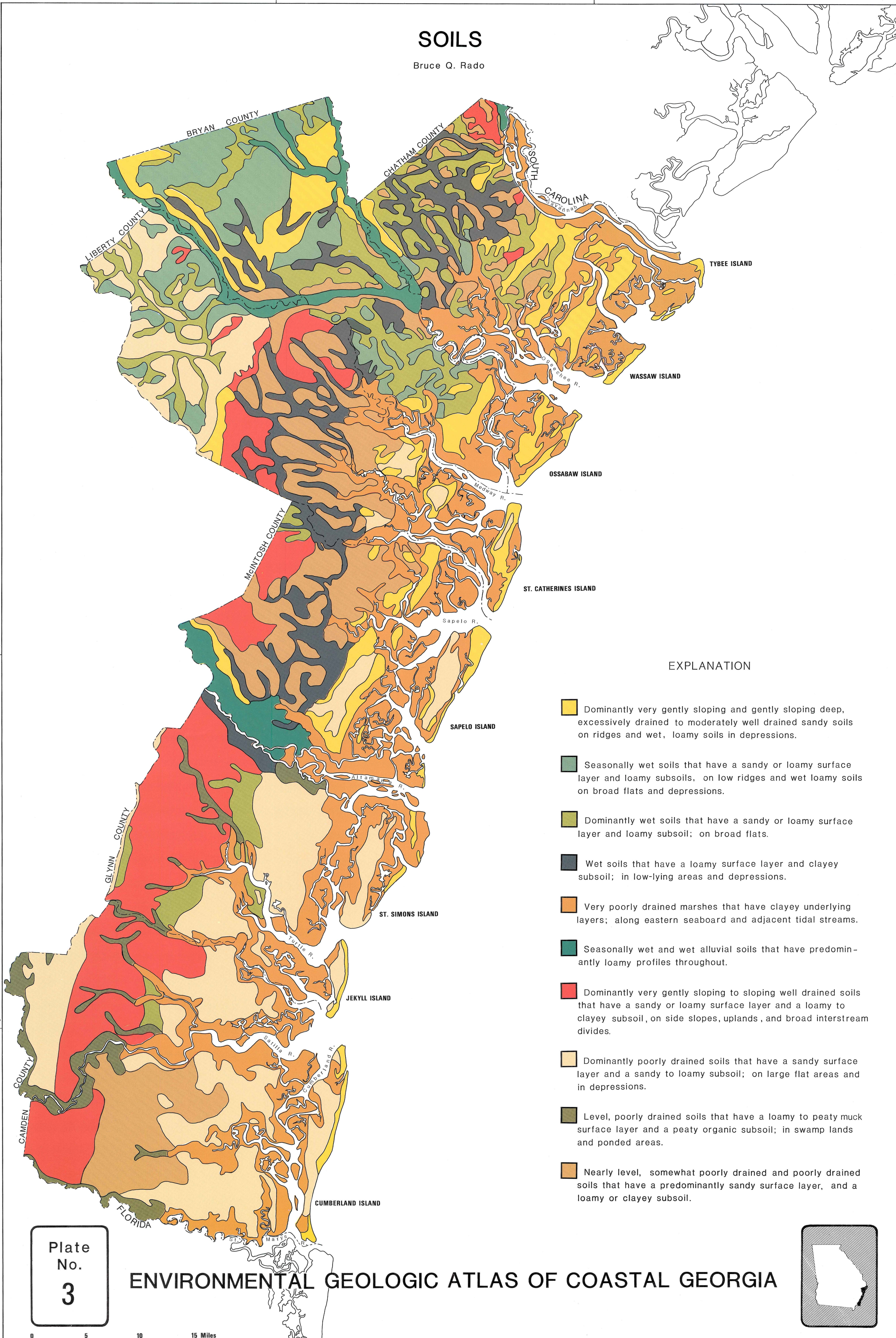
AGE	COMPLEX	BARRIER ISLAND ELEVATION	BACK-BARRIER ELEVATION
Holocene	Holocene	average 10-20' above MSL	average 0-7' above MSL
Pleistocene	Silver Bluff	average 10-20' above MSL	average 0-7' above MSL
Pleistocene	Princess Anne	average 15-20' above MSL	average 10-20' above MSL
Pleistocene	Pamlico	average 25-40' above MSL	average 15-25' above MSL
Pleistocene	Talbot	average 55-75' above MSL	average 45-50' above MSL
Pleistocene	Penholoway	average 75-95' above MSL	average 55-70' above MSL

Plate No. 2

ENVIRONMENTAL GEOLOGIC ATLAS OF COASTAL GEORGIA

SOILS

Bruce Q. Rado



EXPLANATION

- Dominantly very gently sloping and gently sloping deep, excessively drained to moderately well drained sandy soils on ridges and wet, loamy soils in depressions.
- Seasonally wet soils that have a sandy or loamy surface layer and loamy subsoils, on low ridges and wet loamy soils on broad flats and depressions.
- Dominantly wet soils that have a sandy or loamy surface layer and loamy subsoil; on broad flats.
- Wet soils that have a loamy surface layer and clayey subsoil; in low-lying areas and depressions.
- Very poorly drained marshes that have clayey underlying layers; along eastern seaboard and adjacent tidal streams.
- Seasonally wet and wet alluvial soils that have predominantly loamy profiles throughout.
- Dominantly very gently sloping to sloping well drained soils that have a sandy or loamy surface layer and a loamy to clayey subsoil, on side slopes, uplands, and broad interstream divides.
- Dominantly poorly drained soils that have a sandy surface layer and a sandy to loamy subsoil; on large flat areas and in depressions.
- Level, poorly drained soils that have a loamy to peaty muck surface layer and a peaty organic subsoil; in swamp lands and ponded areas.
- Nearly level, somewhat poorly drained and poorly drained soils that have a predominantly sandy surface layer, and a loamy or clayey subsoil.

