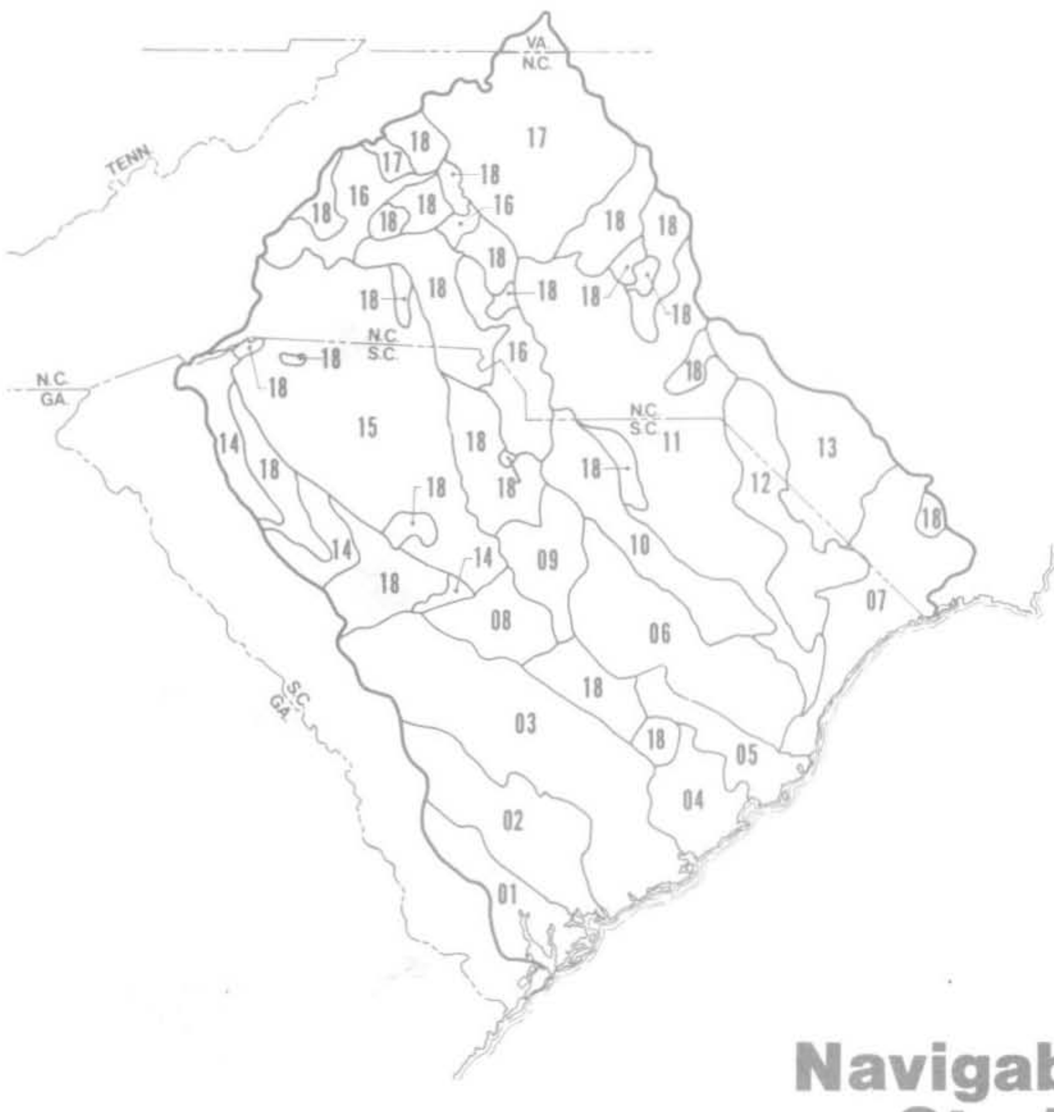
U.S. ARMY CORPS OF ENGINEERS
CHARLESTON DISTRICT
Charleston, South Carolina

SUMMARY



Navigability Study
1977

STANLEY CONSULTANTS

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SECTION 1

INTRODUCTION

Purpose

The purpose of this study is to collect, develop, and evaluate information on waterbodies within the boundaries of the Charleston District, Corps of Engineers, for establishing the classification of "navigable waters of the U. S." and "waters of the U. S." (During the course of this study the term "navigable waters" was changed to "waters of the U. S." Herein references to "navigable waters" are synonymous with "waters of the U. S.") Study objectives include definition of the present head of navigation, the historic head of navigation, the potential head of navigation, and the headwaters of all waterbodies within the district.

The information generated as a part of the study will be utilized by the Charleston District in administration of its programs dealing with water resource project construction permits in "navigable waters of the U. S." (River and Harbor Act of 1899), and the deposit of dredge or fill material in "waters of the U. S." ("navigable waters") or their contiguous wetlands (Section 404 of PL 92-500).

Scope

The scope of this project is generally summarized by the following:

1. Outline drainage areas, locate headwater points where mean flow is five cubic feet per second (cfs), summarize lake data (10 to 1,000 acres), establish stream mileage for "navigable waters of the U. S.", and prepare a stream catalog summary for the district.
2. Conduct field surveys of waterbodies to establish mean water levels and obstruction clearances for evaluating the potential head of navigation.
3. Analyze available hydrological data to estimate mean, maximum, and minimum discharge rates at obstructions and other selected locations.
4. Conduct a literature review to identify past, present, and future uses of waterbodies for interstate commerce.

5. Conduct a legal search to identify Federal and state court cases which impact on navigation classifications.
6. Prepare plan and profile drawings, maps of the district showing significant physical features, and a map delineating the recommended navigation classifications.
7. Prepare reports of all major river basins and large lakes (greater than 1,000 acres) including information on physical characteristics, navigation projects, interstate commerce, court decisions, navigation obstructions, and recommended classification of waterbodies for navigation.
8. Prepare a summary report outlining navigation-related information for the entire district as well as the methodology, procedures, and other factors pertinent to the development of each of the river basin reports.

Conduct of this study relies heavily upon available information. Compilation and evaluation of existing data from many sources and development of field survey information are the main contributions to the new water resource data base represented by this study.

Summary Report and Related Documents

Information pertaining to this navigability study for the Charleston District has been compiled into a series of reports. A complete listing of the reports is presented below to permit cross referencing for additional information.

