NOS Oceanographic Circulation
Survey Report No. 6

Southeast Atlantic Coast Estuaries

Sapelo Sound to St. Simons Sound

Georgia Circulation Survey: 1980

January 1984
Rockville, Md.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service

NOS Oceanographic Survey Reports

This series of reports presents information on circulatory surveys by the National Ocean Service. Normal activity includes the measurements of water flow (currents), tides, temperature, salinity, and occasionally other parameters needed for understanding the physical processes. These surveys are made primarily for the Nation's navigational waterways; however, data are also obtained to describe the circulation patterns of estuaries and harbors.

These reports offer information on sampling locations, measurement techniques, processing and analysis routines, data formats, and general information on the survey area. They do not present technical interpretations of hydrodynamics of the areas.

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No. 2 Tampa Bay Circulatory Survey 1963. Demetrio A. Dinardi, August 1978, (PB 299-163).

No. 3 Puget Sound Approaches Circulatory Survey From 1973 Through 1976. Bruce B. Parker and James T. Bruce, August 1980, (PB81 113375).

No. 4 Cook Inlet Circulatory Survey: 1973-75. Richard C. Patchen, James T. Bruce, and Michael J. Connolly, June 1981, (PB81-245-235)

No. 5 New York Harbor Circulation Survey: 1980-81. David R. Browne and Gary Dingle, February 1983, (PB83-228-635).

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U.S. DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

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CONTENTS

FIGURES

TABLES

Southeast Atlantic Coast Estuaries
Sapelo Sound to St. Simons Sound
Georgia Circulation Survey

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ABSTRACT

A circulation survey of the Southeast Atlantic Coast Estuaries was conducted from March through June 1980 by the National Ocean Service. The areas studied were: Sapelo Sound, Doboy Sound, Altamaha Sound, St. Simons Sound, and their tributaries. In this report, these waterways are referred to collectively as the Georgia Estuaries. In situ measurements of currents, tides, water temperature and conductivity were collected. In addition, air pressure, air temperature, and wind speed and direction were measured. Information about these measurements and the survey in general are illustrated in charts, tables, and graphic diagrams. This report also summarizes historic data collected in the areas mentioned above prior to the 1980 survey.

1.0. INTRODUCTION

1.1. Purpose of Report

The purpose of this report is to inform potential users of the data collected during the National Ocean Service (NOS) 1980 circulation survey in the Georgia Estuaries. This report presents information on station locations, periods of occupation, instruments, sampling rate, data quality, and processing procedures. A chapter summarizing historic current and tide data collected by the NOS in the Georgia Estuaries prior to this survey is also included in this report.

1.2. Circulation Survey Description

The acquisition of data by which water movement can be described constitutes a circulation survey. This includes the measurements of currents, tides, water temperature and conductivity, wind speed and direction, barometric pressure, and air temperature. Measurements are made at selected locations and depths to obtain a three-dimensional description of circulation.

Currents are horizontal water movement caused by periodic astronomic tide-producing forces, density differences between water masses, river runoff, and changes in wind stress and atmospheric pressure. Concurrently, there is vertical water movement resulting from the astronomic tide-producing forces. This change in sea level, due to astronomic forces, is called the tide. The density structure of water masses is determined by temperature and conductivity profiles. The measurement of atmospheric parameters is necessary for the study of nontidal water movement caused by winds and changing atmospheric pressure.

The project designated OPR-G803-FE-80 includes the Southeastern Atlantic Georgia Estuaries proper. This survey occurred from March through June 1980 and covered the Sapelo Sound to St. Simons Sound entrances of Georgia.

The NOAA Ship FERREL performed the field work for this survey. The FERREL is a 133-foot Class IV vessel, with a draft of 7 feet and a cruising speed of 10 knots. Norfolk, Virginia, is the home port of the FERREL. The ship complement consists of five commissioned officers and 14 crew members. The FERREL has a 40-square-foot wet oceanographic laboratory and a 500-square-foot electronics laboratory.

Results from the analysis of current meter data collected during this survey will appear in the NOS tidal current tables; these results will serve to make navigation in the Georgia Estuaries safer. Another benefit derived from current data collected is as an aid in the prediction of oil spill and pollutant transport.

Tide data analysis results will appear in NOS tide tables; the tide data may aid in determination of marine and land boundaries. Both current and tide data are useful for coastal engineering and can serve as input for oceanographic research.

The current meter data collected can be obtained from the National Oceanographic Data Center (NODC), Page Building 1, 2001 Wisconsin Avenue, N.W., Washington, DC 20235.

1.3. Survey Area

This circulation survey report covers the Southeastern Atlantic Estuaries of Georgia. These waterways include Sapelo Sound, Doboy Sound, Altamaha Sound, St. Simons Sound, and their tributaries (figure 1). These areas will be referred to collectively as the Georgia Estuaries.

Within these Georgia Estuaries is the port of Brunswick, the second largest commercial port in the state. Other aspects in the Georgia Estuaries include: the tidal flow at Sapelo Island for salt marsh studies and a game refuge sanctuary on Blackbeard Island. This circulation survey can provide data to users concerned with the physical dynamics of the region as a tool to help safeguard its ecology.

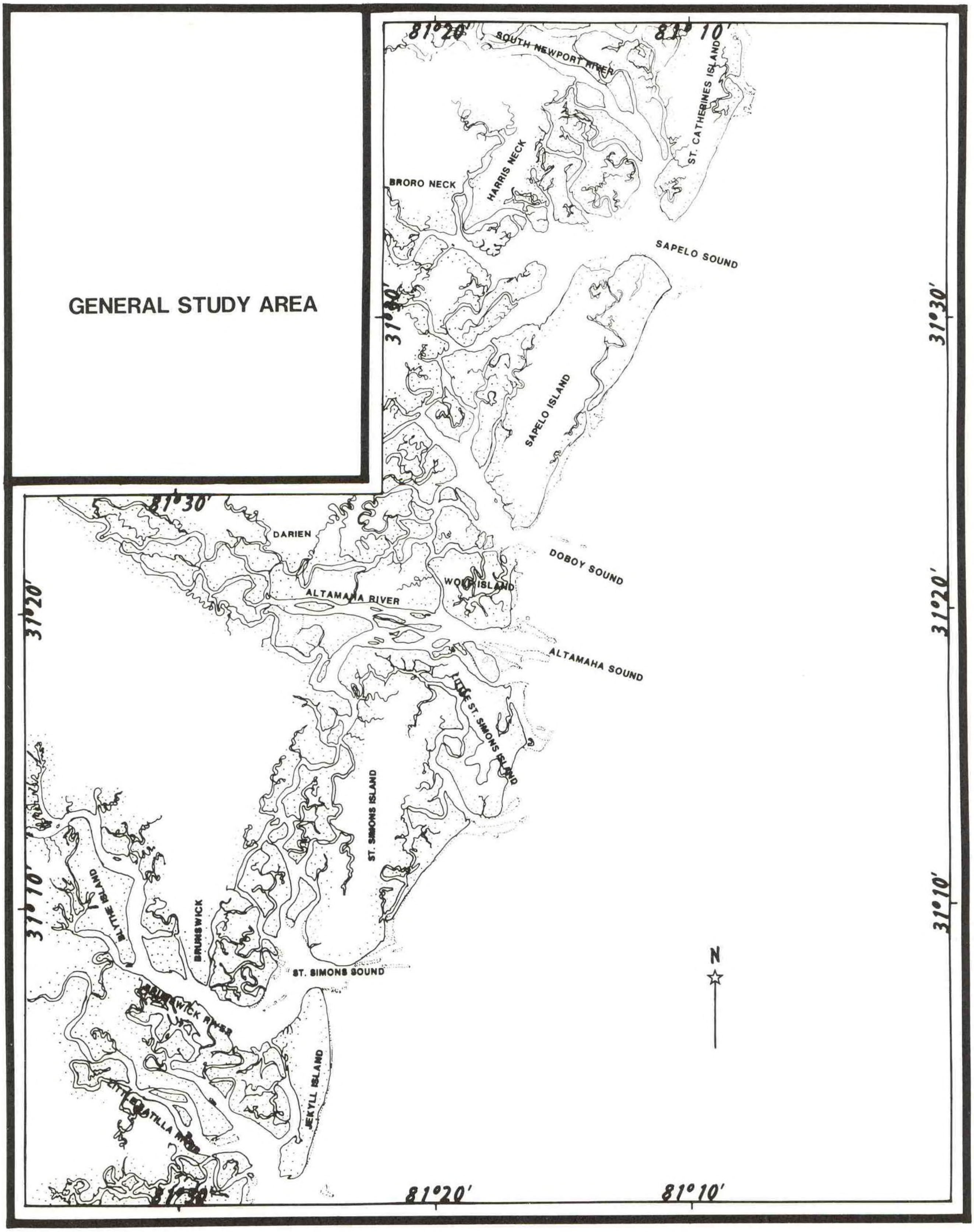

Figure 1.--General Study Area

2.0. CURRENT DATA

2.1. Current Meter Station Locations

The locations of current meter stations occupied during the 1980 survey are shown in figures 2 through 4. Information about these stations, such as latitude, longitude, data quality, etc. is given in table 2. Most stations were deployed for a minimum of 15 days with some stations deployed for 30 days or longer; however, there were three stations with less than 15 days of data. Scheduling was based on the need for simultaneous observations at certain locations. The bar chart in figure 5 depicts the actual time periods of current meter stations occupied during the survey.

2.2. Instrumentation

The Grundy Model 9021G current meter was used for this survey. This meter records data on a 3-inch diameter, ¼-inch wide magnetic tape in a 10-bit binary code. Information such as meter serial number, current direction, current speed, water temperature and conductivity, sample count or time in hours and minutes are recorded. See figures 6 and 7.

The speed sensor is a Roberts-type rotor and the meter is oriented toward the current by a large tail fin. Speed is measured by counting the revolutions of the rotor averaged over a 10-minute sampling period. Current direction is measured with a gimballed compass and recorded at the end of the 10-minute sampling period. Temperature is measured with a platinum-resistance thermometer directly exposed to the water. Conductivity is measured through changes in the mutual inductance of a transformer. The depth sensor is a bulk silicon bridge transducer with temperature compensation. A crystal oscillator ensures the time accuracy of sampling interval and tape motor speed throughout the deployment.