Plate No. 3

ENVIRONMENTAL GEOLOGIC ATLAS OF COASTAL GEORGIA

MINING AND MINERAL OCCURRENCES

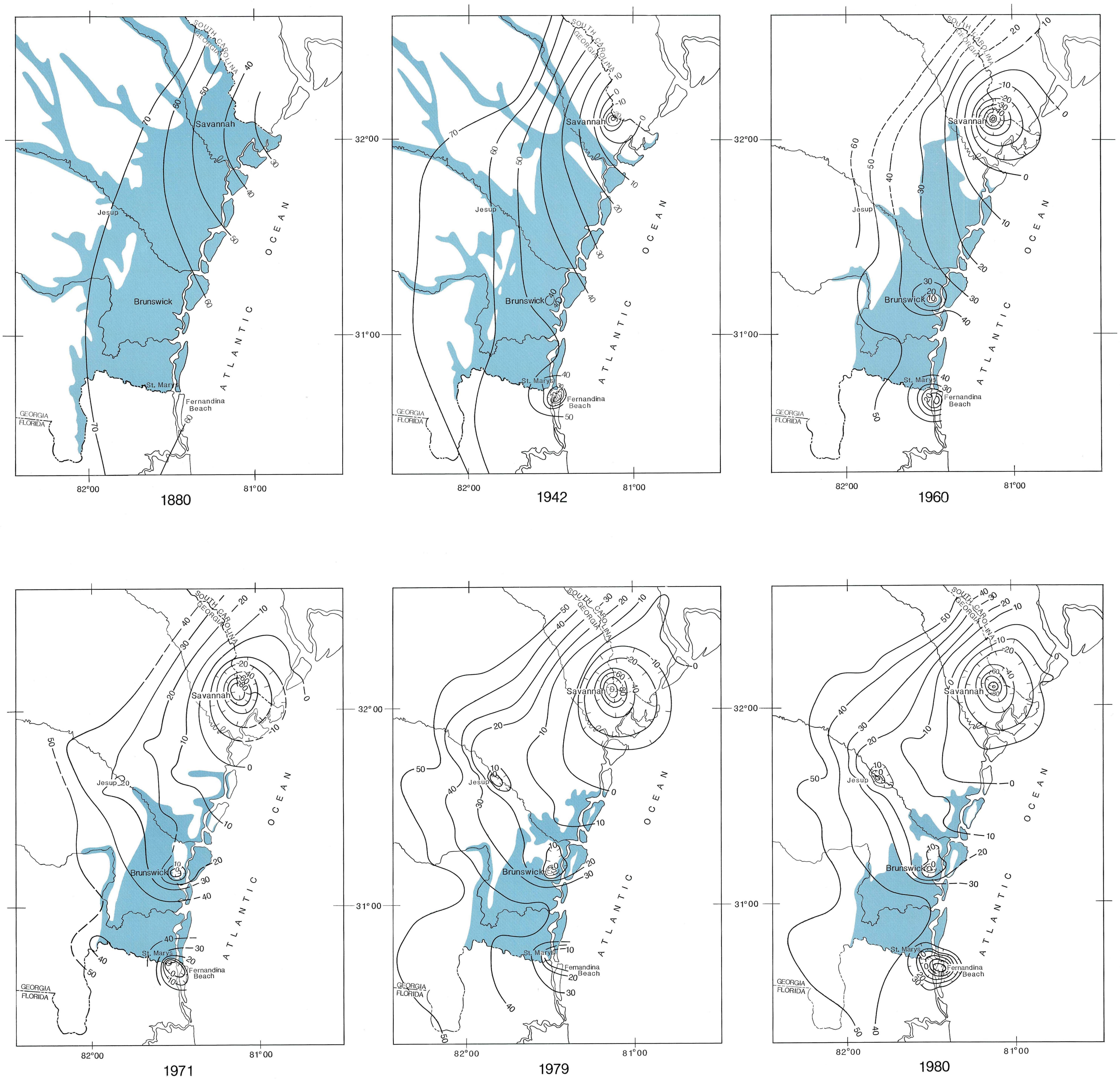
Bruce J. O'Connor

Plate No. 4

ENVIRONMENTAL GEOLOGIC ATLAS OF COASTAL GEORGIA

POTENTIOMETRIC SURFACE OF THE PRINCIPAL ARTESIAN AQUIFER 1880 – 1980

Madeleine F. Kellam



1880 · 1942 · 1960 · 1971 · 1979 · 1980

EXPLANATION

Area where flow from artesian wells could have been obtained.

——— 50 — — — —

Potentiometric contour

Shows altitude at which water level would have stood in tightly cased wells. Dashed where approximately located. Contour interval is 10 feet. Below -20 foot contour, contour interval is 20 feet. Datum is mean sea level.

0 5 10 15 20 MILES

The Principal Artesian Aquifer (PAA) is the major source of groundwater in Georgia. The aquifer is composed of Middle Eocene- to Miocene-aged limestone. In the coastal zone, the PAA is formed of several different permeable limestones, separated by semi-confining units. The PAA is overlain by sandy clays and clays of Miocene age. The lower confining unit is a dense dolomitic limestone of Middle Eocene age.

Water enters the tilted strata of the aquifer in the recharge area in the upper Coastal Plain. The upper confining unit holds the water under pressure, so that the water will rise above the top of the aquifer in tightly cased wells which penetrate the PAA. Such wells are known as artesian wells. The height relative to mean sea level (MSL) to which the water in cased wells will rise is illustrated by the potentiometric maps above. When the potentiometric surface exceeds the elevation of the land surface, water in a cased well in the PAA will rise above the land surface. Such a well is known as a flowing artesian well.

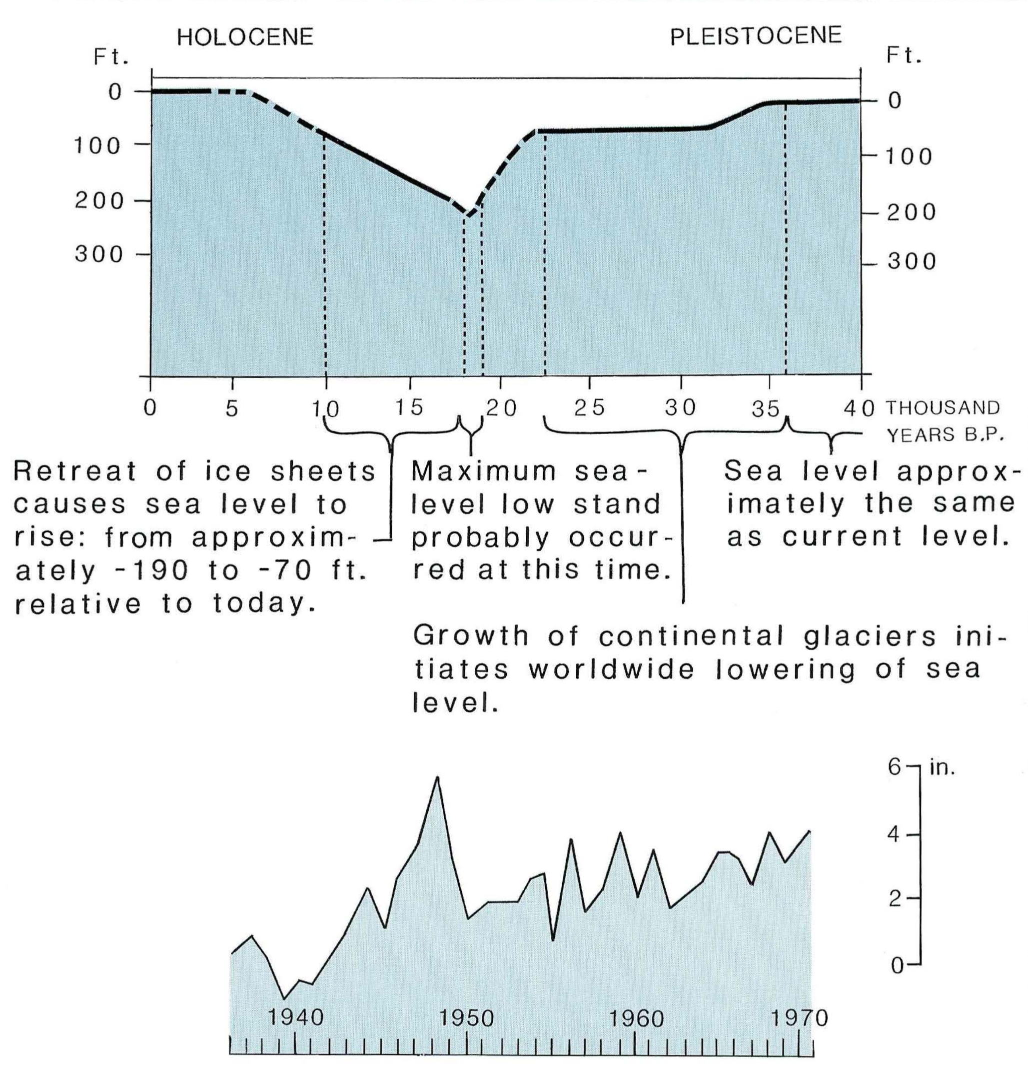
Increased use of the PAA has caused a decline in the potentiometric level. For example, a 500 ft. deep well drilled into the PAA in Savannah in 1880 would have resulted in a flowing artesian well, for the water would rise 40 ft. above MSL in a cased well. In 1980, the water in the same well would only rise to 130 ft. below MSL, making it necessary to pump the water to the surface.