Number	Title
--	Summary Report
01	Coosawhatchie River Area
02	Combahee River Area
03	Edisto River Area
04	Cooper River Area
05	Santee River Basin
06	Black River Area
07	Waccamaw River Basin
08	Congaree River Basin
09	Wateree River Basin

Number	Title
10	Lynches River Basin
11	Great Pee Dee River Basin
12	Little Pee Dee River Basin
13	Lumber River Basin
14	Saluda River Basin
15	Broad River Basin
16	Catawba River Basin
17	Yadkin River Basin
18	Lakes - Greater Than 1,000 Acres
--	Coastal Supplement

The Summary Report provides an overview of the entire study of district waterbodies. The presentation herein is divided into two parts including a summary of the findings and a summary of the methodology for each major topic. The sections in the Summary Report are correlated with similar sections in the eighteen individual drainage area reports. Each of the topics covered by the report sections is a factor in the decision-making process for navigation classification. A major objective of the Summary Report is to document the detailed procedures used to prepare the data base and to reach the conclusions and provide the recommendations concerning navigation classifications in the district.

The eighteen individual drainage area reports provide information specific to the particular waters in the identified basin. Data references are listed in the Bibliography of each individual basin report dealing with the navigation study. The Coastal Supplement report contains only stream catalog data and a few coastal drawings. All information used to prepare this Summary Report has been taken from the previously identified eighteen reports covering the Charleston District. Reference should be made to both these individual drainage area reports as well as the Summary Report to obtain a thorough understanding of the study approach and results.

Acknowledgements and Data Sources

The contribution of the many project team members within the Corps of Engineers, Charleston District, and Stanley Consultants during this study is gratefully acknowledged by Stanley Consultants. In addition to the legal search and other evaluations and input from Charleston District staff, several others made significant contributions to this study effort. Dr. J. W. Gordon, Assistant Professor in the Department of History, The Citadel, prepared the narrative and literature review information on past and present interstate commerce for Stanley Consultants.

Several state water resource, transportation, utility and planning agencies also cooperated and provided useful data for compiling these reports. Federal water resource and regulatory agencies also provided information along with public and private operators of large reservoirs.

SECTION 2

PHYSICAL CHARACTERISTICS

- Summary of Findings
- Summary of Methodology

SUMMARY OF FINDINGS

General

The physical characteristics of waterbodies in the Charleston District are a major factor in determining navigation classifications.

In each of the eighteen individual reports prepared as a part of this study, tables and data are presented on selected physical characteristics of streams classified as "navigable waters of the U. S." or major waterbodies within each report area. Summaries of stream and large lake physical characteristics and data on key stream gaging stations are presented in this section. Further details are found in the individual reports.

Basin Physical Characteristics

A summary of the physical characteristics for all major stream basins is presented in Table 1. This table shows the principal stream and code, length from mouth to headwater, elevation change, drainage area, mean discharge at the mouth, and limits of tidal influence. The drainage area shown is that directly tributary to the indicated stream and does not include major upstream areas covered by other reports.

The physical characteristics vary significantly throughout the district among the stream report areas; eight have major streams subject to tidal influence: Coosawhatchie (01), Combahee (02), Edisto (03), Cooper (04), Santee (05), Black (06), Waccamaw (07), and the Great Pee Dee (11).

The Broad River (15) has the largest directly contributing drainage area and the greatest elevation change within the district; 5,340 square miles and 2,440 feet, respectively. The Great Pee Dee River (11), which receives drainage from the Yadkin River (17), has the largest mean discharge at the mouth of 17,810 cfs. The Great Pee Dee is also the longest major stream.

TABLE 1

SUMMARY OF BASIN PHYSICAL CHARACTERISTICS

Major River In Report Area With Code[1)]	Report No.	Length-Mouth to Headwaters[2)] (mi)	Elevation Change[2)] (ft)	Drainage Area[3)] (sq.mi.)	Mean Discharge at Mouth[4)] (cfs)	Limit of Tidal Influence[5)] (R.M.)
Coosawhatchie R. 01-01	01	50.0	130	590	520	9.0
Combahee River 02-01	02	109.0	270	1,860	1,310	37.0
Edisto River 03-01	03	196.0	500	3,000	3,300	37.0
Cooper River 04-01	04	48.1	5	500	15,150	45.0
Santee River 05-01	05	87.7	40	1,350	3,120	37.0
Black River 06-01	06	145.9	180	2,080	1,460	40.0
Waccamaw River 07-01	07	149.0	50	1,750	1,930	60.0
Congaree River 08-01	08	52.0	55	730[6)]	10,140	None
Wateree River 09-01	09	76.1	65	910	7,020	None
Lynches River 10-01	10	195.6	495	1,400	1,400	None
Great Pee Dee R. 11-01	11	232.0	280	5,270	17,810	33.0
Little Pee Dee R. 12-01	12	109.0	190	1,400	3,770	None

TABLE 1 (continued)

SUMMARY OF BASIN PHYSICAL CHARACTERISTICS

Major River In Report Area With Code[1]	Report No.	Length-Mouth to Headwaters[2] (mi)	Elevation Change[2] (ft)	Drainage Area[3] (sq.mi.)	Mean Discharge at Mouth[4] (cfs)	Limit of Tidal Influence[5] (R.M.)
Lumber River 13-01	13	143.0	415	1,740	1,910	None
Saluda River 14-01	14	182.0	2,270	2,510	2,910	None
Broad River 15-01	15	168.0	2,440	5,340	6,520	None
Catawba River 16-01	16	202.0	1,470	3,780	6,680	None
Yadkin River 17-01	17	198.0	2,000	4,300	5,590	None

1) See Section 7 for explanation of code.

2) From mouth (or downstream report basin boundary) to a remote point in the basin having a mean annual flow of five cfs (or to the upstream report basin boundary if the headwaters occur in another basin upstream).

3) Drainage area of major stream and its tributaries including major lakes.

4) Flow at mouth (or downstream report basin boundary) includes report basin and all upstream flow contributions.

5) See Section 2 for explanation of methodology for determining extent of tidal influence.

6) Drainage area does not agree with USGS information available at time of this writing (USGS drainage area is approximately 580 sq.mi.).

Gaging Stations

Stream flow varies throughout the Charleston District from the coast in South Carolina to more mountainous areas in North Carolina. Table 2 presents a listing of one selected active U. S. Geological Survey (USGS) gaging station located on the major stream in each report area if available. The location description and mean, minimum, and maximum flows are shown in Table 2. Drainage areas shown include all upstream contributing areas. The individual basin reports provide a more complete listing of key stream gaging stations.

Large Lake Physical Characteristics

Lakes within the Charleston District having a surface area greater than 1,000 acres are covered in detail in Report 18. Table 3 presents a summary of the twenty-five large lake physical characteristics. Data listed includes lake name and code, location, surface area, and gross storage.