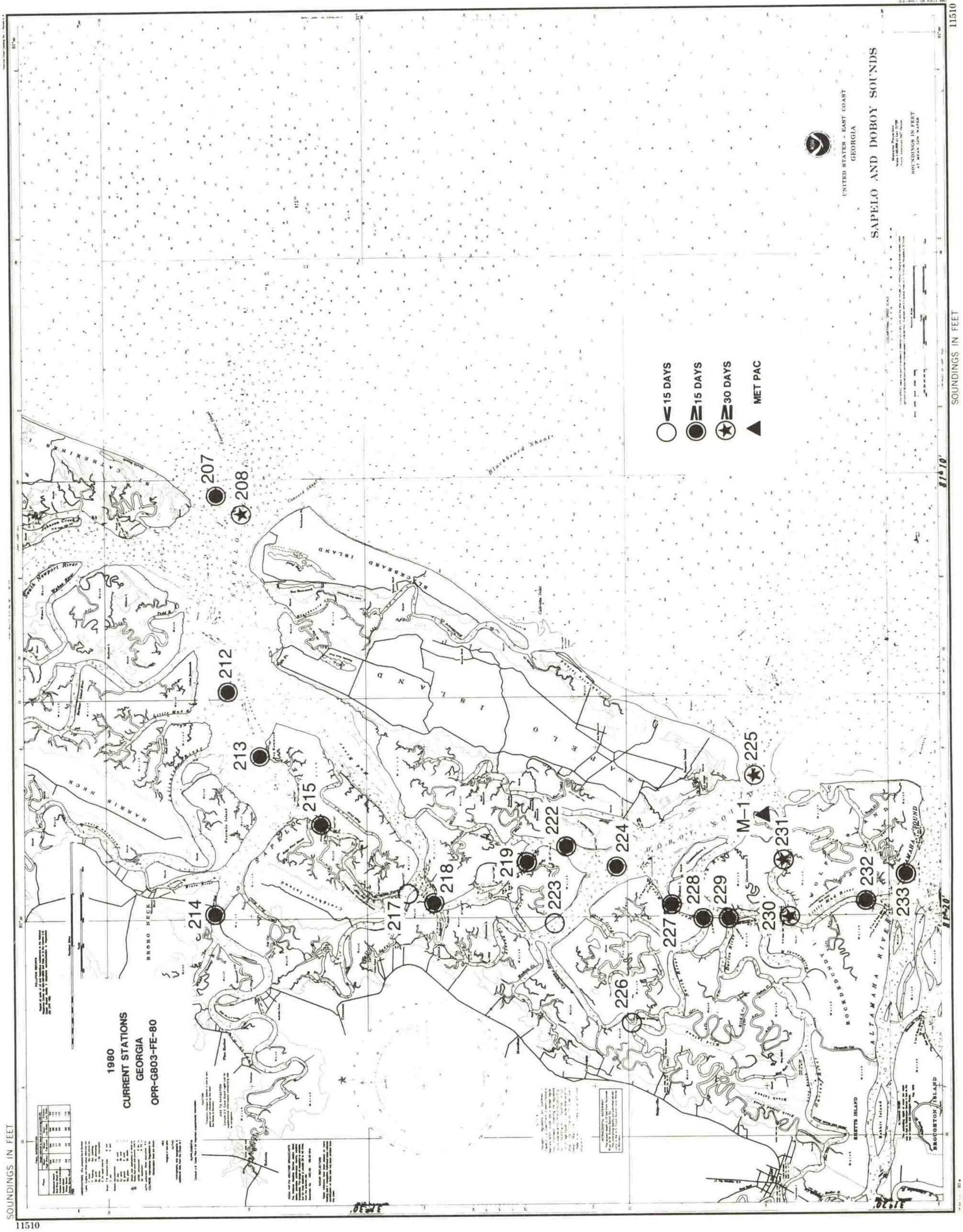

Figure 2.--1980 Current Meter Stations

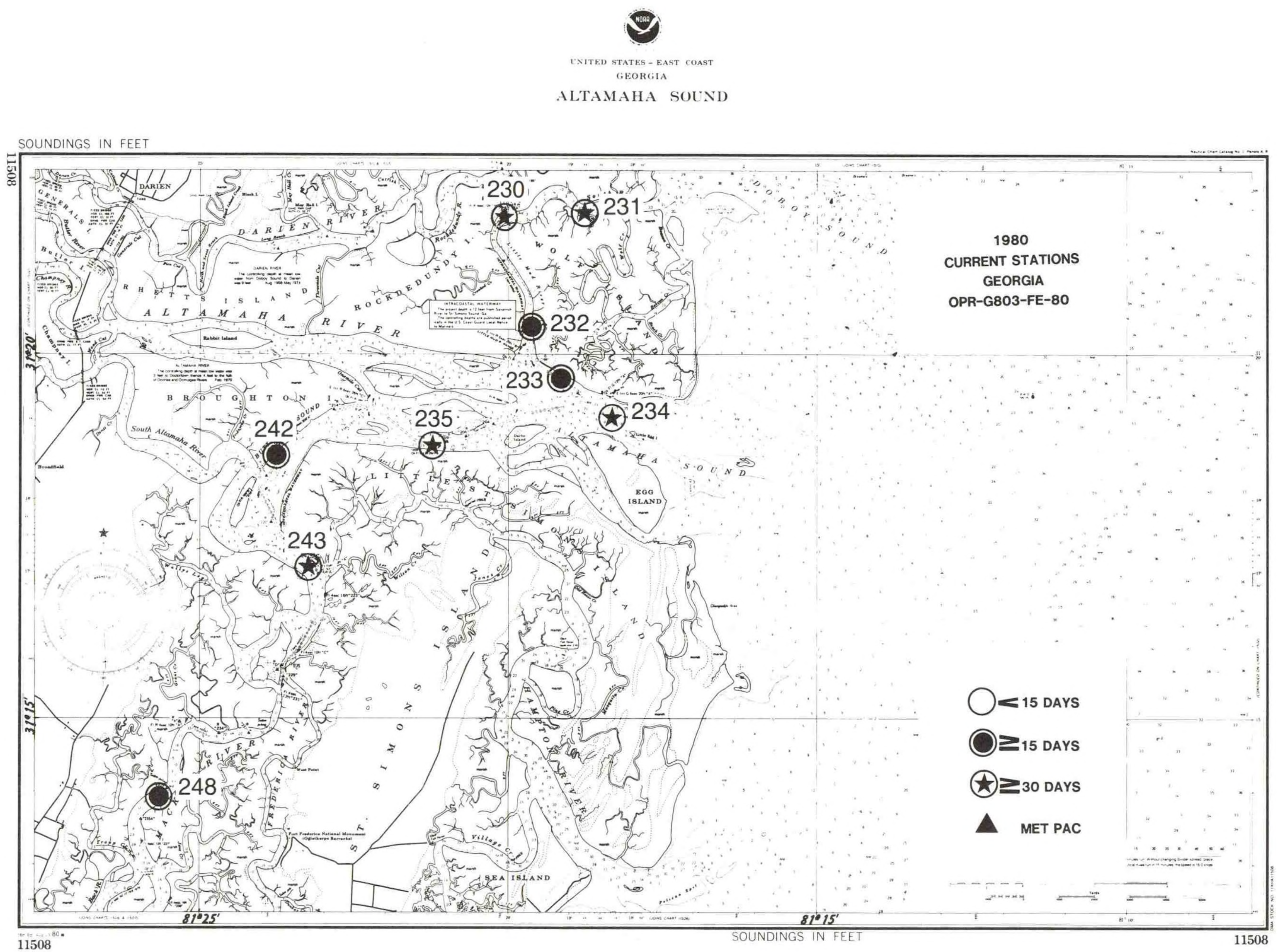

Figure 3.--1980 Current Meter Stations

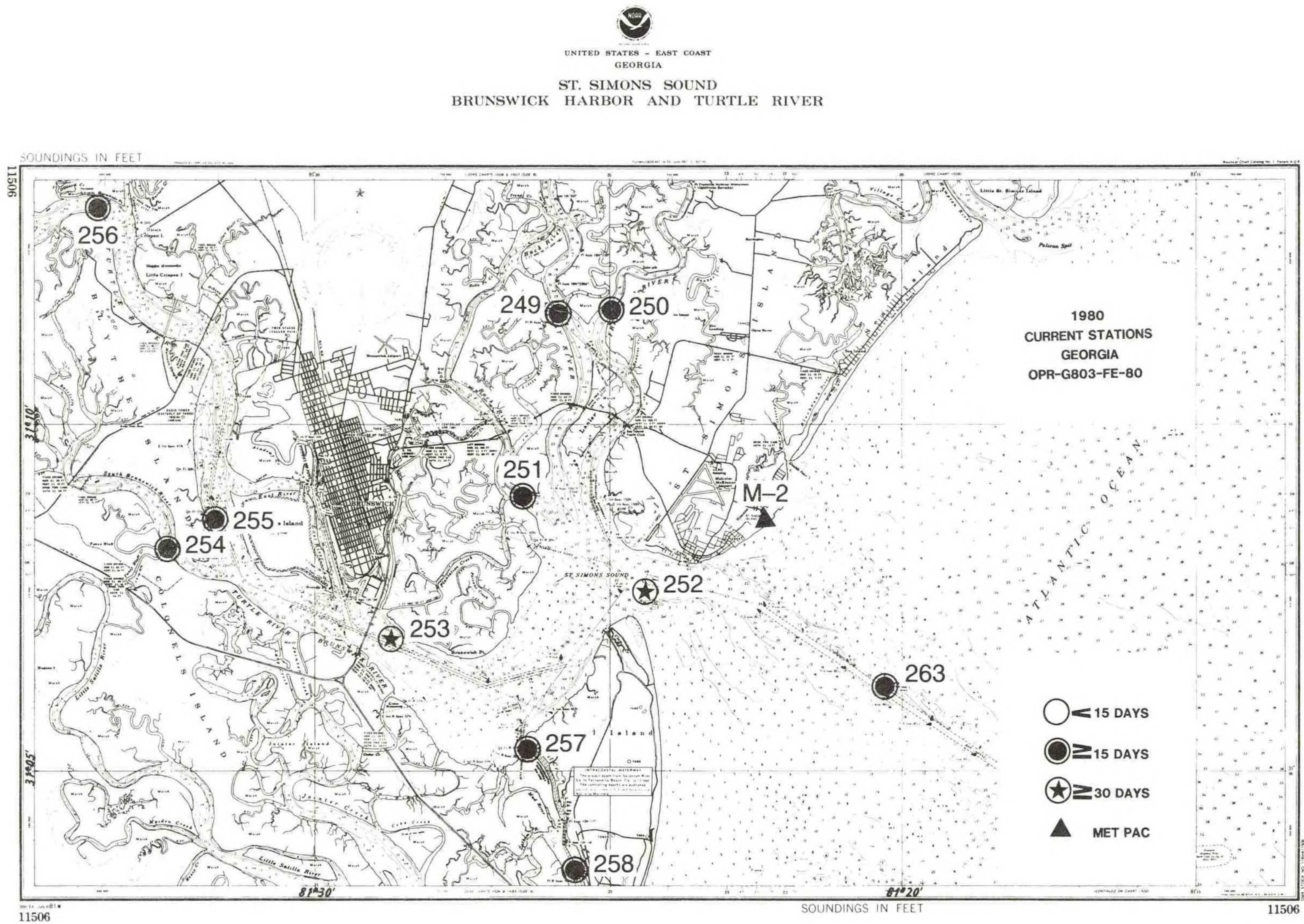

Figure 4.--1980 Current Meter Stations

Table 1. - Key to 1980 Current Meter Data Tables

*1. Number indicates depth below surface in feet at mean low water.

*2. Days of Data are days of useable data.

*3. S = Speed Sensor (rotor)

D = Direction Sensor (vane)

T = Temperature Sensor

C = Conductivity Sensor

P = Pressure Sensor

*4. Proc. Comp. = Processing Completed

*5. T.CH. = Data Time Checks
(Number indicates missing (-) or extra (+) data intervals.)

Table 2.--Georgia Estuaries Current Meter Data for 1980

STA.	LATITUDE (N)	LONGITUDE (W)	DEPTH OF WATER (FT)	DEPTH*1 OF METER (FT)	DATES OF OBSERVATION	DAYS*2 OF DATA	SENSORS*3 IN OPERATION S	D	T	C	P	PROC.*4 COMP.	T.CH.*5
207	31°32.8'	81°10.4'	21	8.5	03/27-04/16/80	20	x	x	x	x			x
208	31°32.5'	81°11.1'	41	28.5	04/03-04/16/80	0	Meter Malfunction						
				20.3	03/25-04/16/80	22	x	x	x	x			x
				10.5	03/25-04/16/80		x	x	x	x		x	+1
208	31°32.4'	81°14.8'	39	28.5	04/18-05/02/80	14	x	x	x	x	x		x
				20.3	04/16-05/02/80	16	x	x	x	x	x	x	x
				10.5	04/17-05/02/80	15	x	x	x	x	x	x	No
212	31°32.7	81°14.8'	38	26.6	03/27-04/18/80	22	x	x	x	x		x	x
				18.4	03/27-04/18/80		x	x	x	x			x
213	31°32.1'	81°16.3'	29	18.4	03/27-04/18/80	22	x	x	x	x		x	x
				10.2	03/27-04/18/80	0	Meter Malfunction						
214	31°32.9'	81°20.0'	24	12.5	03/27-04/18/80	22	x	x	x	x		x	x
215	31°30.8'	81°17.9'	21	8.5	03/28-04/17/80	20	x		x	x		x	x
217	31°29.2'	81°18.4'	15	4.6	04/17-05/01/80	14	x	x	x	x	x	x	x
218	31°28.7'	81°19.7'	21	8.5	03/28-04/17/80	20	x	x	x	x		x	x
219	31°26.9'	81°18.8'	15	4.6	04/17-05/02/80	15	x		x	x		x	-240
222	31°26.2'	81°18.5'	21	8.5	04/16-05/01/80	15	x	x	x	x	x	x	x
223	31°26.5'	81°20.2'	14	4.6	04/18-04/30/80	12	x	x	x	x		x	x
224	31°25.2'	81°18.9'	23	8.5	04/15-05/02/80	17	x	x	x	x		x	x
225	31°20.5'	81°15.8'	37	23.1	03/28-04/17/80	20	x	x	x	x		x	x
				15.1	03/28-04/17/80		x	x	x	x		x	x
225	31°22.5'	81°16.8'	35	23.1	04/17-05/03/80	16	x	x	x	x		x	x
				15.1	04/17-05/03/80		x		x	x		x	x
				23.1	05/03-05/16/80	13	x	x	x	x		x	x
				15.1	05/03-05/16/80		x	x	x	x		x	x
226	31°24.9'	81°22.5'	21	8.5	04/18-05/01/80	13	x	x	x	x	x	x	x
227	31°24.2'	81°19.7'	27	15.4	04/15-04/30/80	15	x	x	x	x	x	x	x
				7.2	04/15-04/30/80		x	x	x	x	x	x	x
228	31°23.5'	81°22.0'	17	4.6	04/15-04/30/80	15	x	x	x	x	x	x	x