In some areas of heavy pumpage, such as Brunswick, the quality of water has deteriorated. Pumping has caused a lowering of hydrostatic head, known as a cone of depression, in the PAA. This has resulted in the infiltration of brackish water from lower strata into the aquifer. The potential for salt-water intrusion also exists in Savannah.

As use of the PAA increases, the area of artesian flow will continue to decrease. Although a large quantity of ground water is available from the PAA for future use, conservation of this vital natural resource must be practiced.

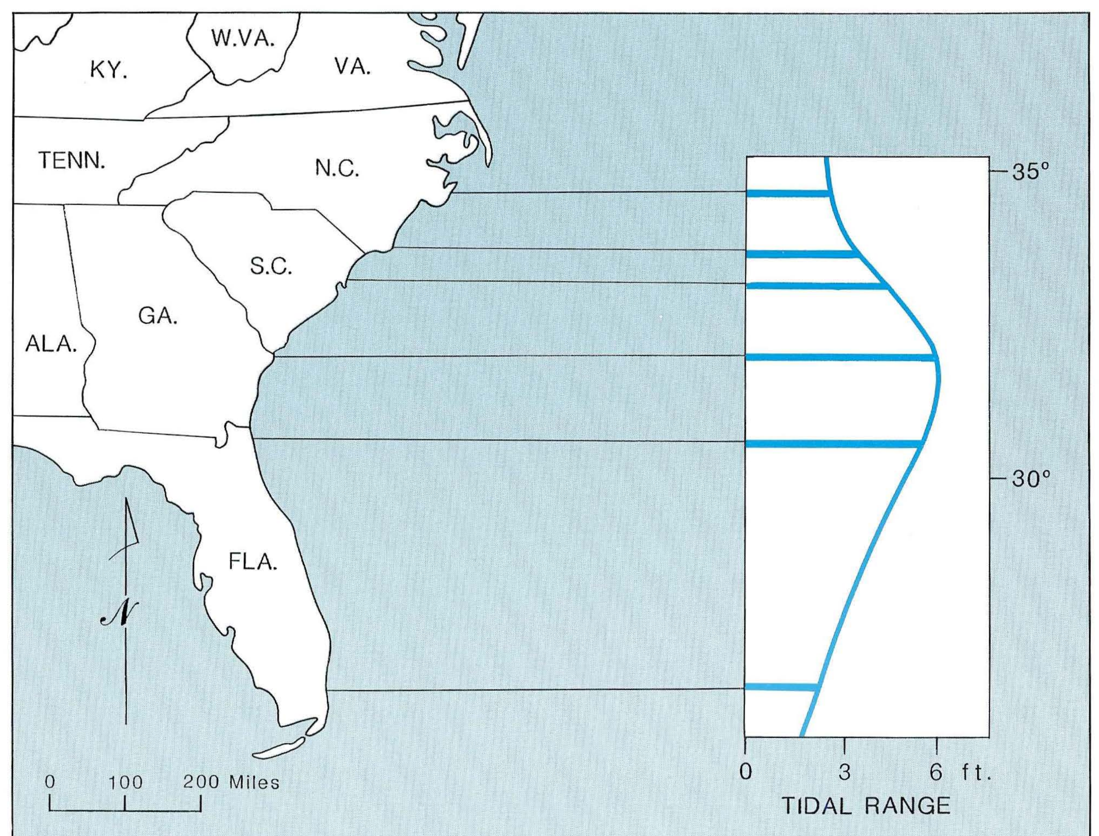
COASTAL PROCESSES

Martha M. Griffin



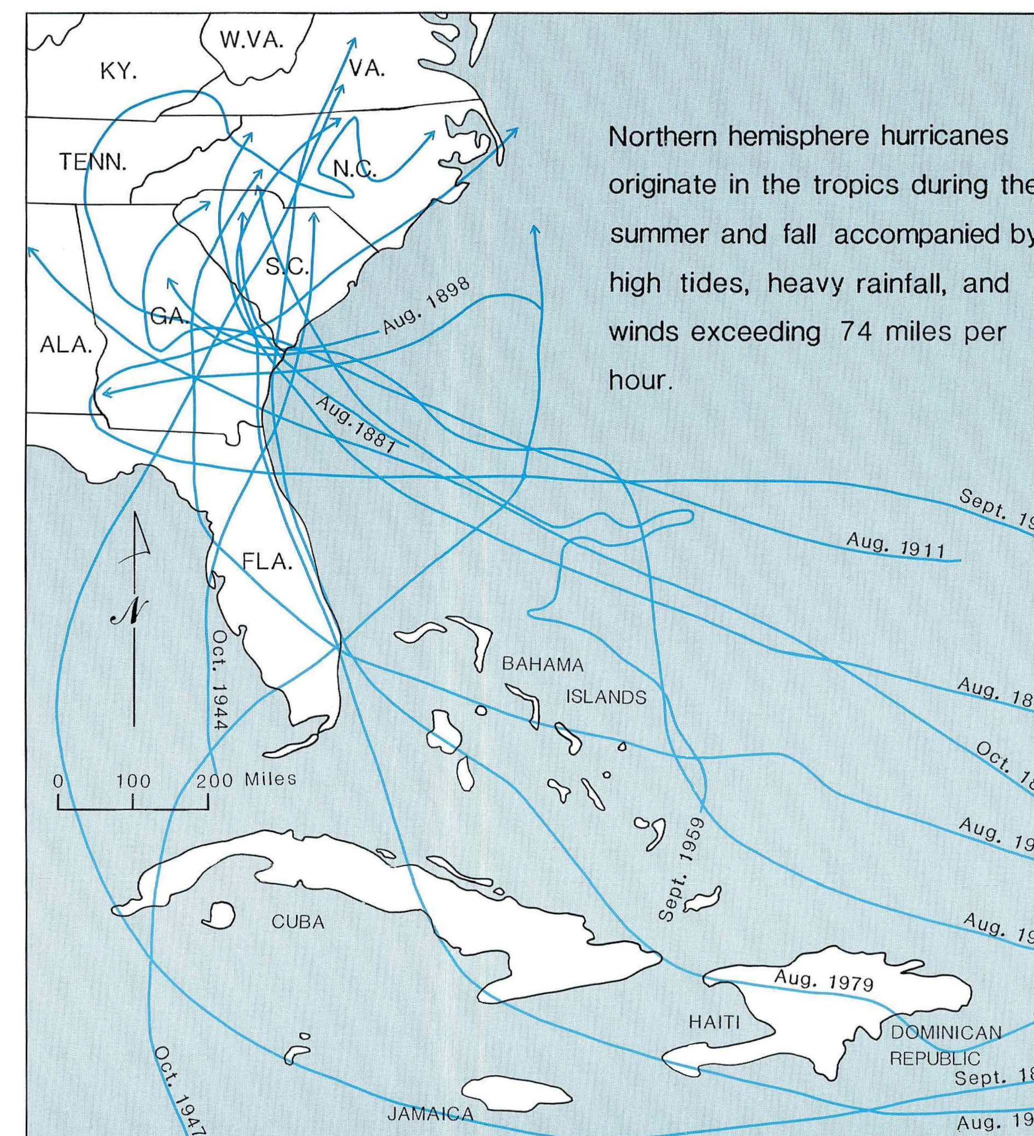