The large lake characteristics vary significantly mainly due to geographic location. Most are man-made reservoirs; only Lake Waccamaw is a natural lake. Lake Marion (18-03) has the largest surface area with about 110,600 acres, while Lake Murray (18-04) has the greatest gross storage with approximately 2,114,000 acre-feet of water. Variation in lake characteristics are also related to the purpose for which they were constructed. Most lakes serve a number of purposes; however, power generation is common for just about every large lake within the district.

TABLE 2

SUMMARY OF KEY STREAM GAGING STATIONS

Stream	Report No.	USGS Gaging Station Number and Location	Drainage Area (sq.mi.)	Mean Flow (cfs)	Minimum Flow[1] (cfs)	Maximum Flow[2] (cfs)
Coosawhatchie R.	01	02176500 - Located near the City of Hampton, in Hampton Co., S.C., at U.S. 601 Highway bridge	203	190	3.7	485
Combahee River	02	02175500 - Salkehatchie River (fork to Combahee) near Miley, S.C., Hampton Co., at U. S. Highway 601 bridge, 2.4 miles downstream of Savannah Creek	341	349	88	680
Edisto River	03	02175000 - Located near Givhans, S.C., Dorchester County, at S.C. Highway 61 bridge, 2.3 miles downstream from Four Hole Swamp	2,730	2,690	720	5,800
Cooper River	04	No stream gaging stations	--	--	--	--
Santee River	05	02171500 - Located near Pineville, S.C., in Berkeley County, on bank 2.4 miles downstream from Lake Marion Dam	14,700	2,279	497	16,000
Black River	06	02136000 - Kingstree, S.C., Williamsburg County, on U.S. Highway 52 bridge	1,260	933	30	2,250
Waccamaw River	07	02110500 - Located in Horry County, S.C., on downstream side of S.C. 9 Highway bridge	1,110	1,214	39	3,250

TABLE 2 (continued)

SUMMARY OF KEY STREAM GAGING STATIONS

Stream	Report No.	USGS Gaging Station Number and Location	Drainage Area (sq.mi.)	Mean Flow (cfs)	Minimum Flow[1] (cfs)	Maximum Flow[2] (cfs)
Congaree River	08	02169500 - Columbia, S.C., Lexington County, downstream from Gervais Street bridge and downstream from the confluence of Broad and Saluda Rivers	7,850	9,294	3,220	15,700
Wateree River	09	02148000 - Located near Camden, S.C., Kershaw County, on U.S. 1 Highway bridge	5,070	6,326	1,000	11,800
Lynches River	10	02132000 - Located near Effingham, S.C., in Florence County, on U.S. Highway 52 bridge just upstream of SCLRR bridge	1,030	1,020	255	2,150
Great Pee Dee R.	11	02131000 - Near Pee Dee in Marion County, S.C., on U.S. 76 Highway bridge	8,830	9,657	3,200	18,000
Little Pee Dee R.	12	02135000 - Located near Galivants Ferry, Horry-Marion Counties, S.C. on U.S. 501 Highway bridge	2,790	3,265	700	7,300
Lumber River	13	02134500 - Located in Robeson County, N.C., downstream of U.S. 74 Highway bridge and 1 mile downstream from Seaboard Coast Line Railroad bridge near Boardman	1,220	1,338	348	3,179

TABLE 2 (continued)

SUMMARY OF KEY STREAM GAGING STATIONS

Stream	Report No.	USGS Gaging Station Number and Location	Drainage Area (sq.mi.)	Mean Flow (cfs)	Minimum Flow[1] (cfs)	Maximum Flow[2] (cfs)
Saluda River	14	02169000 - Near Columbia, S.C., Richland County, upstream from Old Saluda Mill and 1.6 miles upstream from confluence with Broad River	2,510	2,910	380	5,600
Broad River	15	02161500 - At Richtex, S.C., Richland County, on bank upstream from Little River	4,850	6,196	1,780	11,000
Catawba River	16	02146000 - Located near Rockhill, S.C., York County, on U.S. Highway 21 bridge 3.5 miles downstream of Lake Wylie Dam	3,050	4,559	1,000	8,200
Yadkin River	17	02116500 - At Yadkin College in Davidson County, N.C., on U.S. 164 Highway bridge	2,280	2,961	1,189	4,876

1) Exceeded or equaled 90 percent of the time.

2) Exceeded or equaled 10 percent of the time.

TABLE 3

SUMMARY OF LAKES GREATER THAN 1,000 ACRES

Lake Code[1]	Lake Name	Location (county & state)	Surface Area[2] (acres)	Gross Storage[2] (acre-ft)
18-01	Lake Moultrie	Berkeley County, South Carolina	60,400[3]	1,211,000[3]
18-02	Lake Waccamaw	Columbus County, North Carolina	8,938	39,327
18-03	Lake Marion	Calhoun, Sumter, Orangeburg, Clarendon, and Berkeley Counties, South Carolina	110,600[3]	1,400,000[3]
18-04	Lake Murray	Newberry, Saluda, Richland, and Lexington Counties, South Carolina	51,000[3]	2,114,000[3]
18-05	Parr Reservoir	Newberry and Fairfield Counties, South Carolina	1,850[3]	28,120[3]
18-06	Wateree Lake	Fairfield and Kershaw Counties, South Carolina	13,710[3]	310,000[3]
18-07	Lake Robinson	Chesterfield and Darlington Counties, South Carolina	2,250[3]	31,000[3]
18-08	Fishing Creek Reservoir	Chester and Lancaster Counties, South Carolina	3,370[3]	80,000[3]
18-09	Blewett Falls Lake	Anson and Richmond Counties, North Carolina	2,500	97,000
18-10	Lake Greenwood	Laurens, Greenwood, and Newberry Counties, South Carolina	11,400[3]	260,000[3]

TABLE 3 (continued)

SUMMARY OF LAKES GREATER THAN 1,000 ACRES

Lake Code[1)]	Lake Name	Location (county & state)	Surface Area[2)] (acres)	Gross Storage[2)] (acre-ft)
18-11	Lake Wylie (Lake Catawba)	Gaston and Mecklenburg Counties North Carolina; York County, South Carolina	12,455	107,670*
18-12	Mountain Island Reservoir	Gaston and Mecklenburg Counties, North Carolina	3,235	57,300
18-13	Lake Tillery	Stanly and Montgomery Counties, North Carolina	5,260	168,000
18-14	Badin Lake	Stanly and Montgomery Counties, North Carolina	5,973	279,000
18-15	Tuckertown Lake	Rowan and Davidson Counties, North Carolina	2,529	43,000
18-16	North Saluda Reservoir (Poinsett Reservoir)	Greenville County, South Carolina	1,080[3)]	76,108[3)]
18-17	William C. Bowen Reservoir	Spartanburg County, South Carolina	1,600[3)]	24,550[3)]
18-18	Buffalo Lake	Cleveland County, North Carolina	1,275	38,000
18-19	Lake Norman	Iredell, Catawba, Lincoln, and Mecklenburg Counties, North Carolina	32,510	1,093,600