Table 2.--Continued

STA.	LATITUDE (N)	LONGITUDE (W)	DEPTH OF WATER (FT)	DEPTH*1 OF METER (FT)	DATES OF OBSERVATION	DAYS*2 OF DATA	SENSORS*3 IN OPERATION S	D	T	C	P	PROC.*4 COMP.	T.CH.*5
229	31°23.0'	81°20.1'	13	4.6	04/15-05/02/80	17	x	x	x	x	x	x	x
230	31°21.9'	81°20.1'	14	4.6	04/15-05/03/80	18	x	x	x	x		x	x
				4.0	05/03-05/16/80	13	x	x	x	x	x	x	-40
231	31°22.0'	81°18.7'	25	12.5	04/19-05/03/80	14	x	x	x	x		x	x
				5.0	04/19-05/03/80		x	x	x	x	x	x	x
			24	5.0	05/03-05/16/80	13	x	x	x	x		x	x
				12.5	05/03-05/16/80		x	x	x	x	x	x	x
232	31°20.4'	81°19.7'	12	4.0	05/01-05/16/80	15		x	x	x		x	x
233	31°19.6'	81°19.1'	12	4.0	05/01-05/16/80	15	x	x	x	x	x	x	x
234	31°19.1'	81°18.3'	15	4.0	05/16-06/10/80	25	x	x	x	x		x	-876
					06/17-06/25/80	8	x	x	x	x		x	x
235	31°18.7'	81°21.2'	24	13.5	04/30-05/16/80	16	x	x	x	x	x	x	x
					05/15-06/10/80	26	x	x	x	x	x	x	x
242	31°18.6'	81°24.8'	12	4.0	04/30-05/16/80	16	x	x	x	x	x	x	x
243	31°17.1'	81°23.2'	12	4.0	04/30-05/16/80	16	x	x	x	x		x	x
				4.0	05/16-06/10/80	25	x	x	x	x		x	x
248	31°15.9'	81°25.5'	18	4.0	05/14-06/10/80	27	x	x	x	x		x	x
249	31°11.5'	81°25.8'	22	9.5	05/13-06/10/80	28	x	x	x	x		x	x
250	31°11.5'	81°25.1'	17	4.0	05/14-06/10/80	27	x	x	x	x	x	x	x
251	31°08.9'	81°26.5'	28	18.1	06/02-06/27/80	25	x	x	x	x	x	x	x
				10.2	06/03-06/27/80	24	x	x	x	x	x	x	x
252	31°07.6'	81°24.3'	39	20.0	04/29-05/15/80	16	x	x	x	x		x	x
				28.5	05/13-06/10/80	28	x	x	x	x		x	x
				20.3	05/13-06/10/80		x	x	x	x		x	x
				28.5	06/03-06/27/80	24	x	x	x	x		x	-1
				10.5	06/03-06/27/80		x	x	x	x		x	x
253	31°06.9'	81°28.6'	29	16.4	05/17-06/11/80	25	x	x	x	x		x	x
				8.2	05/14-06/11/80	28	x	x	x	x	x	x	x
				16.4	06/02-06/27/80	25	x	x	x	x	x	x	x
				8.2	06/03-06/27/80	24	x	x	x	x	x	x	x

Table 2.--Continued

STA.	LATITUDE (N)	LONGITUDE (W)	DEPTH OF WATER (FT)	DEPTH*1 OF METER (FT)	DATES OF OBSERVATION	DAYS*2 OF DATA	SENSORS*3 IN OPERATION S	D	T	C	P	PROC.*4 COMP.	T.CH.*5
254	31°08.3'	81°32.5'	20	8.5	06/02-06/28/80	26	x		x	x	x	x	x
255	31°08.6'	81°31.6'	30	18.4	06/03-06/28/80	25	x		x	x		x	x
				10.2	06/03-06/27/80	24	x	x	x	x		x	x
257	31°05.3'	81°26.4'	19	4.0	06/11-06/18/80	7	x	x	x	x		x	x
	31°05.3'	81°26.4'	19	4.0	06/18-06/28/80	10	x	x	x	x		x	x
258	31°03.5'	81°25.6'	11	4.0	06/11-06/27/80	16	x	x	x	x		x	x
263	31°06.3'	81°20.3'	30	18.4	06/02-06/27/80	25	x	x	x	x	x	x	-30
				10.2	06/03-06/27/80	24	x	x	x	x		x	-60

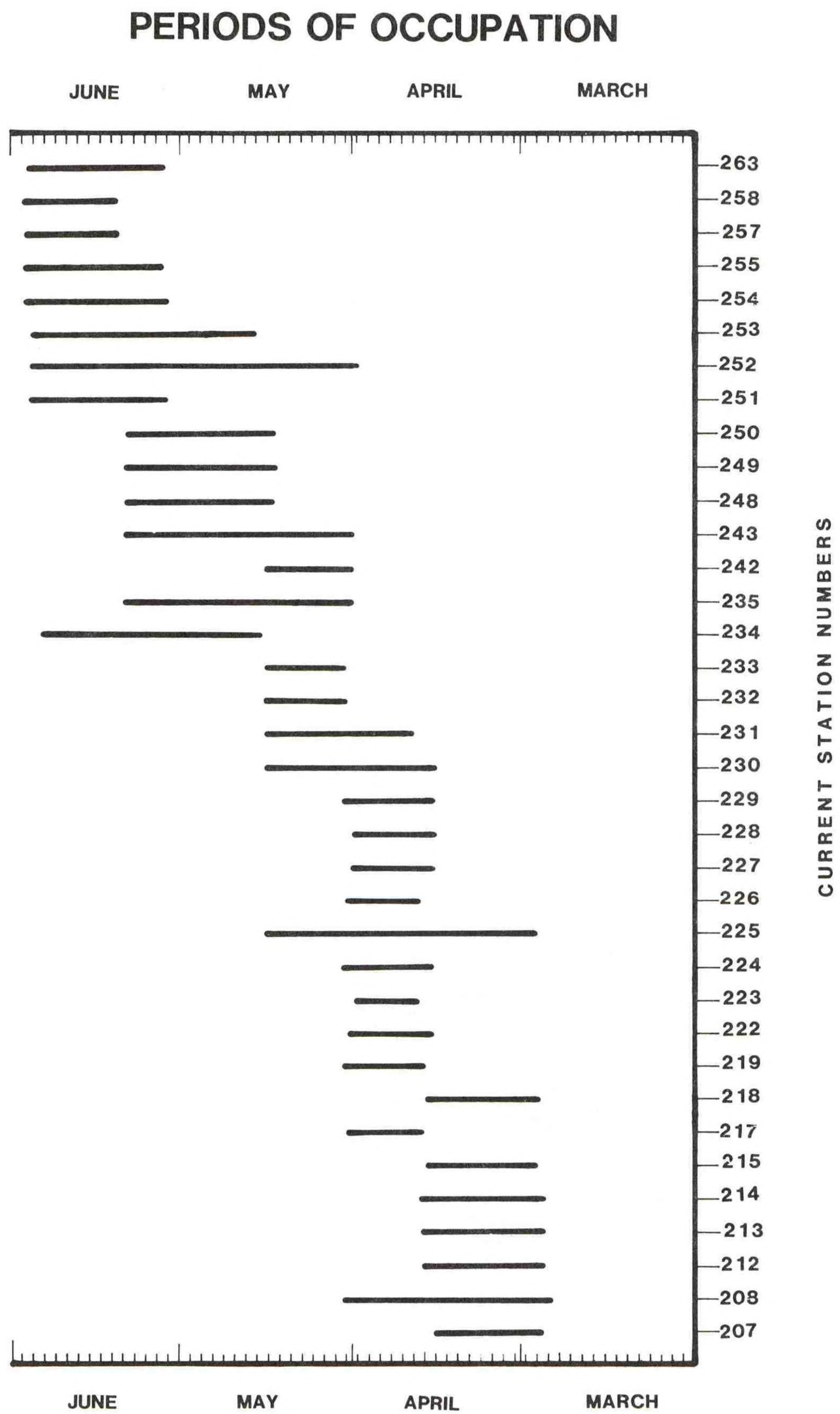

Figure 5.--Current Meter Periods of Validated Data

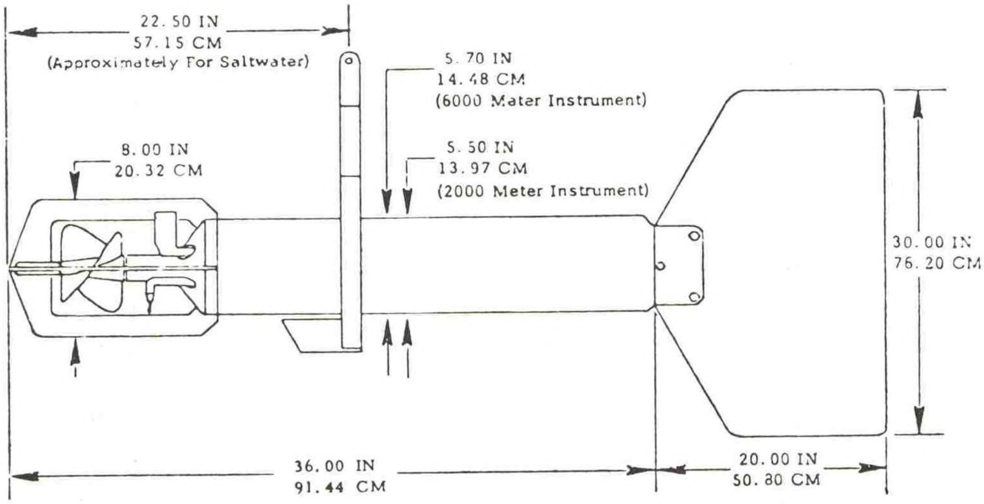

Figure 6.--*Grundy 9021 G Current Meter Dimensions*

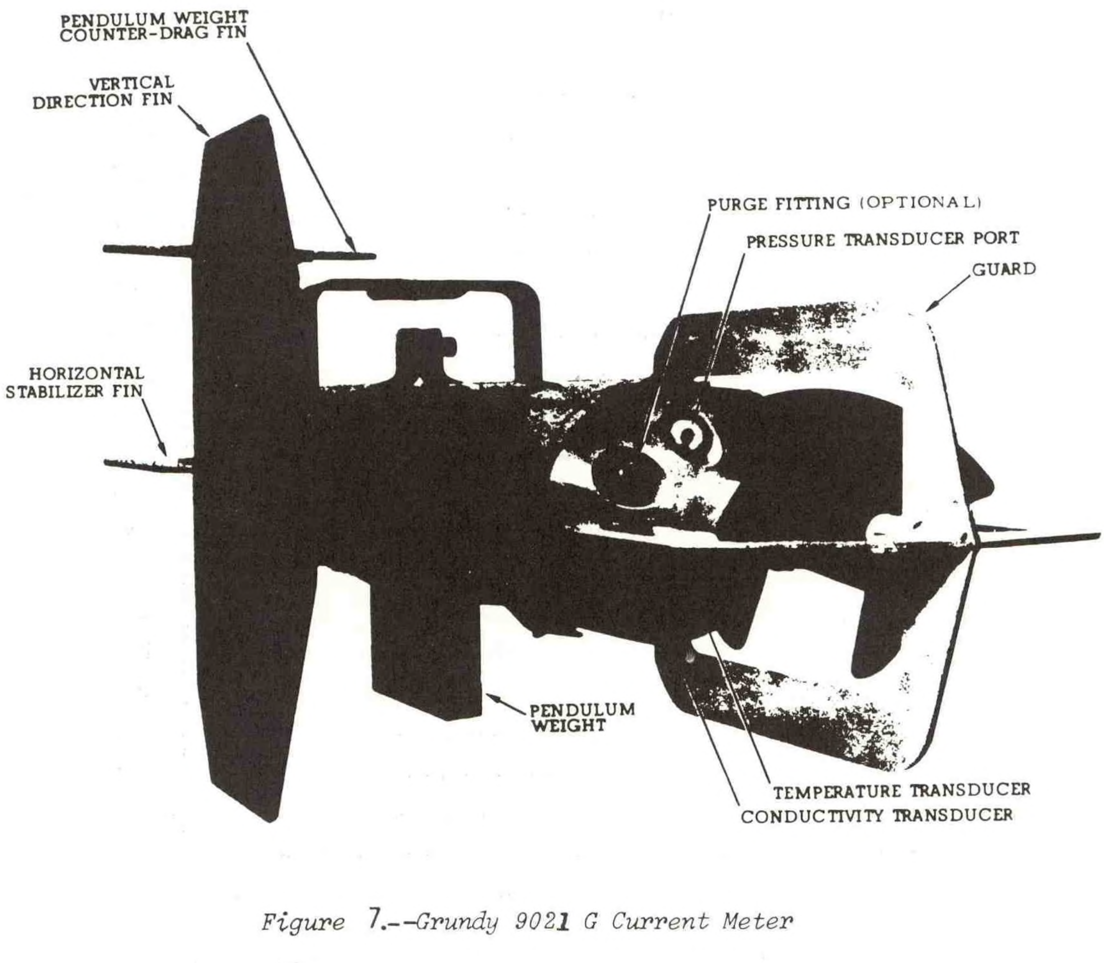

Figure 7.--*Grundy 9021 G Current Meter*

The meter uses a 12V DC battery for power supply. An acoustic telemetry output allows remote monitoring of performance.