Curve showing recent sea-level rise recorded at Fort Pulaski, Georgia. On the east coast, a progressive rise in sea level has occurred since 1890. Mean sea-level curves indicate a rate of 0.09 inches per year for the period 1929-1971. This gradual rise is the single most important long-term agent of shoreline retreat.

A. SEA LEVEL CHANGE



Variation of tidal range and wave energy along the Georgia Bight. The effect of the regional embayment, which characterizes the south-eastern coast, is to magnify tidal range and minimize wave energy. The Georgia coast has an average tidal fluctuation of approximately 6 ft. Spring ranges of 9 ft. are common. Wave heights of average between 2.6 ft. and 4.1 ft.

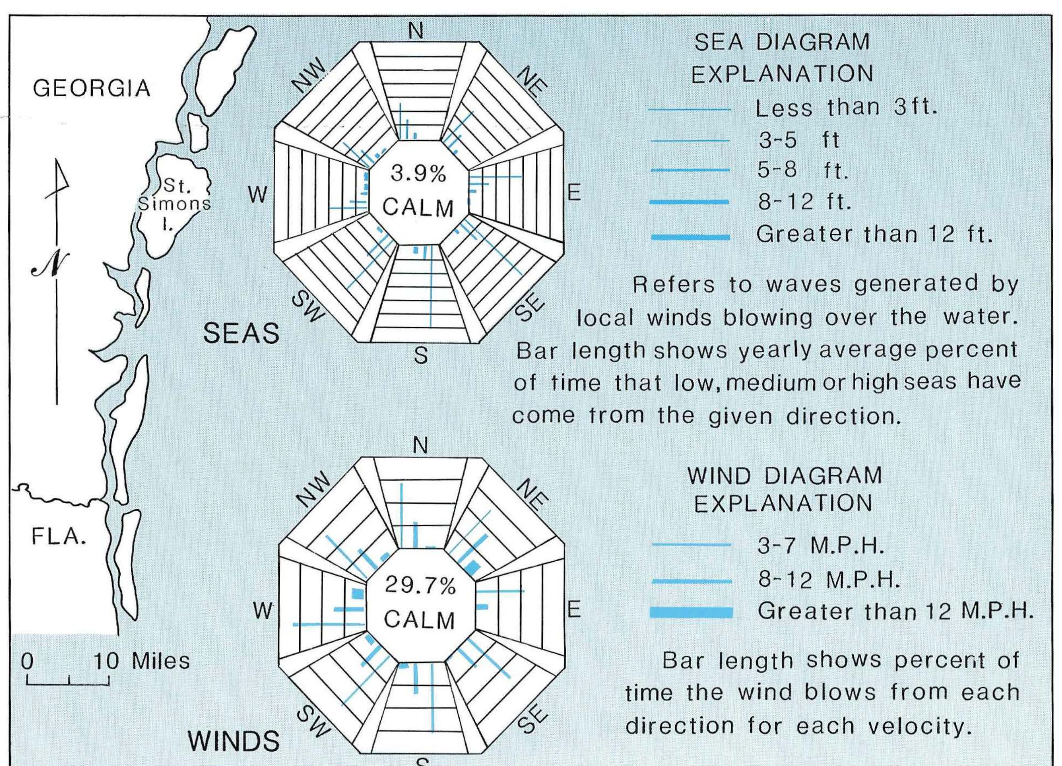
B. TIDAL RANGE



Northern hemisphere hurricanes originate in the tropics during the summer and fall accompanied by high tides, heavy rainfall, and winds exceeding 74 miles per hour.