TABLE 3 (continued)

SUMMARY OF LAKES GREATER THAN 1,000 ACRES

Lake Code[1]	Lake Name	Location (county & state)	Surface Area[2] (acres)	Gross Storage[2] (acre-ft)
18-20	High Rock Lake	Davidson and Rowan Counties, North Carolina	15,886	254,000
18-21	Lookout Shoals Reservoir	Alexander, Catawba, and Iredell Counties, North Carolina	1,270	31,111
18-22	Lake Hickory	Caldwell, Alexander, and Catawba Counties, North Carolina	4,110	127,479
18-23	Rhodhiss Lake	Caldwell and Burke Counties, North Carolina	3,515	73,000
18-24	Lake James	McDowell and Burke Counties, North Carolina	6,510	288,800
18-25	W. Kerr Scott Reservoir	Watanga, Caldwell, and Wilkes Counties, North Carolina	4,000	153,000

---

1) See Section 7 for explanation of code.

2) At maximum pool unless otherwise indicated.

3) At normal pool elevation.

* Reference North Carolina information.

SUMMARY OF METHODOLOGY

General

Information used to present and summarize physical characteristics in the eighteen individual reports consists of location map, significant features maps, physical characteristics table, and key stream gaging stations table.

Sources of information used to present physical characteristics include: U. S. Army Corps of Engineers, Charleston District; state and regional planning agencies; state water resource agencies; USGS maps and gaging station data; county highway maps; and reservoir operators and utilities.

This part of Section 2 discusses the procedures used to develop the physical characteristics data for each major river report and the lakes report.

Location Map

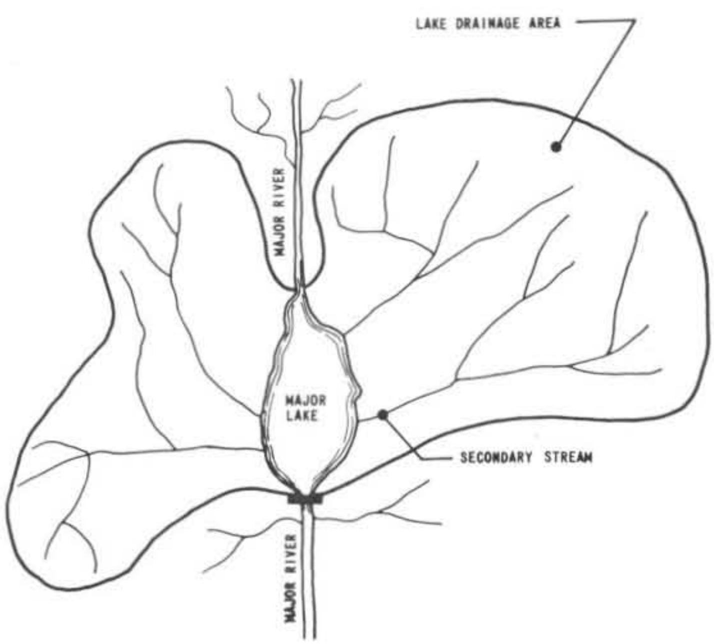
The location map shows the entire Charleston District, major streams, large lakes (greater than 1,000 acres), the report areas or basin outlines, and the coding of all report areas. Plate 1 shows the study area. For each individual report included in this study, the particular area being reported on is isolated and represented by shading on the location map.

The base map used for the location map was developed from USGS maps (1:500,000) and provided by the Charleston District, Corps of Engineers. The rivers in the district were reviewed on the map and a series of areas outlined to group streams into a logical sequence for study and reporting. Some reports cover just one major river and these are titled "basin" reports. Others cover several streams in addition to the major river and are titled "area" reports (see the listing in Section 1). The report basins/areas were numbered in a sequence from west to east and from south to north as shown on Plate 1.

The drainage areas for each report were first outlined on the USGS topographic maps (1:250,000) and then transferred to the 1:500,000 base map. Similarly, drainage areas for major lakes (greater than

1,000 acres) were also outlined and transferred to the Plate 1 base map. Methodology for determining lake drainage areas consisted of outlining the tributary area from the dam to the upstream end of the lake. (The upstream extent of lakes was determined from USGS maps and/or data supplied by operators or owners.) This includes the drainage areas of all secondary streams directly feeding the lake. Figure 1 shows an example of this procedure. In a number of situations there are several lakes on a major river in consecutive order. Usually, drainage area for one lake was extended from its dam to the dam of the next lake upstream. However, in some cases this procedure was altered depending upon the stream characteristics and distance between major lakes. An example is found in the Catawba River basin (Plate 1) with Lookout Shoals Lake (18-21), Lake Hickory (18-22), and Rhodhiss Lake (18-23).

FIGURE 1
MAJOR LAKE DRAINAGE AREA



Significant Features Maps

Significant features maps cover the entire drainage area for each report. These maps show streams and lakes, transportation systems, counties and municipalities, drainage areas (report boundaries), and report names and codes. The maps also show major stream river mileage, tidal influence limits, and navigation limits. Plate 2 is an example of one of the significant features maps.

USGS topographic maps (1:250,000) were used as base maps to develop the significant features maps. The report drainage areas were outlined as described previously.

River mile determinations for these maps were developed by starting at the mouth of the river and indicating mileage upstream to or above the uppermost navigation limit. River miles were "ticked off" every five miles and marked every ten miles as shown in Figure 2. The plan and profile drawings (1:24,000) discussed in Section 6, were used as the basis for transferring the river miles to the significant features maps (1:250,000). In several situations, river mile markings were needed above the stream area covered on the plan and profile drawings. In these instances, river miles were determined on USGS quadrangle maps (1:24,000 or 1:62,500) and then transferred onto the significant features maps (1:250,000). (Section 6 provides more details on the procedures for establishing the river miles on the maps.)

The limit of tidal influence is indicated on key streams by the designation "T" (see Figure 2 and Plate 2). The methodology for determining these points is presented later in this section.

Limits of navigation are placed on the significant features maps for each report at the appropriate location. The limits are noted as follows and are shown on Figure 2 and Plate 2:

"N" - Present limit of "navigable waters of the U. S."