Estimates of measurement uncertainties for current meters used in this survey can be found in the Engineering Support Office technical report TE3-81-008, "Uncertainty Estimates for Oceanographic and Meteorological Measurements - Tide and Tidal Current Survey - Sapelo Sound to Saint Andrews Sound, Georgia, March - June 1980," published April 1981. Copies can be obtained by sending a request to Director, NODC, Page Building 1, E/OC, 2001 Wisconsin Avenue, N.W., Washington, D. C. 20235. Appendix A contains a summary of the Total Measurement Uncertainties (TMU) associated with the data from the 1980 Georgia Estuaries.

The taut-wire mooring system shown in figure 8 was designed to hold from one to three current meters. The meters are attached to stand-offs and situated on the main cable such that the surface meter is 15 feet below the surface and the bottom meter is 5 feet above the bottom.

2.3. Data Translation and Analysis

A Grundy Model 8321 tape translator was used onboard ship to transcribe 3-inch current meter tapes onto a nine-track computer compatible tape. After receiving the tapes and respective station logs at NOS in Rockville, a two-phase processing scheme was carried out on the data using software written for the UNIVAC 1100 computer. During this procedure, Grundy instrument units are converted into engineering units. Corrected times are applied when needed in time-checking data, and statistical editing is carried out to eliminate erroneous data values due to mechanical or electronic meter malfunctions.

The data from this survey are harmonically analyzed with a 15-day or 29-day Fourier harmonic analyses. The results can be used to describe the variability of the predominant tidal constituents in the Georgia Estuaries. Nonharmonic comparison analyses are carried out on these data for relating the survey stations (data less than 1 year) to a longer reference station. Finally, spectral analyses are performed on these data to show variation and causes of nontidal components.

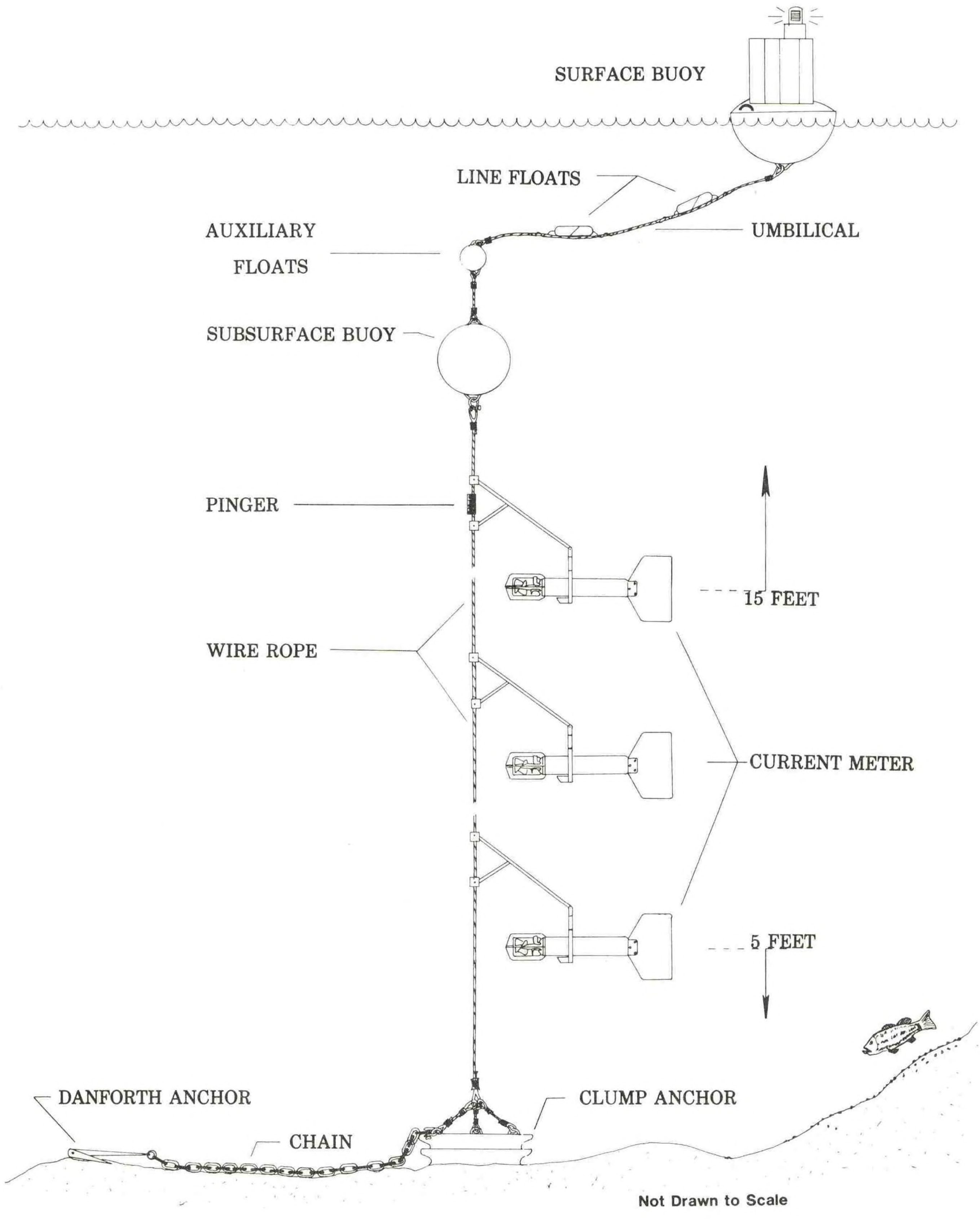

Figure 8.--Current Meter Taut-Wire Mooring System

The data are sent to NODC; there the data are archived and disseminated upon request. Results of analysis of the data collected will be used to update the "Tidal Current Tables, Atlantic Coast of North America," beginning with the 1985 edition.

3.0. CONDUCTIVITY AND TEMPERATURE DATA

3.1. CTD Stations

A Grundy Model 9400 conductivity, temperature, versus depth (CTD) unit provided time-series observations at two station sites and along a transect (see figures 9 and 10). Refer to table 3 to obtain CTD measurements. Note, relevant information regarding long-period measurements are labeled "TS" and transect measurements are labeled "ST."

Casts were taken at half-hour intervals over periods of 11 hours and 13.5 hours at two time-series stations. These stations show how the water density structure changed throughout a tidal cycle. The stations forming the transect were taken to determine the longitudinal variation in density structure; the stations were done as quickly as possible to minimize the temporal effect.

3.2. Instrumentation

The Grundy Model 9400 CTD unit is equipped with a platinum-resistance thermometer that senses temperature, an inductive transformer that senses conductivity, and a bonded strain gage for sensing pressure. The Grundy 8428 data logger processes analog signals which are then recorded on nine-track magnetic tape by a Kennedy 9832 tape recorder. In processing the data, salinity was derived from the temperature and conductivity data. Density was computed in the form of sigma-t, from the averaged salinity and temperature values. These computations are found in the "Unesco Technical Papers in Marine Science," Ninth Report of the Joint Panel on Oceanographic Tables and Standards, No. 30, 1978. In addition, some Niskin bottle water samples were collected at depths where the CTD indicated constant values of salinity and temperature. These samples were used to compare with CTD profile data.