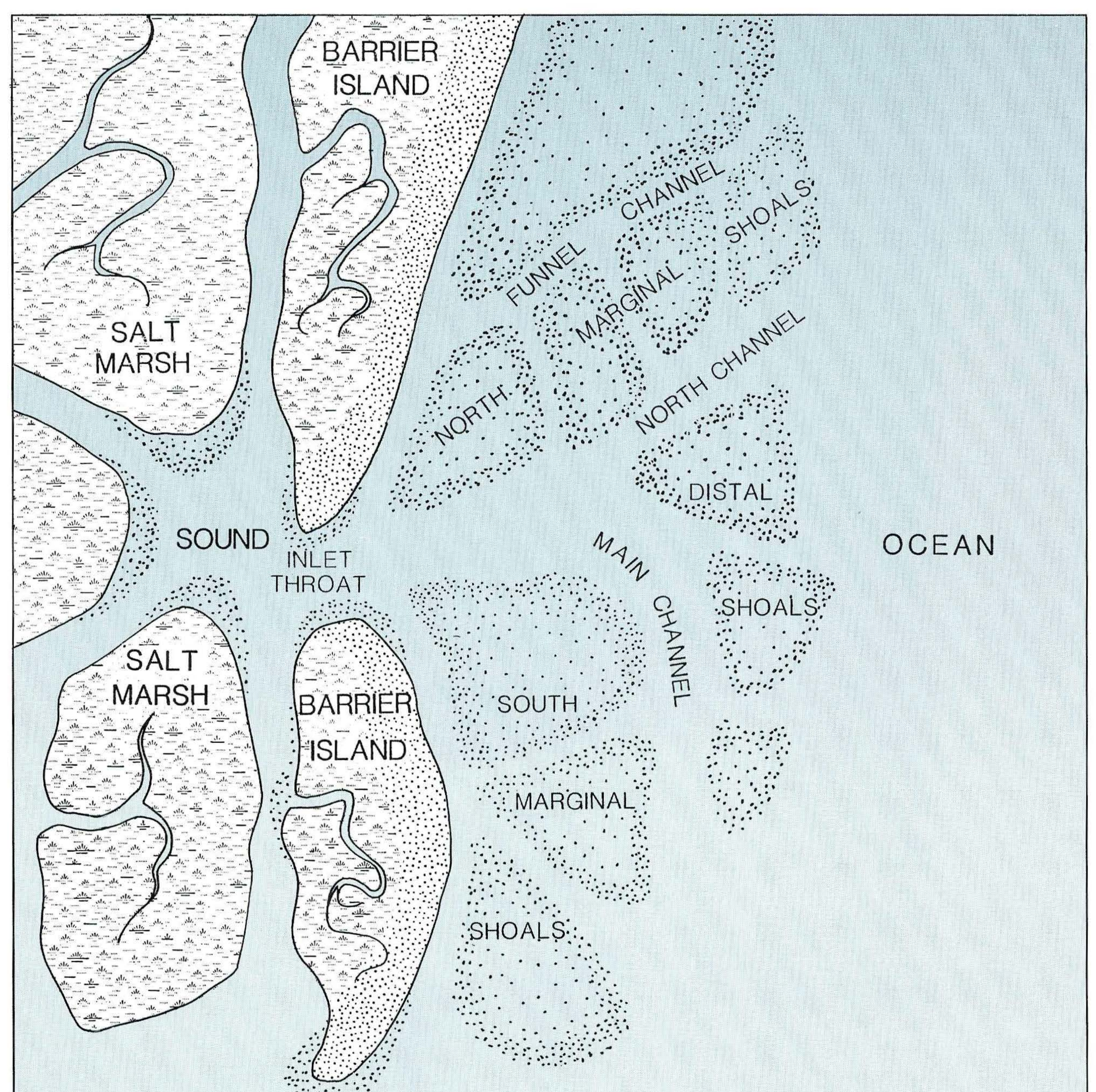
On the average, a severe hurricane strikes Georgia's coast once in every ten years. Hurricanes greatly influence shoreline sediment distribution patterns. Island modification occurs by erosion on the seaward side and deposition by overwash and inlet flow on the landward side.

C. HURRICANE STRIKES



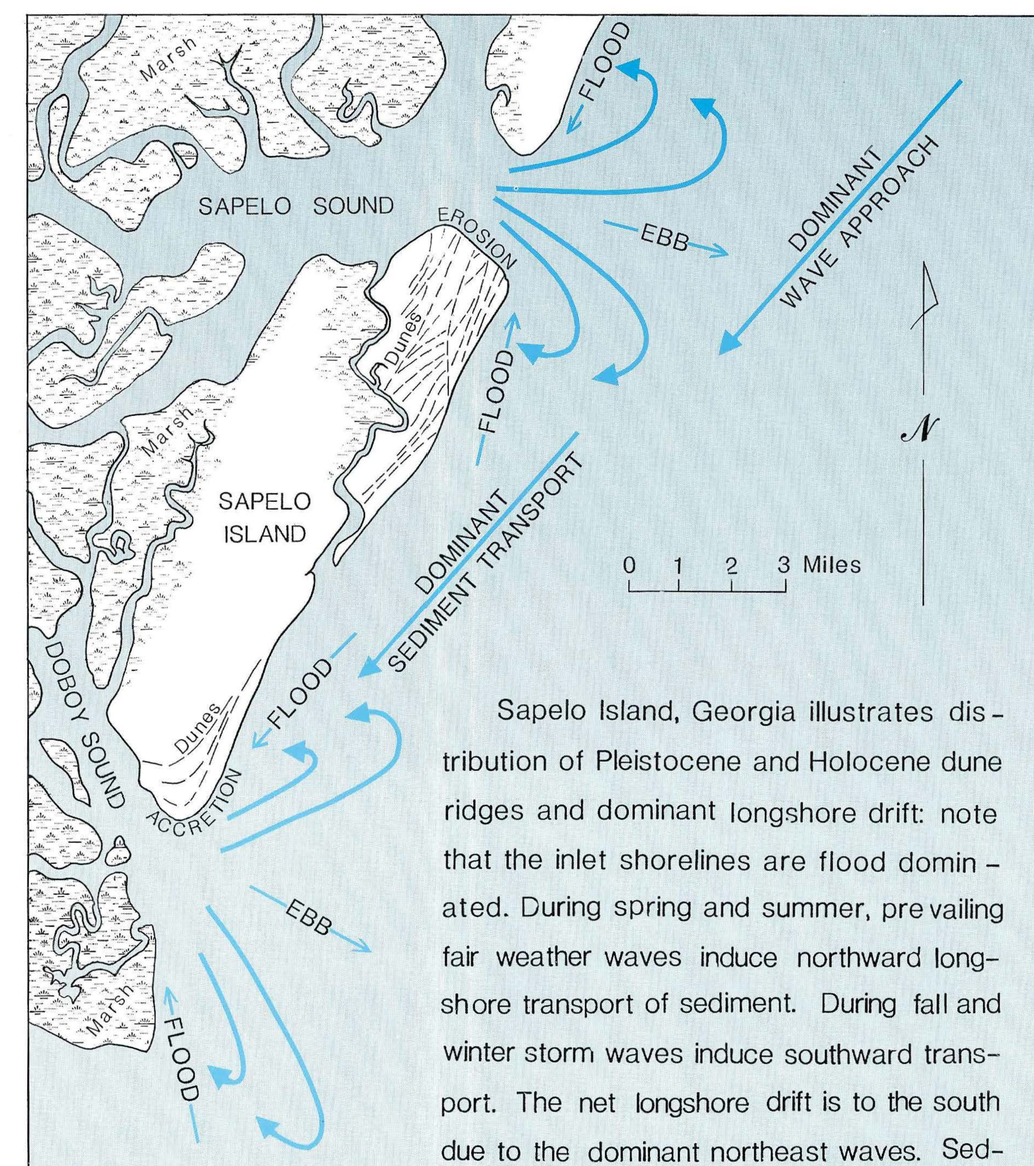
Waves most often approach the shore from the south and southeast, but north and northeast waves have higher energy and a much greater impact upon the shoreline. High velocity winds most often approach shore from the northeast, producing tidal surges; high waves and above normal water levels produce destructive forces along the shore. The winds of a "Northeaster" storm do not reach hurricane velocity, but they impact a larger area for a longer period of time.