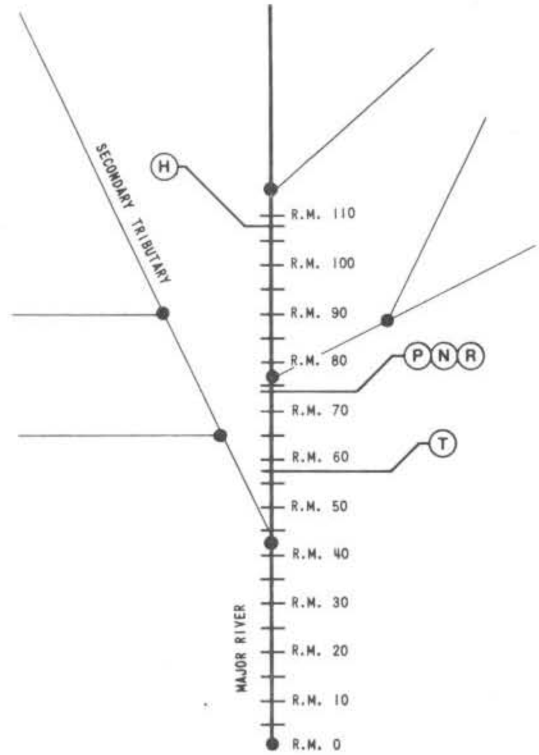
"H" - Historic limit of navigation.

"P" - Practical limit of navigation (recommended).

"R" - Limit of "navigable waters of the U. S." (recommended).

Section 6 discusses the methodology for determining the limits of navigation.

FIGURE 2
SIGNIFICANT FEATURES MAPPING SYSTEM



Basin Physical Characteristics

The physical characteristics table presented in each basin report consists of stream code, and approximate values for length from mouth to headwaters, elevation change, drainage area, mean discharge at mouth, tidal influence limits, confluence locations with other streams, and present "navigable waters of the U. S." limits. The following subsections summarize the procedures used to develop this data.

Stream Name and Code - Only major streams in each report area were selected to appear in the table. The streams were coded using the procedures outlined in Section 7.

Length-Mouth to Headwaters - For each report the major stream(s) was noted by river mileage from its mouth to the headwaters of that particular stream.

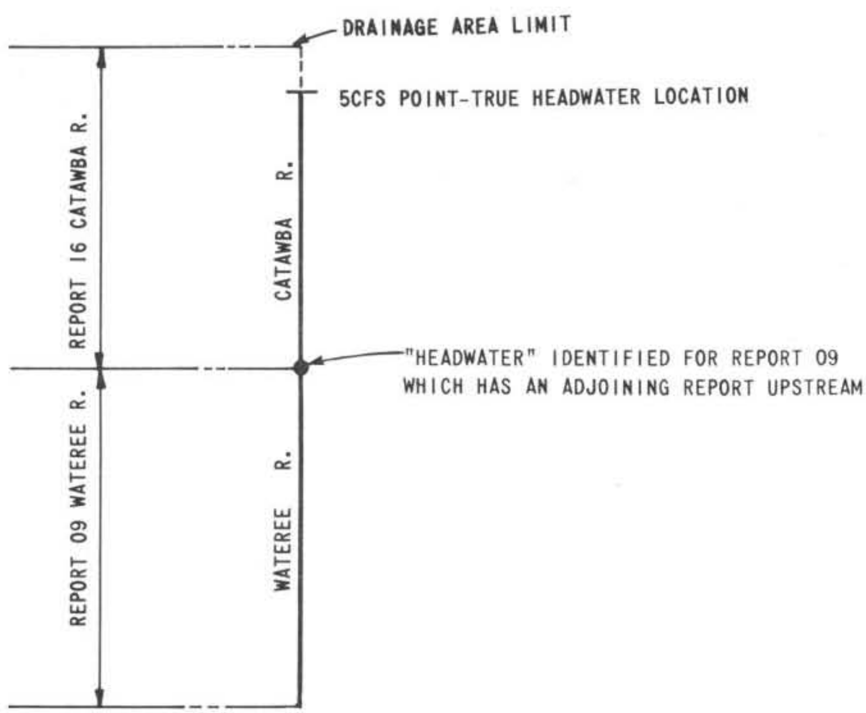
To determine the length of streams from the mouth to headwaters the techniques described in the previous subsection "Significant Features

Maps" were utilized. From the uppermost river mile developed for the significant features maps to the headwaters location a map wheel was used to approximate the distance.

For some reports the headwaters location (extremely remote located five cfs point) was not located within that report. The following summarizes the different situations that exist within the district as related to headwater locations:

1. The headwater location may be located in another report which covers an upstream tributary river. For example, in Report 09 (Wateree), the most remote upstream headwaters are located in Report 16 (Catawba River). Figure 3 shows that in Report 09 the "headwater" location is identified at the boundary of the report area. In Report 16 the "true" five cfs headwater location is noted.

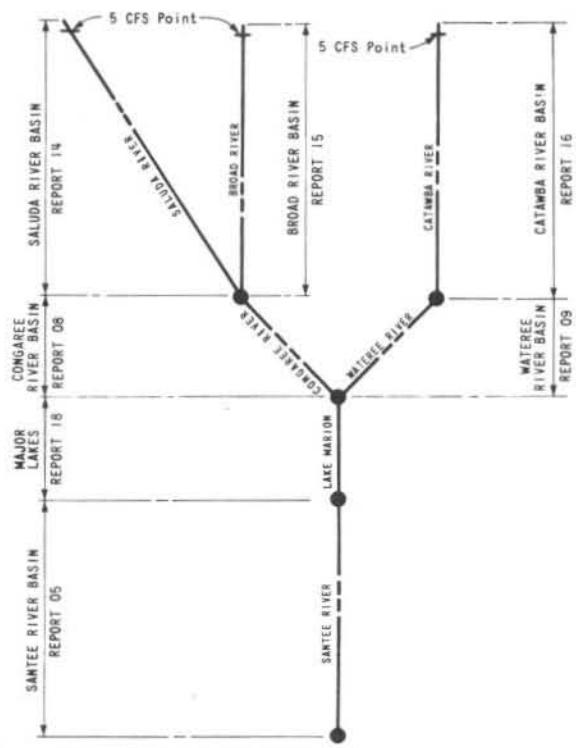
FIGURE 3
HEADWATER LOCATION RELATIVE TO REPORT AREA



2. The headwater location may be located in two or more upstream report areas. An example of this case is headwater locations for the Santee River. The headwater may be located in either the Saluda, Broad, or Catawba River Reports (14, 15, and 16, respectively). For this particular case a length to a headwaters location for the Santee River was not given, but reference to all three reports was noted and the length to the end of the report area was given. Figure 4 indicates the report areas in relation to headwaters for the Santee River and other typical "downstream" reports.