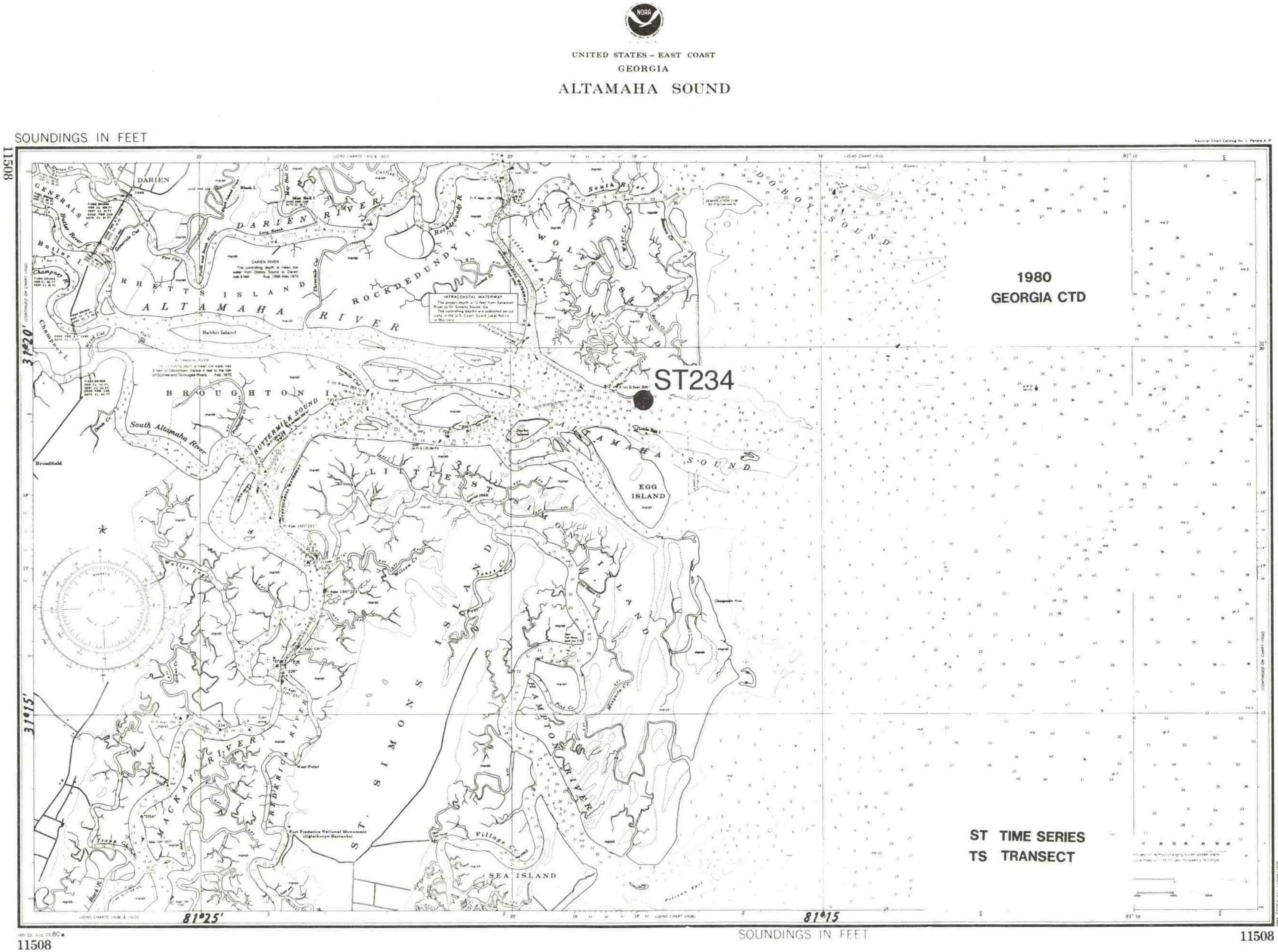

Figure 9.--CTD Cast Locations Taken During 1980 Survey

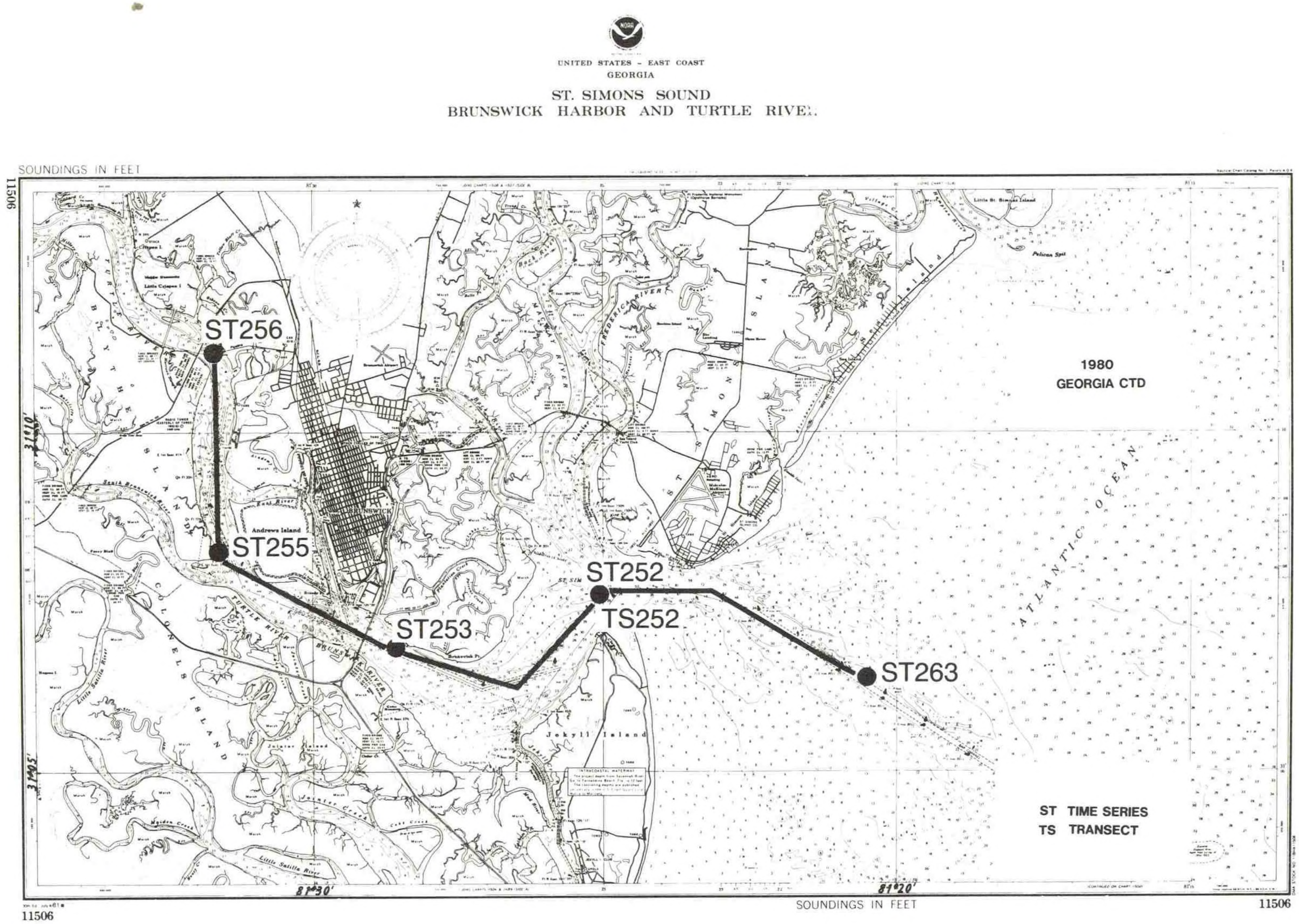

Figure 10.--CTD Cast Locations Taken During 1980 Survey

Table 3.--CTD Time Series and Transect Measurements Conducted During the 1980 Georgia Circulation Survey

STATION	LAT. (N)	LONG. (W)	*DATE	TIME (GMT)	APPROX. WATER DEPTH (M)	BOTTOM DATA DEPTH (M)
TS234	31°19.2'	81°18.4'	F05/16/80 L05/17/80	2130 0200	61	5.1 (MIN) 8.8 (MAX)
TS 252	31°07.6'	81°25.5'	F05/16/80 L05/16/80	0700 1100	125	10.6 (MIN) 14.8 (MAX)
ST263	31°06.2'	81°20.3'	06/12/80	1305	91	7.9
ST252	31°07.6'	81°24.4'	06/12/80	1738	122	11.9
ST253	31°06.8'	81°28.7'	06/12/80	1810	91	8.8
ST255	31°08.6'	81°31.7'	06/12/80	1846	91	9.5
ST256	31°11.2'	81°31.8'	06/12/80	1907	92	7.4

* F refers to first cast of a time series.
L refers to last cast of a time series.

4.0. TIDE DATA

4.1. Tide Stations

Locations for tide gages occupied during the 1980 Georgia Estuaries project are shown in figures 11 through 13. Relevant information about each tide station is given in table 4. All stations were occupied for at least 30 days and one station (867-7344) was in operation for 1 year. Short period (30-day) tide stations were installed concurrently with nearby current stations.

The NOAA Ship FERREL and its crew installed the tide gages. A reconnaissance of the proposed sites was accomplished before tide gages were installed; this helped to determine the availability of structures for gages, water depth, recovery of old bench marks, and possible sites for new bench marks. During installation, differential levels were run from the tide staff to established bench marks and, whenever possible, to the National Geodetic Vertical Control Network.

4.2. Instrumentation, Processing, and Analysis

The analog-digital-recorder (ADR) tide gage was the only type used in this project. Refer to table 5 for gage specifications.

The ADR gage records samples every 6 minutes on foil-backed paper tape, which is processed using a mechanical translator and a computer. The general processing steps are: (1) putting the 6-minute sample onto computer compatible magnetic tape; (2) deriving hourly values (selecting the nearest 6-minute value to the hour), and storing the values on cards and tape in tabulated form; and, (3) tabulating high and low water, various tidal data (e.g., mean high water, mean low water, and mean sea level), and other relevant parameters.

Tide stations are analyzed using: (1) 29-day Fourier harmonic analyses; (2) least-squares harmonic analyses (for 1-year series); (3) nonharmonic comparison analyses relating a short-period station (less than 1 year) to a