D. WINDS AND SEAS - ST. SIMONS ISLAND



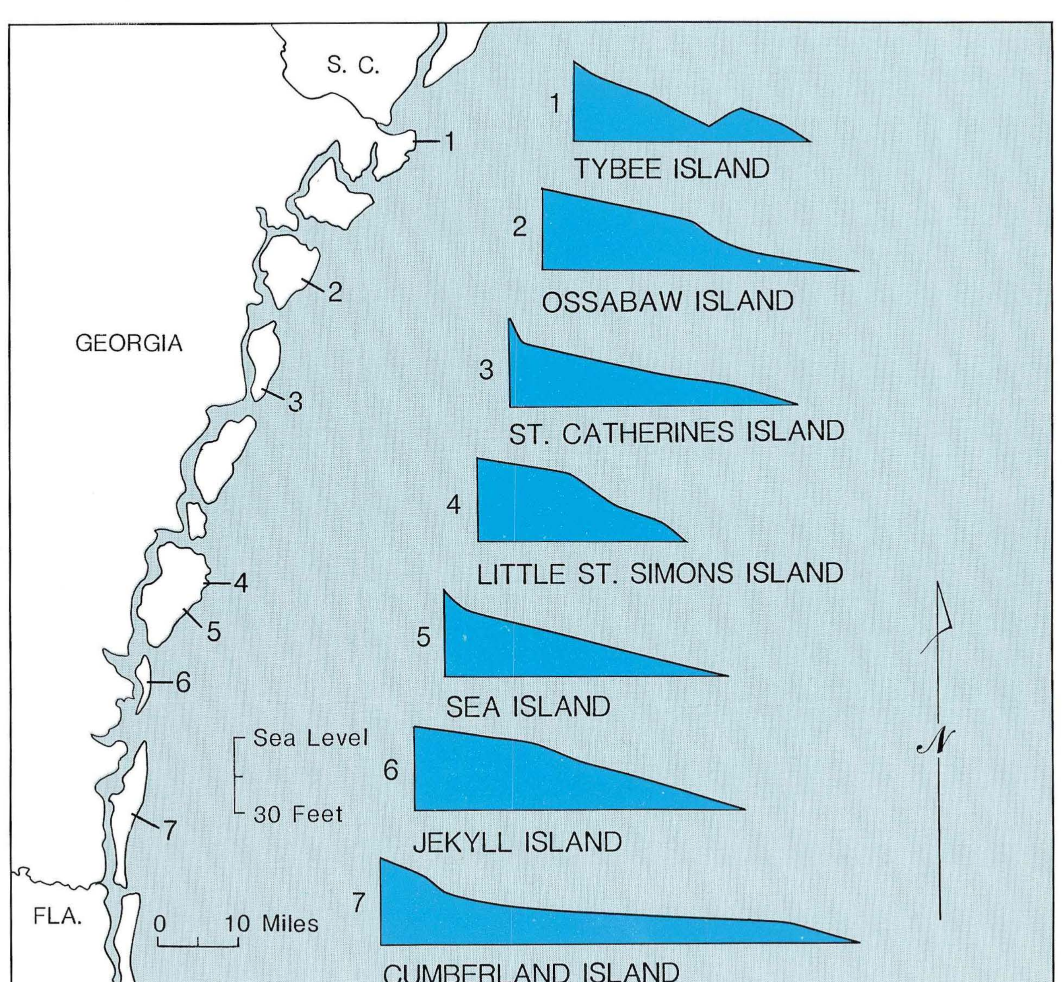
Unaltered inlets are marked by well-developed ebb-tidal deltas, which are both sediment sources and sinks for adjacent barrier islands. Sand stored in the deltas is eventually transported southward to downdrift shorelines. Shoal-induced wave refraction produces a mechanism for onshore transport of stored sediment.

E. INLET DYNAMICS



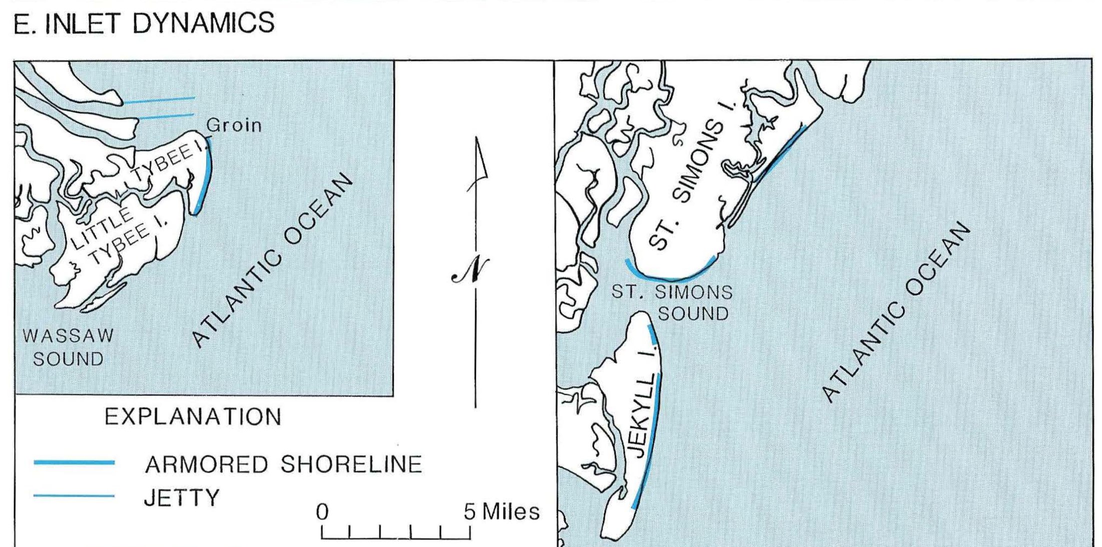
Sapelo Island, Georgia illustrates distribution of Pleistocene and Holocene dune ridges and dominant longshore drift: note that the inlet shorelines are flood dominated. During spring and summer, prevailing fair weather waves induce northward longshore transport of sediment. During fall and winter storm waves induce southward transport. The net longshore drift is to the south due to the dominant northeast waves. Sediment reworking in the inlets is dependent on patterns and magnitudes of reversing tidal currents.

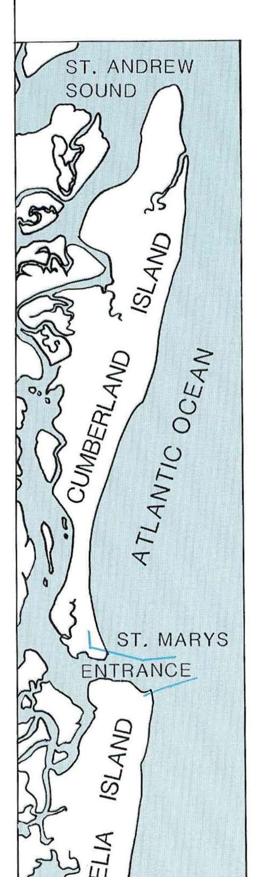
F. SEDIMENT TRANSPORT



Compare dredged and undredged areas off Tybee (1) and Little St. Simons (4) Islands, both deltaic islands. Extensive shoaling off Ossabaw (2) reflects its deltaic nature. Note steep gradients of profiles off eroding St. Catherines (3) and Sea (5) Islands. The shallow sand sheet seaward of Jekyll (6) suggests Holocene landward migration. The Cumberland (7) profile shows historically stable Stafford Shoal.