3. The headwaters location may be either on a stream which is tributary to the main river covered in the report or on the main river.

FIGURE 4
HEADWATER LOCATION WITHIN TWO OR MORE REPORT AREAS



Elevation Change - The elevation change represents the approximate difference in water surface elevation from the mouth to the headwaters for each stream. The USGS quadrangle maps were used to determine this information. The contours were represented at 10 and 20 feet intervals, depending on the USGS map used. As a result, the elevation changes are only approximate.

The elevations were estimated by first noting where contours crossed the stream channel, either above or below the appropriate five cfs point and stream mouth. Then the water surface elevations at the specific points were estimated by using a straight-line interpolation on the basis of river mile distance. In the case of the five cfs headwater location, this often involved extension of the stream to the appropriate contour line. The following example is provided using Figure 5 data:

1. At river mile 60 on the secondary stream, elevation 130 feet msl crosses the stream; at an extension of the stream to river mile 80 the elevation is 140 feet msl; and the headwaters five cfs point is located at river mile 70.
2. On the major river, elevation 120 feet msl crosses the stream at river mile 30, and the elevation 110 feet msl crosses at a point 5 miles below the mouth.
3. The approximate headwater elevation is:

$$130 + \frac{10}{20} \times 10 = 135 \text{ feet msl}$$

4. The approximate elevation at the mouth is:

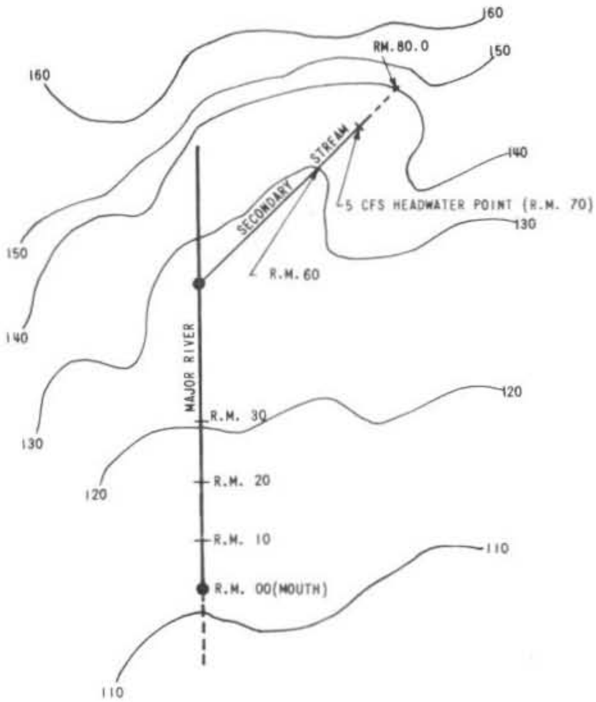
$$110 + \frac{5}{35} \times 10 = 111 \text{ feet msl (rounded)}$$

5. The elevation change rounded to the nearest five feet is:

$$135 - 111 = 24 \text{ feet; use } 25 \text{ feet}$$

In reports which have the headwaters located in another report area, the elevation change presented is from the mouth of the major stream to the end of the report area. Examples of these situations occur in the Santee River and the Great Pee Dee River reports. The elevation change

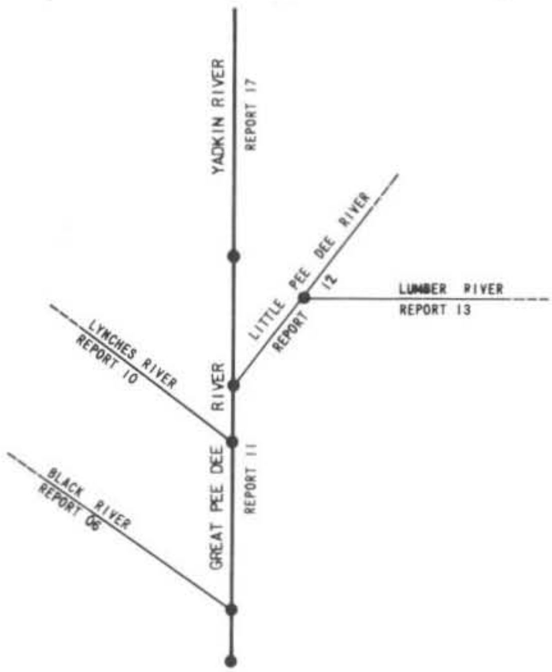
FIGURE 5
ELEVATION CHANGE EXAMPLE



for the Santee River is from the mouth of the Santee River to the dam at Lake Marion. The elevation change for the Great Pee Dee River is from its mouth to the beginning of the Yadkin River report.

Drainage Area - Drainage areas were determined for major streams within each basin. The drainage area for the major streams in the report area as well as contributing drainage areas from other reports are tabulated. For example, the total drainage area for the Great Pee Dee River includes a combination of several report areas as shown in Figure 6. The Yadkin River, Little Pee Dee River, Lumber River, Black River, and the Lynches River report areas all drain to the Great Pee Dee River; therefore, all report drainage areas totaled equal the drainage area of the Great Pee Dee River. River basin drainage areas include drainage areas of large lakes located within that basin.

FIGURE 6
TYPICAL RIVER SYSTEM NETWORK



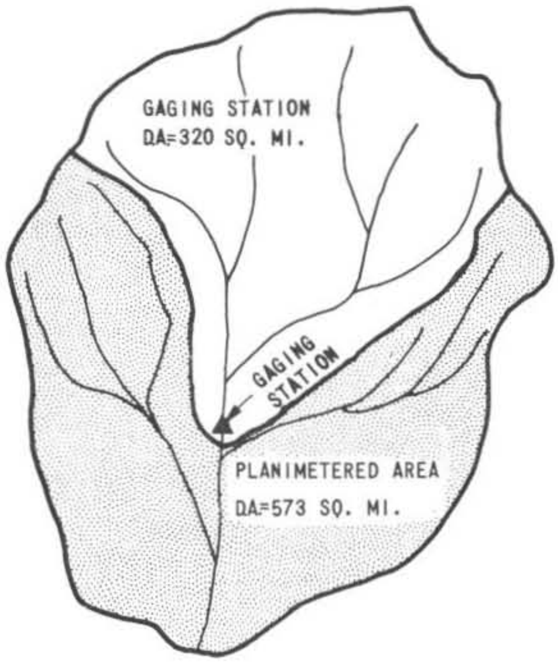
Drainage areas were determined by using the USGS topographic maps (1:250,000) and drainage areas reported at key USGS gaging stations. The procedure used was to first locate the gaging station nearest the mouth of the stream. Then, the complete drainage area was determined by planimetering the remaining area. In some cases where a gaging station was not available, the entire drainage area was planimetered for a major stream. Figure 7 illustrates how the total stream drainage area for a report was calculated at 893 square miles. The drainage area values were then rounded to the nearest 10 square miles.