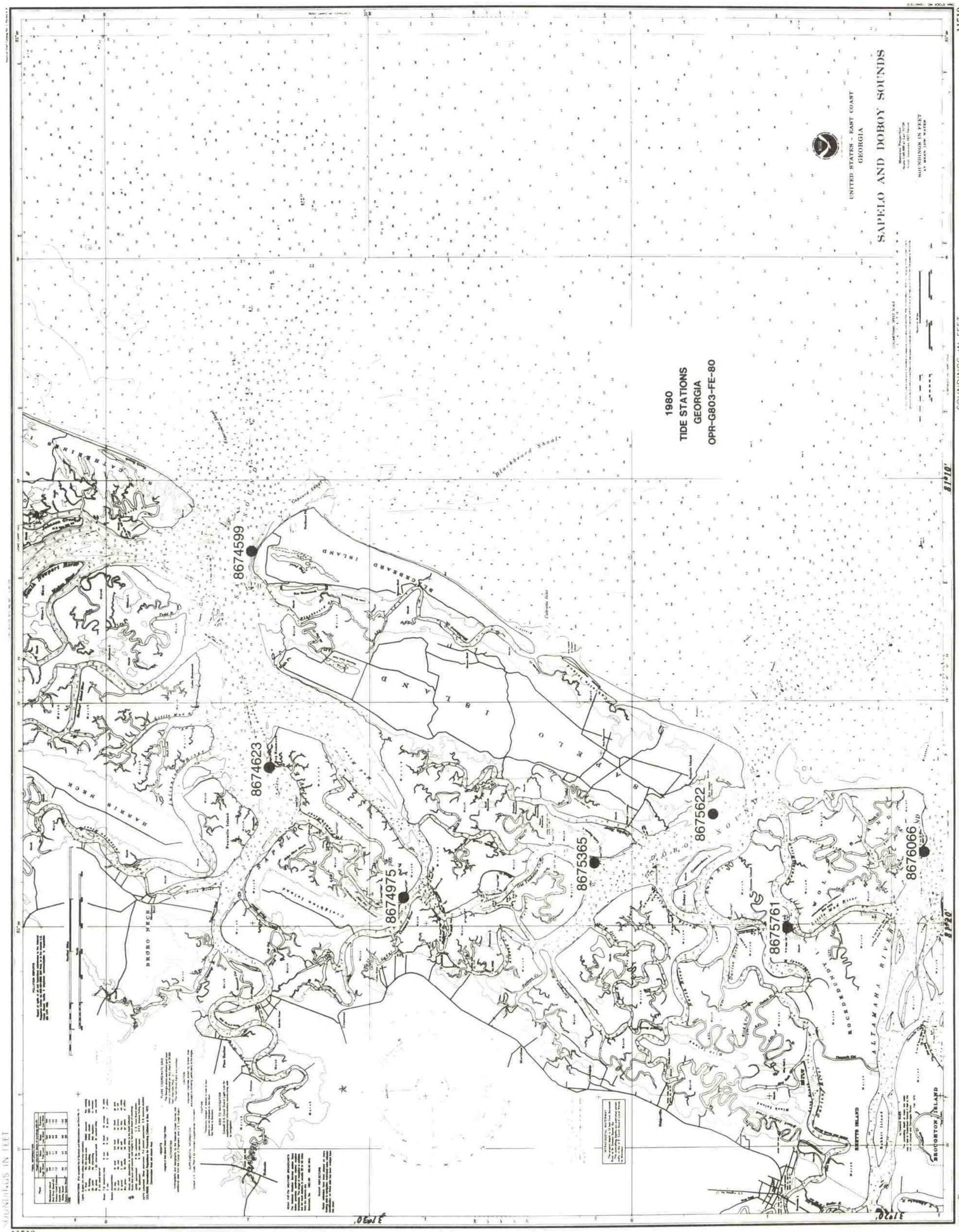

Figure 11.--Tide Gage Stations Installed During 1980 Survey

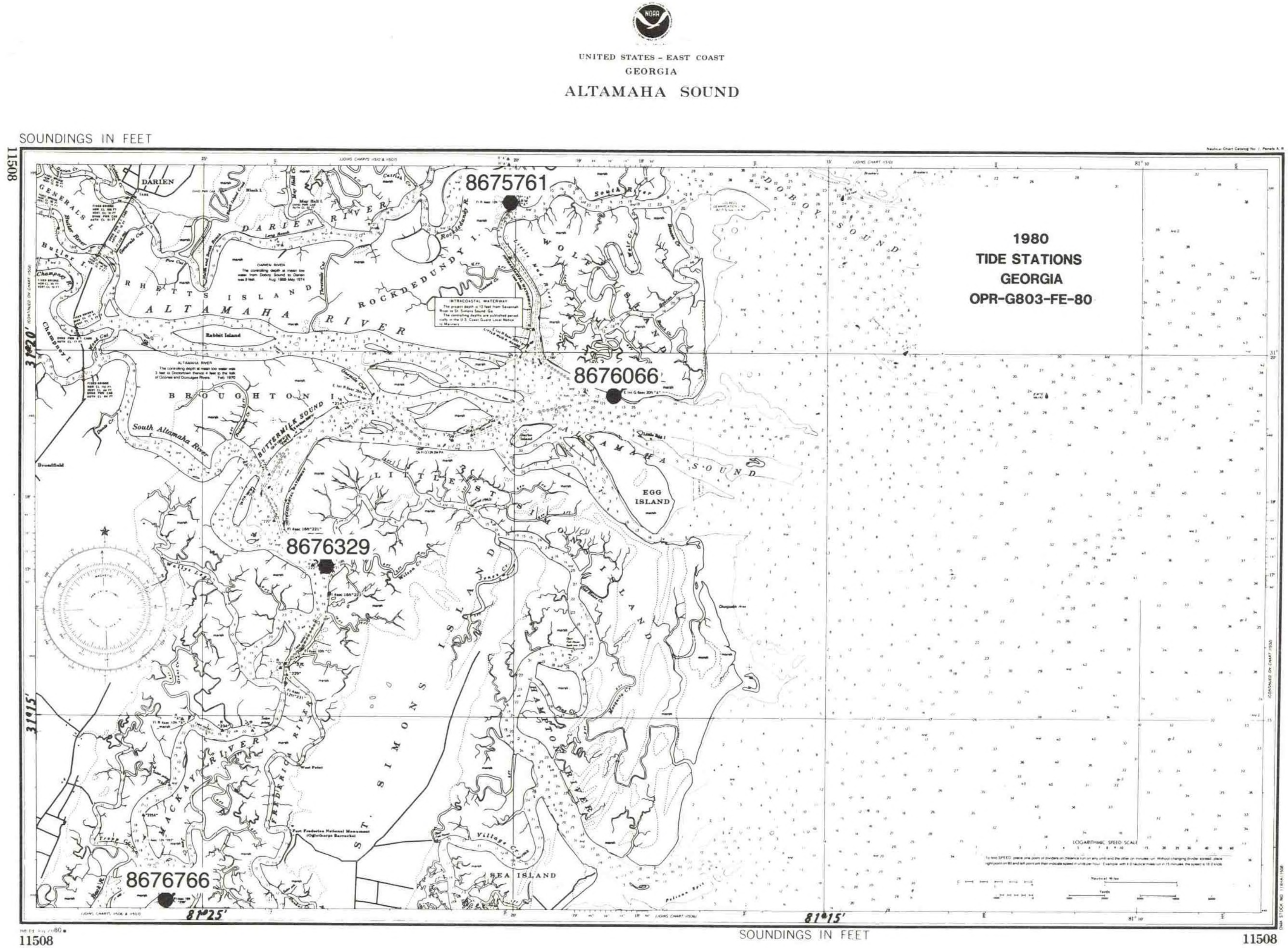

Figure 12.--Tide Gage Stations Installed During 1980 Survey

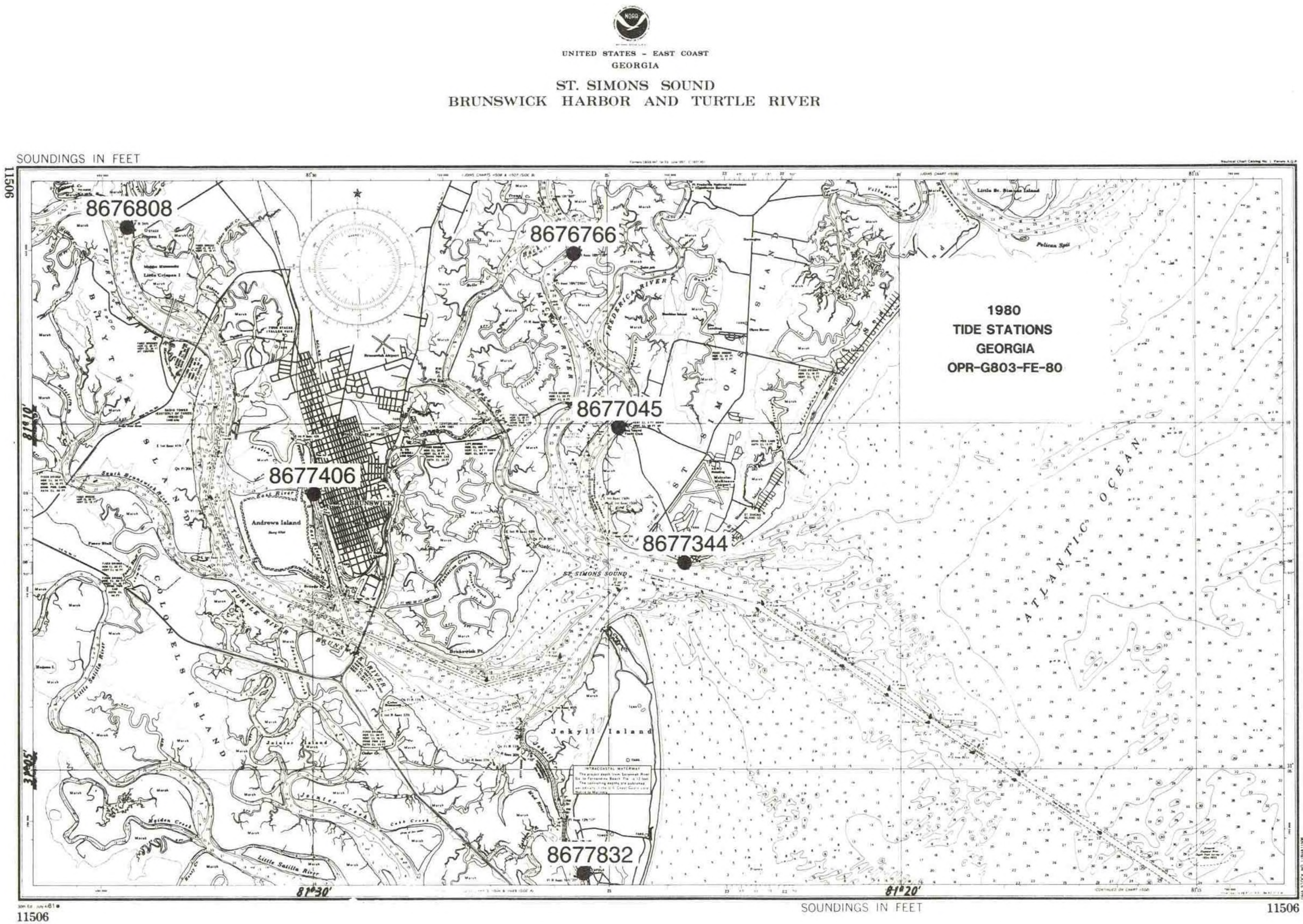

Figure 13.--Tide Gage Stations Installed During 1980 Survey

Table 4.--Tide Stations Occupied During the 1980 Survey

STATION NO	STATION	LAT(N)	LONG(W)	DATES OF OBSERVATION
8674599	N. Blackbeard Island, GA	31°32.2'	81°11.6'	03/25/80-04/30/80
8674623	Dog Hammock, GA	31°31.9'	81°16.2'	03/14/80-04/29/80
8674975	Head of Mud River, GA	31°29.2'	81°19.2'	03/15/80-04/28/80
8675365	Little Sapelo Island, GA	31°25.9'	81°18.4'	03/31/80-05/19/80
8675622	Sapelo Island, Old Tower	31°23.4'	81°17.3'	03/18/80-05/21/80
8675761	South and Little Mud River, GA	31°22.4'	81°20.1'	04/09/80-05/20/80
8676066	Wolf Island, GA	31°19.3'	81°18.5'	05/20/80-06/24/80
8676329	Wilson Creek, GA	31°17.1'	81°23.1'	04/24/80-06/06/80
8676766	MacKay River, GA	31°12.6'	81°25.5'	05/16/80-06/19/80
8676808	Crispin Island, Turtle River	31°12.8'	81°33.0'	05/22/80-06/25/80
8677045	Frederica River, GA	31°10.1'	81°24.8'	05/08/80-06/23/80
8677344	St. Simons Lighthouse, GA	31°07.9'	81°23.8'	04/21/80-04/21/81

Table 4.--Continued

STATION NO	STATION	LAT(N)	LONG(W)	DATES OF OBSERVATION
8677406	East River, GA	31°07.1'	81°29.1'	05/13/80-06/27/80
8677832	Jekyll Island Club, GA	31°03.5'	81°25.4'	05/23/80-06/27/80

Table 5.--Tide Gage Specifications

<u>ADR (Analog - Digital Recorder)</u>

Manufacturer: Fischer-Porter

Range: 0-99.99 feet

Precision: ± 1/2 binary count

Recorder: Foil-backed paper tape (punch)

Record Format: Binary - decimal code

Sampling Rate: 6-minute intervals

Duration: Chart - 3 months

Chart drive, battery - 3 months

Processing: Mechanical translator

Mode of Operation: Float movement is translated into binary code and recorded on paper tape.

longer period control station; (4) various filtering and spectral techniques; and (5) FR 80 microfilm plotting. The harmonic constants will be used to make predictions for table 1 of the "Tide Tables, High and Low Water Predictions, East Coast of North and South America Including Greenland." Results from items (1), (2), and (3) will be used in table 2 of this same publication.

5.0. HISTORICAL DATA

5.1. Introduction

NOS, formerly known as the U.S. Coast and Geodetic Survey, was established in 1807. During its existence, a large amount of current and tide data were collected throughout the United States. NOS's historical current data in the Georgia Estuaries dates back to the 1830's. The historical tide data collected from these waters dates back to the start of the 1800's.

5.2. Current Data

Little current data were collected between 1834 and the early 1900's. The most recent circulation study in the Georgia Estuaries prior to this survey was carried out in 1934. A summary of current data collected in this area by NOS is given in table 6. The method for collecting current data was by surface current pole or Price current meters. Information concerning these early methods of current measurements is in the "Manual of Current Observations," U.S. Coast and Geodetic Survey, S.P. 215, 1950. Predictions and mean values for some of these historical current stations are found in the "Tidal Current Tables, Atlantic Coast of North America," published by NOS.

Figures 14 through 16 show an improvement in the 1980 Georgia survey over the two previous circulation studies within these estuaries. First, there is a threefold increase in station sites; second, there is an increase in duration of observations for each meter; and third, the present method of measurement is an improvement in accuracy over the old current pole.

Table 6.--NOS Historical Current Data

COMMANDING OFFICER	LOCATION	NUMBER OF STATIONS	DATES OBSERVED	DURATION (DAYS)	METHOD OF OBSERVATION
E. F. Hicks	St. Simons Sound Entrance	1	March 13-15, 1934	2	Pole/Meter
E. F. Hicks	Brunswick River, Quarantine Dock, St. Simons Sound	1	March 15-17, 1934	2	Pole/Meter
E. F. Hicks	Brunswick, Prince Street Dock, St. Simons Sound	1	March 13-15, 1934	2	Pole/Meter
E. F. Hicks	Turtle River, Off Allied Chemical Corp. Dock, St. Simons Sound	1	March 15-17, 1934	2	Pole/Meter
E. F. Hicks	MacKay River, North Troup Cr. Entrance, St. Simon Sound	1	March 15-17, 1934	2	Pole/Meter
E. F. Hicks	Onemile Cut, S.E. of Altamaha Sound	1	March 19-21, 1934	2	Pole/Meter
E. F. Hicks	Duplin River Entrance, Doboy Sound	1	March 19-21, 1934	2	Pole/Meter
E. F. Hicks	Mud River, N.E. New Teakettle Cr., Sapelo Sound	1	March 19-21, 1934	2	Pole/Meter

Table 6.--Continued

COMMANDING OFFICER	LOCATION	NUMBER OF STATIONS	DATES OBSERVED	DURATION (DAYS)	METHOD OF OBSERVATION
E. F. Hicks	Sapelo Sound Entrance, GA	1	March 21-23, 1934	2	Pole/Meter
E. F. Hicks	Johnson Creek, Midway of Sapelo Sound	1	March 21-23, 1934	2	Pole/Meter
L. A. Potter	Doboy Sound Entrance, GA	1	1919	2	Pole/Meter
L. A. Potter	Doboy Sound Bar, GA	1	1919	2	Pole/Meter