G. NEARSHORE BATHYMETRY





Because barrier islands are dynamic systems, any man-made changes in the coastal zone will modify the sediment budget. Jetties constructed in the late 1800's to facilitate navigation have these side effects: drastic alteration of the ebb-tidal delta, initially intensified deposition adjacent to the jetties, probable elimination of downdrift sediment transport, and development of a sediment sink seaward of the jetties. Protective shoreline structures can prevent the landward encroachment of the mean high water shoreline, but they generally accelerate the natural rate of erosion near the armored shoreline or along adjacent downdrift shorelines. Groins, built perpendicular to the shoreline, generally result in updrift accretion and downdrift erosion.

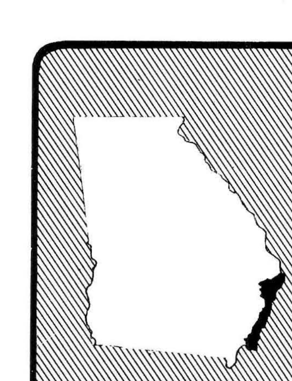
H. MAN-MADE FEATURES

The configuration of the Georgia coastline is controlled by sediment supply and the combination of wave and tidal regimes. The barrier islands of Georgia lie well within the extensive regional embayment known as the Georgia Bight. Because tidal effects are magnified by this embayment, Georgia has the highest tides of the entire southern U. S. coast, averaging 6 to 10 feet. The coast of Georgia is tide dominated, as compared to wave-dominated coasts north and south of Georgia. To accommodate this large volume of water, the Georgia barrier island system is one of short, broad islands separated by deep tidal inlets.

A great quantity of sand is stored in extensive shoal systems seaward of both the inlets and the central portions of the islands. These shoals absorb much of the wave energy of storm attacks and are thus directly linked to beach configuration.

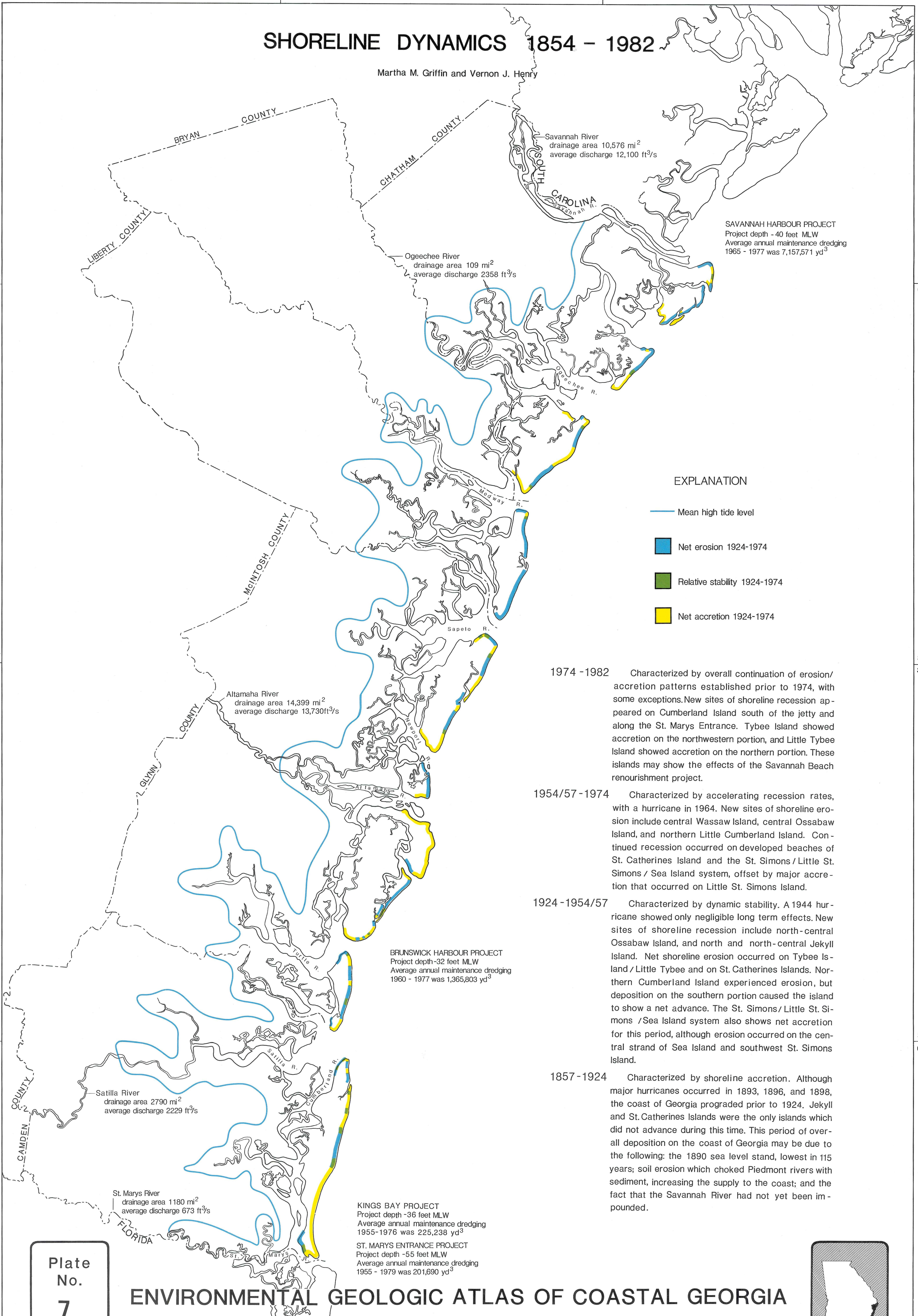
The broad, shallow continental shelf adjoining Georgia so dampens wind and wave energy that wave heights are typically 9 to 12 inches, the lowest on the east coast of the United States. Because the strongest winds are from the northeast, waves strike the shore most forcefully from that direction, resulting in a net movement, or longshore transport of sand from north to south. Any interruption of this flow of sand results in a greatly altered shoreline and, frequently the expenditure of vast sums of money for corrective measures.

I. SUMMARY



SHORELINE DYNAMICS 1854 - 1982

Martha M. Griffin and Vernon J. Henry



1974 -1982 Characterized by overall continuation of erosion/accretion patterns established prior to 1974, with some exceptions. New sites of shoreline recession appeared on Cumberland Island south of the jetty and along the St. Marys Entrance. Tybee Island showed accretion on the northwestern portion, and Little Tybee Island showed accretion on the northern portion. These islands may show the effects of the Savannah Beach renourishment project.