Mean Discharge at Mouth - The mean annual discharge was determined for all major streams within the basins. The discharge in cubic feet per second (cfs) was determined by the use of USGS gaging station data, drainage areas, and average watershed yield information.

The average annual discharge (rounded to the nearest 10 cfs) was calculated by one of two methods:

1. If a gaging station was located near the stream mouth, the average yield (cfs/sq.mi.) at the station was computed by

FIGURE 7
DRAINAGE AREA DETERMINATION



dividing the reported discharge (cfs) by the contributing drainage area (sq.mi.). This yield was then multiplied by the drainage area at the stream mouth to provide an approximation to the average annual discharge.

2. If a gaging station was not located near the stream mouth, the annual yield (cfs/sq.mi.) was estimated from an "iso-yield" map. (Development of the "iso-yield" map is described in Section 6.) The yield from the map was then applied to the total stream drainage area to estimate the discharge.

<u>Limits of Tidal Influence</u> - The following methodology was developed to approximate the upstream extent of tidal influence on affected navigable rivers in the study area. This development was necessary because sufficient information was not readily available within the Charleston District office. The tidal influence limits obtained are

estimates only and may vary appreciably from actual field conditions. However, the intent was to formulate a uniform method which could be applied to any tidal stream in the district.

The complexities of unsteady flow and coastal hydrodynamics made exact determination of the extent of tidal influence in rivers well beyond the scope of this study. The methodology utilized produced results which, although approximate, are consistent with other necessary assumptions and approximations made in the course of this study.

For purposes of this study, the upstream extent of tidal influence is defined as the river mile location where the horizontal plane of mean high tide intersects the established mean water surface profile of any particular stream.

The following assumptions were made:

1. Mean tide level (mtl), mean sea level (msl), and zero elevation according to National Geodetic Vertical Datum (NGVD) are equivalent at all tide stations. This is reasonable as values vary by only about 0.3 feet along the limited coastline involved in this study.
2. Water surface profiles of streams entering the ocean slope to elevation zero (NGVD) at river mile zero at mean tide conditions.
3. USGS topographic map contours indicate stream water surface profiles under average flow conditions. Thus, stream profiles extracted from USGS topographic maps are representative of mean annual conditions. It is recognized this is not the actual situation, but it is considered within the accuracy of this study.
4. Mean sea level conditions are depicted on USGS topographic maps. This is reasonable and is sometimes actually stated on the maps of the coastal area.

Using conversion values provided in communications with the National Ocean Survey and Tide Tables 1976 (High and Low Water Predictions, East Coast of North and South America Including Greenland, U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Survey, 1975), mean high tide (mht) elevations (in terms of NGVD) were developed for the primary tide stations at Charleston Harbor and the Savannah River Entrance. Minor adjustments as contained in the tide tables, were then made to determine mht elevations at appropriate subordinate tide stations. These subordinate tide stations were selected as being representative of mht at the mouths of the various rivers for which stream profiles are presented. The rivers and tide stations used to develop tidal plots include:

Tide Station No.	River
2527	Great Pee Dee and Black
2539	Waccamaw
2545	Santee
2587	Back
2593	Cooper
2611	Ashley
2645	Edisto
2655	Combahee
2691	Coosawhatchie

An example of how the mht elevation was calculated at each station is as follows:

Stream - "Major River" (located closer to Charleston Harbor than Savannah River Entrance)

5.51 ft (mht at Charleston)*

-2.65 ft (0.0 NVGD = 2.65 Charleston Tide Datum)*

2.86 ft (mht at Charleston, NVGD Datum)

-0.4 ft (Correction for high water elevation at tide station on "Major River" to be applied to Charleston tide station elevation)**

2.46 ft (mht at "Major River" tide station, NVGD Datum; assumed 2.46 ft above msl)

Figure 8 illustrates how the calculated 2.46 ft mht is plotted for "Major River". First the river miles at which the 10 and 20 foot contours cross the stream surface are plotted. Msl is assumed at R.M. 0.0

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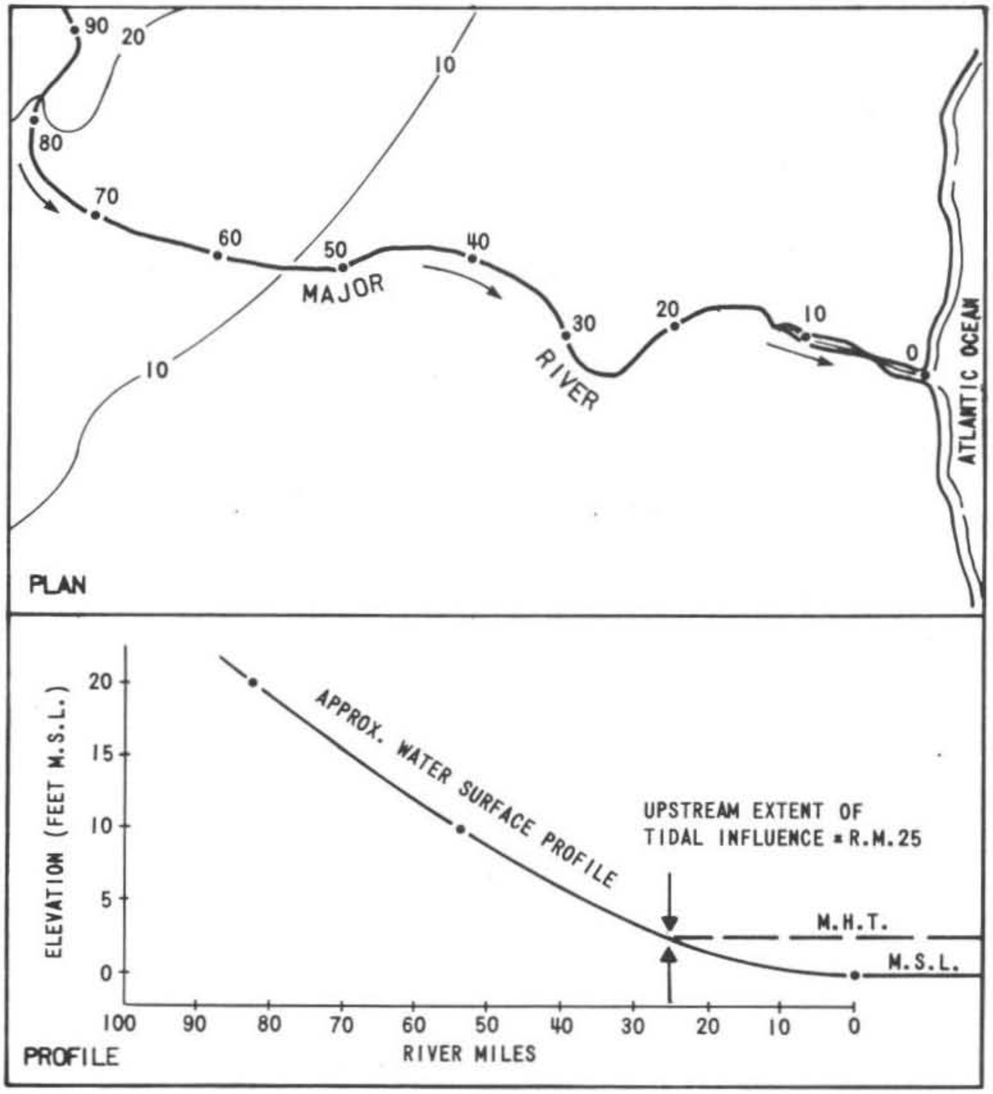
* Data from National Oceanic Survey.