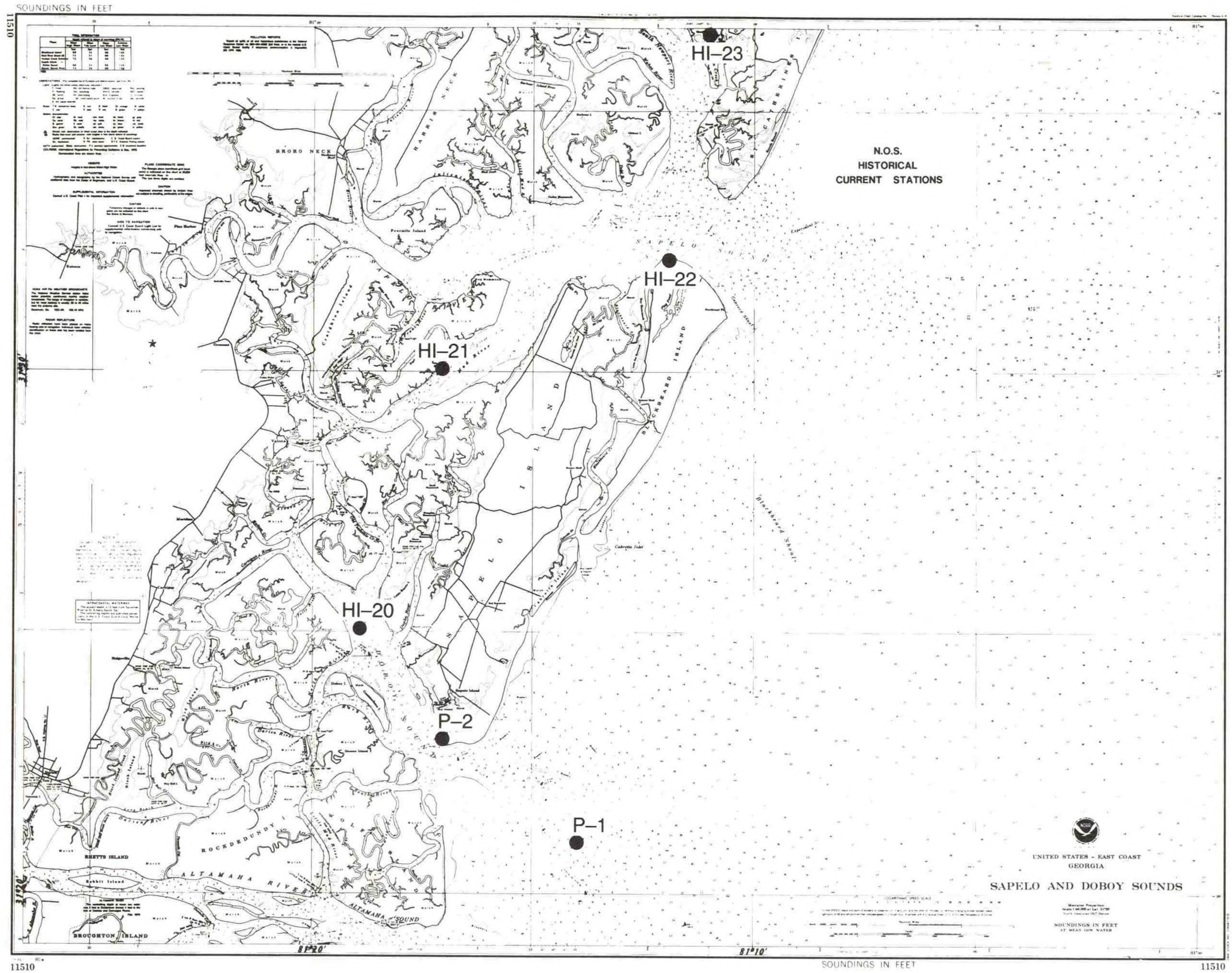

Figure 14.--Historical Current Meter Stations

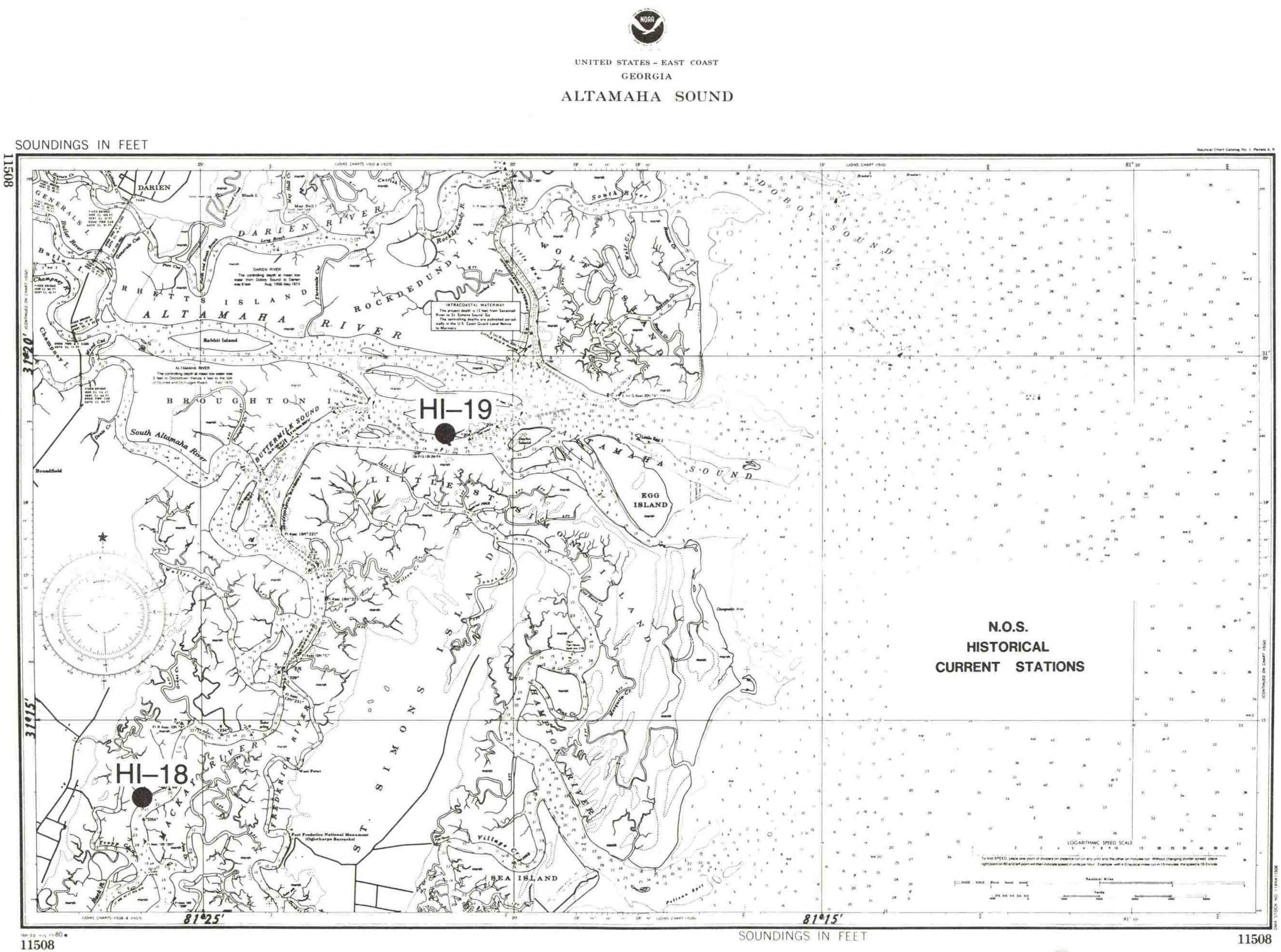

Figure 15.--Historical Current Meter Stations

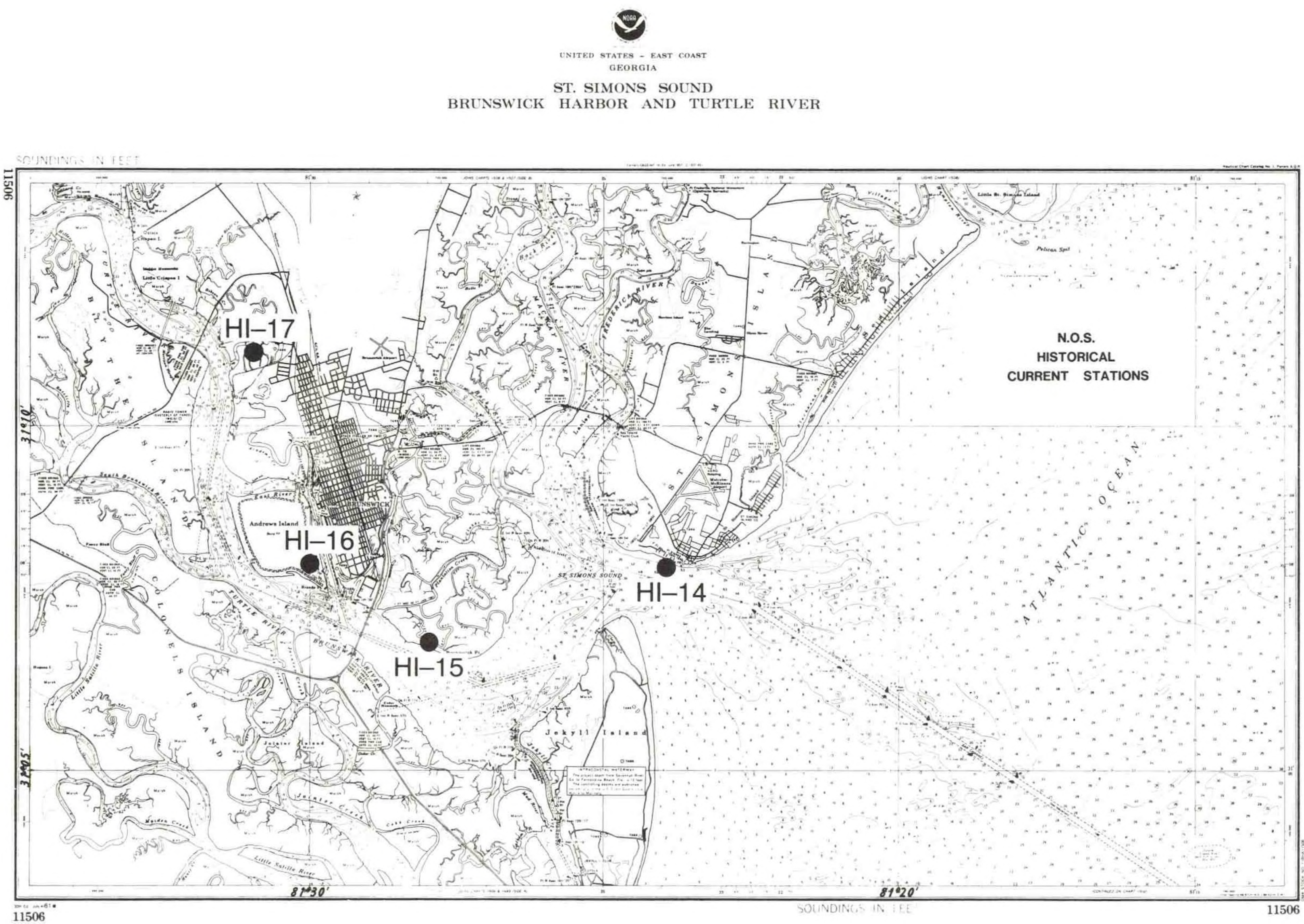

Figure 16.--Historical Current Meter Stations

5.3. Tide Data

Historical tide data in this area are more abundant and of greater duration than historical current data. In addition, some tide stations had data series as recent as 1978. See table 7 for relevant information. Also refer to figures 17 through 19 for stations and their locations. Various types of water level devices were used to obtain these data. Description of these devices are found in the "Manual of Tide Observations," U.S. Coast and Geodetic Survey, Pub. 30-1, 1965, or in "Tidal Datum Planes," U.S. Coast and Geodetic Survey, S.P. 135, 1951. Predictions and mean ranges for some of these historical tide stations are found in the "Tide Tables, High and Low Water Predictions, East Coast of North and South America, Including Greenland," published by NOS.

Table 7.--NOS Historical Tide Data

STATION NO.	STATION	LATITUDE(N)	LONGITUDE(W)	DATES OF OBSERVATION
8672475	Dallas Bluff, Townsend, GA	31°34.8'	81°18.7'	Feb. 11 - Mar. 5, 1964
8674251	Barbour Is., Swain River, GA	31°34.7'	81°14.4'	May 3-June 22, 1977
8674301	S. Newport River, Channel Light "135," GA	31°34.5'	81°11.4'	Mar. 14-June 21, 1977
8674509	Sutherland Bluff, Sapelo River, GA	31°33.9'	81°19.7'	Dec. 29-31, 1858
8674512	Pine Harbor, GA	31°32.9'	81°22.3'	Feb. 11 - Mar. 9, 1964
8674611	Sapelo Sound, GA	31°32.2'	81°12.4'	July 10 - Aug. 16, 1912
8674638	Belleville Point, GA	31°31.9'	81°21.6'	May 5-June 21, 1977
8674678	High Point, Sapelo Is., GA	31°31.4'	81°14.3'	*Jan. 2, 1800
8674783	Front River, GA	31°30.7'	81°18.1'	*Jan. 2, 1800
8674801	Eagle Creek, GA	31°30.6'	81°16.7'	Feb. 11 - Mar. 9, 1964
8674962	Blackbeard Creek, GA	31°29.3'	81°12.6'	Oct. 27, 1967
8675167	Old Teakettle Creek, GA	31°27.4'	81°19.2'	April 24 - May 7, 1868
8675245	Hudson Creek Entrance, GA	31°26.8'	81°20.6'	April 16 - 19, 1934
8675623	Sapelo Island (Outside), GA	31°23.5'	81°16.0'	Mar. 6, 1974 - Feb. 2, 1978
8675779	Darien, Darien River, GA	31°22.1'	81°26.1'	Apr. 19-24, 1934
8675843	Three-Mile Cut, Darien River, GA	31°21.4'	81°22.6'	Apr. 5-11, 1934
8675968	One-Mile Cut, Altamaha River, GA	31°20.3'	81°23.2'	Jan. 19 - Feb. 17, 1872
8676265	Hampton River, GA	31°13.0'	81°18.8'	Oct. 9-19, 1934
8676555	Little St. Simons, GA	31°15.0'	81°16.9'	Mar. 31-May 17, 1977
8676722	Dillard Creek, Turtle River, GA	31°13.5'	81°34.3'	Jan. 19-29, 1934
8676743	Frederica River, GA	31°13.3'	81°23.6'	Feb. 16 - Mar. 18, 1872
8677032	Southern R.R. Docks, Turtle River, GA	31°10.8'	81°31.4'	May 9-15, 1857
8677230	Brunswick, GA	31°08.9'	81°29.9'	Feb. 11 - June 6, 1856
8677566	GA Forest Product Co. Wharf, GA	31°05.9'	81°34.4'	Apr. 6-13, 1934
8677576	Jointer Is., Jointer Creek, GA	31°05.7'	81°30.3'	Mar. 21, 1934 - Jan. 2, 1935
8677833	Little Satilla River, GA	31°03.5'	81°29.6'	May 21, 1934