1954/57 - 1974 Characterized by accelerating recession rates, with a hurricane in 1964. New sites of shoreline erosion include central Wassaw Island, central Ossabaw Island, and northern Little Cumberland Island. Continued recession occurred on developed beaches of St. Catherines Island and the St. Simons / Little St. Simons / Sea Island system, offset by major accretion that occurred on Little St. Simons Island.

1924 -1954/57 Characterized by dynamic stability. A 1944 hurricane showed only negligible long term effects. New sites of shoreline recession include north-central Ossabaw Island, and north and north-central Jekyll Island. Net shoreline erosion occurred on Tybee Island / Little Tybee and on St. Catherines Islands. Northern Cumberland Island experienced erosion, but deposition on the southern portion caused the island to show a net advance. The St. Simons / Little St. Simons / Sea Island system also shows net accretion for this period, although erosion occurred on the central strand of Sea Island and southwest St. Simons Island.

1857 - 1924 Characterized by shoreline accretion. Although major hurricanes occurred in 1893, 1896, and 1898, the coast of Georgia prograded prior to 1924. Jekyll and St. Catherines Islands were the only islands which did not advance during this time. This period of overall deposition on the coast of Georgia may be due to the following: the 1890 sea level stand, lowest in 115 years; soil erosion which choked Piedmont rivers with sediment, increasing the supply to the coast; and the fact that the Savannah River had not yet been impounded.

Plate No. 7

ENVIRONMENTAL GEOLOGIC ATLAS OF COASTAL GEORGIA

LAND USE AND LAND COVER

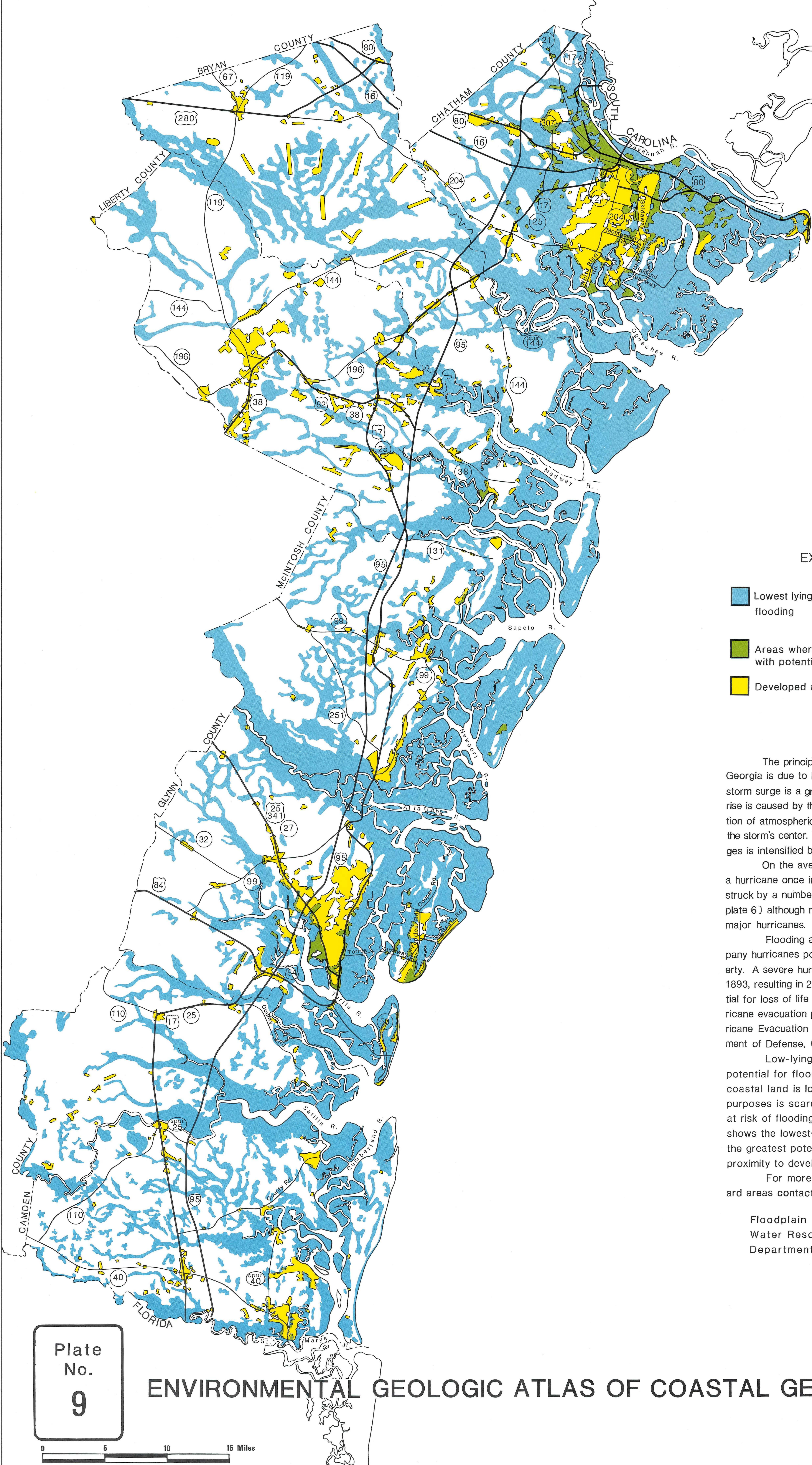
Madeleine F. Kellam

Plate No. 8

ENVIRONMENTAL GEOLOGIC ATLAS OF COASTAL GEORGIA

COASTAL FLOOD HAZARDS

Mary Lynne Pate



EXPLANATION

- Lowest lying areas at greatest risk of flooding
- Areas where development coincides with potential for flooding
- Developed areas

The principal flood hazard along the coast of Georgia is due to hurricane-induced storm surges. A storm surge is a gradual rise in ocean water level. This rise is caused by the action of wind, and by the reduction of atmospheric pressure on the water surface at the storm's center. The destructive force of these surges is intensified by wind-induced waves.

On the average, Georgia's coast experiences a hurricane once in every 10 years. Georgia has been struck by a number of hurricanes in this century (see plate 6) although none of these are considered to be major hurricanes.

Flooding and destructive winds which accompany hurricanes pose a threat to both lives and property. A severe hurricane struck the Savannah area in 1893, resulting in 2000 fatalities. To reduce the potential for loss of life in the event of a severe storm, hurricane evacuation plans have been devised (see Hurricane Evacuation Plan for Coastal Georgia, Department of Defense, Civil Defense Division, 1981).

Low-lying coastal areas have the greatest potential for flooding. Because the majority of coastal land is low, high ground for development purposes is scarce. For this reason, many areas at risk of flooding have been developed. This map shows the lowest-lying coastal areas, which have the greatest potential for flooding, and their relative proximity to developed areas.

For more detailed information on flood hazard areas contact:

Floodplain Management Coordinator,
Water Resources Branch,
Department of Natural Resources

Plate No. 9

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