* Indicates Precomputerized Data

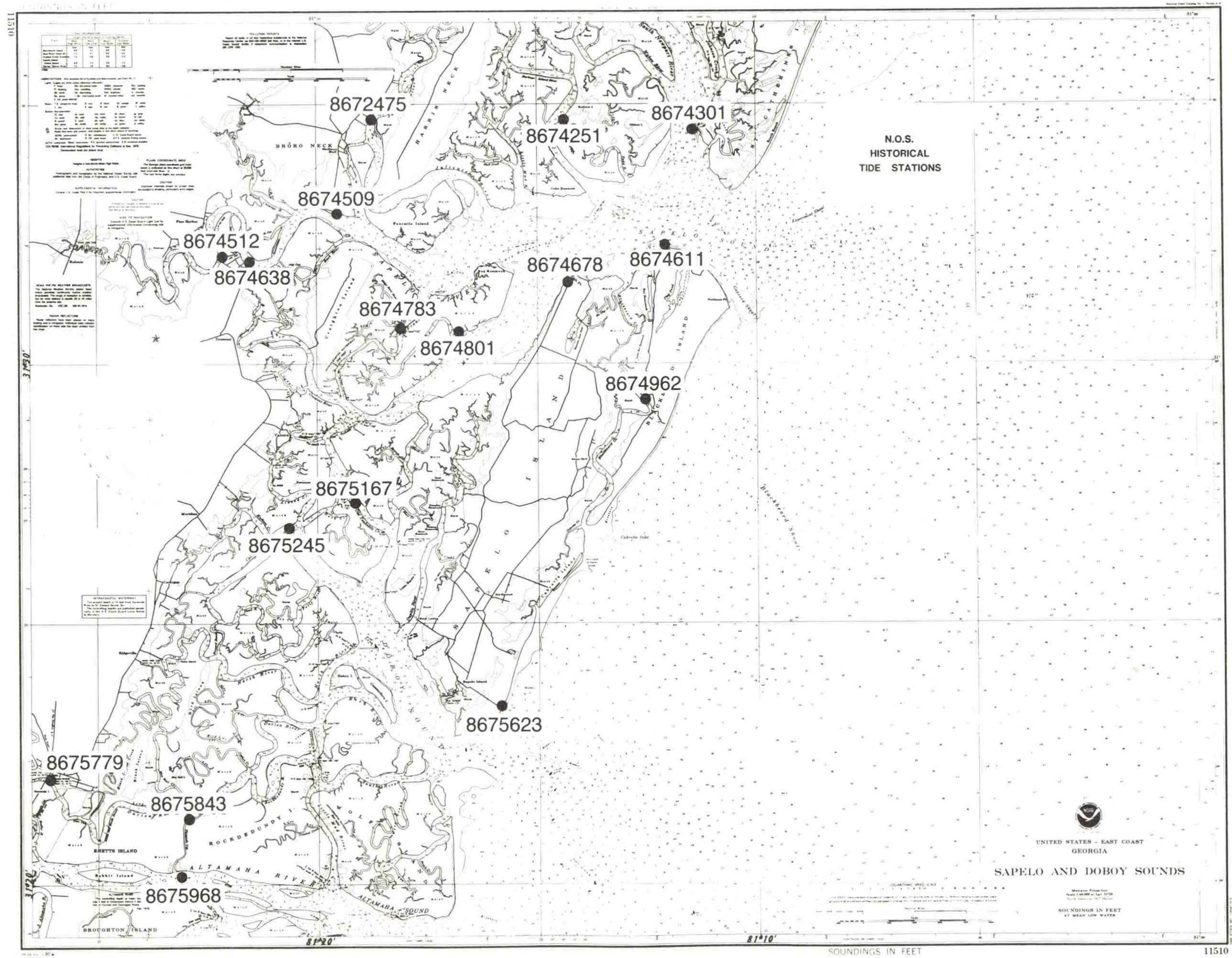

Figure 17.--Historical Tide Gage Locations

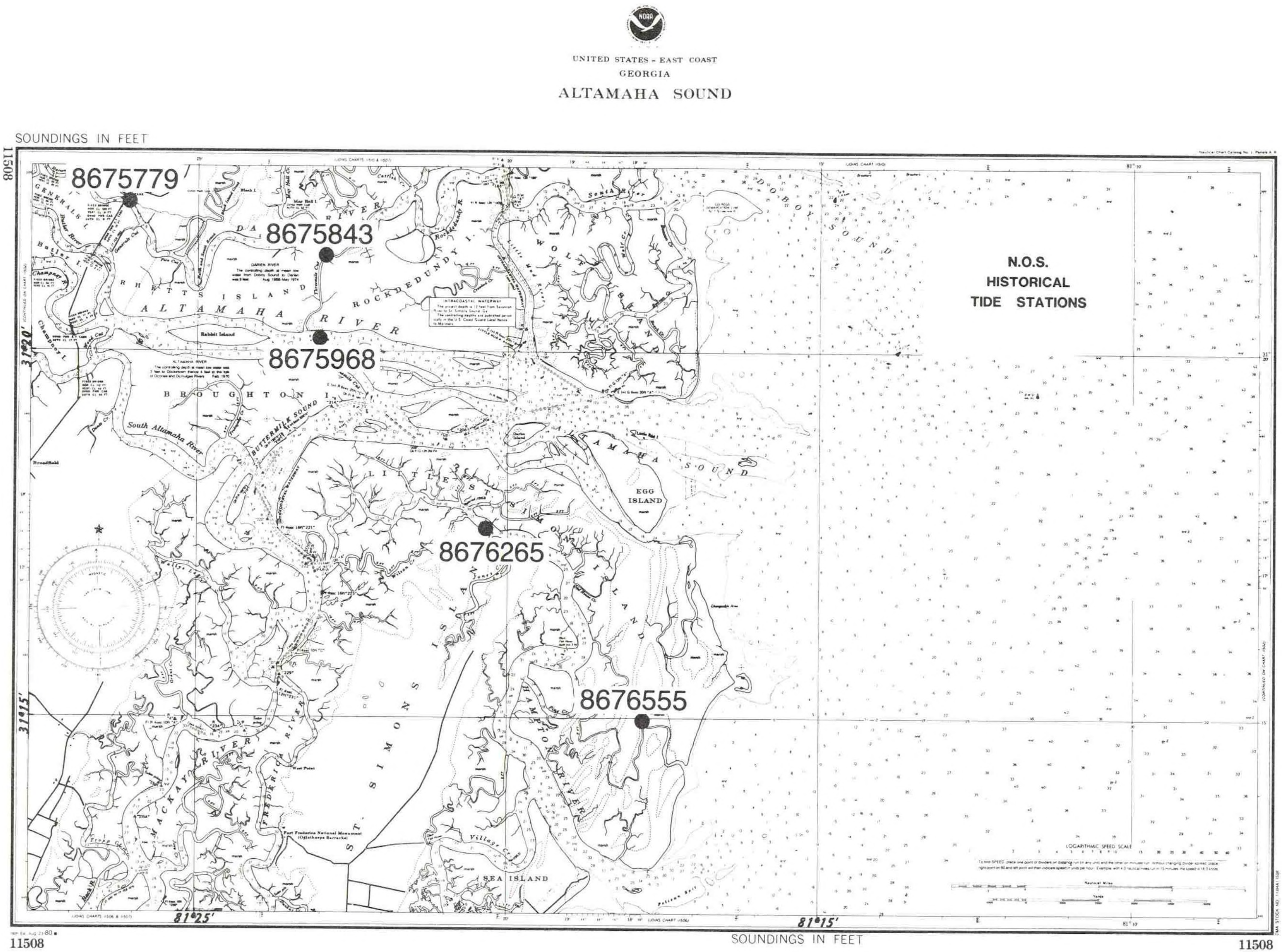

Figure 18.--Historical Tide Gage Locations

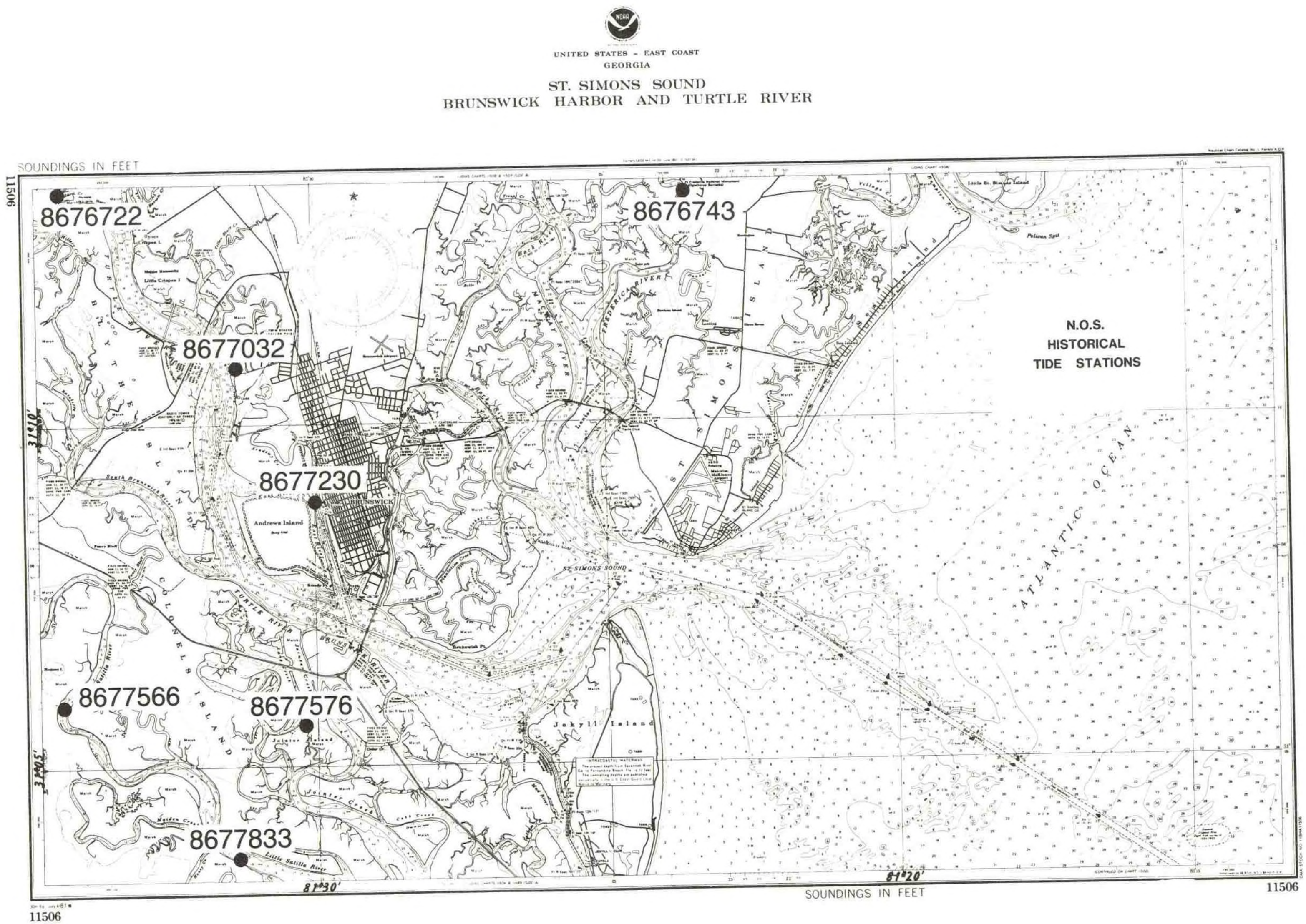

Figure 19.--Historical Tide Gage Locations

Acknowledgements

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APPENDIX A. - 1980 Georgia Estuaries Total Measurement Uncertainties Summary

INSTRUMENT	PARAMETER	TOTAL MEASUREMENT UNCERTAINTY (TMU)
GRUNDY 9021G CURRENT METER	Current Speed	(+5.2, -7.0) cm/s @ 200 cm/s ±6.1 cm/s @ 5cm/s
	Current Direction	±9.1 degrees @ 10 to 200 cm/s
		±12.1 degrees @ 5 to 10 cm/s
	Water Temperature	±0.09°C
	Conductivity	±0.29 mS/cm
	Time	±12.4 ppm, ±32 seconds/month
GRUNDY 9400 CTD	Conductivity	(+0.11, -0.06) mS/cm
	Water Temperature	(+0.027, -0.065)°C
	Pressure	(+1.65, -0.66) dbar
AANDERAA METEOROLOGICAL STATION	Air Temperature	(+0.71, -0.31)°C
	Air Pressure	(+0.5, -2.2) mbar
	Wind Speed	(+1.22, -0.62) m/s
	Wind Direction	±11.0 degrees
GUIDLINE 8400 AUTOSAL	Salinity	(+0.012, -0.006) ppt