** Factors obtained from Tide Tables 1976.

FIGURE 8
EXAMPLE OF TIDAL LIMIT DEVELOPMENT



and a curve to approximate the mean water surface is fitted. The mht elevation is plotted and extended horizontally to meet the stream profile. The intersection is considered the upstream tidal influence limit for this study.

The above approach was used at each of the rivers noted previously. The significant features drawings in each report have a "T" plotted at the tidal influence limit determined for these rivers. For waterbodies between these streams, the extent of tidal influence was interpolated using contours on USGS quadrangle maps. Section 6 presents further information on the use of the tidal limit data.

Confluence - In many cases where significant secondary streams are tributary to the major river in the report, the river mile location at the confluence on the major river is given in the physical characteristics summary. The river mileage was determined in most cases by using the USGS quadrangle maps and a divider to mark off the miles in tenths between the two known mileage points.

Present Navigable Waters of the U. S. - The present river mile limits of "navigable waters of the U. S." was given in the physical characteristics tables. Section 6 discusses the methodology for determining these limits.

Key Stream Gaging Stations

The key stream gaging stations table presented in each individual report includes only those stations which are currently active with reported flow data and only those located on major streams. Each gaging station listed is identified by stream, USGS gaging station number, location description, drainage area (when available), mean flow, minimum flow, and maximum flow.

The following subsections provide comments on each of these items.

Gaging Station Number - Each gaging station listed is assigned a number by USGS. The numbering system lists them in a downstream direction along the main stream; stations on tributaries are listed between main stream stations in the order in which tributaries enter the main stream.

Location Description - General location of each gaging station with respect to physical features was taken from USGS records.

Drainage Area - Drainage areas presented in the table were also obtained from USGS records.

Mean Flow - Mean flow or mean discharge presented in the table is the arithmetic average of individual daily mean discharges during a long-term monitoring period.

Minimum Flow - Minimum flow data for each gaging station listed was included where available. The minimum stream flow is that flow which is exceeded or equaled 90 percent of the time. For South Carolina, the minimum flow was obtained from the South Carolina Streamflow Characteristics Low-Flow Frequency and Flow Duration (U. S. Geological Survey, Columbia, South Carolina, 1967).

Summaries of Streamflow Records (Thomas, N. O., State of North Carolina Department of Natural and Economic Resources, Office of Water and Air Resources, Raleigh, North Carolina, 1973) was used to obtain minimum flow for North Carolina. However, minimum flow (exceeded or equaled 90 percent of the time) was not given specifically at the 90 percent exceedance level in this publication. Therefore, the flow values just less than 90 percent and just greater than 90 percent were interpolated to estimate the minimum flow at 90 percent level. For example, in the Great Pee Dee report gaging station 0212900 minimum flows are listed at: 91.8 percent = 1,900 cfs; 88.4 percent = 2,400 cfs, by interpolation the 90 percent value is 2,165 cfs.

Maximum Flow - Maximum flow data was presented for each gaging station listed where available. The maximum stream flow is that flow which is exceeded or equaled 10 percent of the time.

The methodology for determining maximum flow is the same as for minimum flow outlined above.

Large Lake Physiographic Characteristics

All lakes within the Charleston District having a surface area of 1,000 acres or more were analyzed and summarized in more depth than the smaller lakes. Selected physiographic characteristics within the lake areas included climate, topography, geology, and elevation. Information was primarily developed from Santee River Basin Water and Land Resources - North Carolina, South Carolina (United States Department of Agriculture - Economic Research Service, Forest Service, Soil Conservation Service, September, 1973).

Large Lake Physical Characteristics

Report 18 summarized selected physical characteristics of the large lakes including lake code and name, upstream drainage area, report drainage area, surface area, gross storage, approximate mean discharge (where available), physiographic province, and water use. The following subsections outline the data sources and development procedures for these items.

Lake Code and Name - All major lakes having a surface area of 1,000 acres or more were included in the Lakes Report. Lakes were coded as noted in Section 7. Lake Inventory (Computer printouts, North Carolina Department of Natural and Economic Resources, Water Planning Section, June 18, 1976); and Inventory of Lakes in South Carolina - Ten Acres of More in Surface Area (Coleman, Foster D., and Joe A. Dennis, Physical Inventory, Report No. 119, State of South Carolina Water Resources Commission, Cayce, South Carolina, January 1974) were used to identify and determine lake surface areas. USGS maps were also used to locate large lakes.

Upstream Drainage Area - The drainage areas upstream of each lake (from headwaters of stream to Lakes report area) were determined using techniques previously described in the Basin Physical Characteristics subsection.

Report Drainage Area - The Lakes Report drainage areas include stream systems which drain directly into portions of the lake. The areas were calculated by combination of planimetering USGS maps and assessing gaging station information as previously discussed.

Surface Area - The approximate surface area (in acres) provided for each major lake was determined from written communications with lake owners and operators and references previously noted above.

Gross Storage - For each major lake the capacity or gross storage (in acre-feet) is provided. Estimates of gross storage were obtained from the lake owners and operators surveyed and references noted above.

Approximate Mean Discharge - The mean annual discharge (in cfs) from each large lake was obtained where available. The estimates were provided either by the owners and operators, or from interpretations of data supplied by them.

Physiographic Province - All lakes within the district fall within one of three physiographic provinces: Coastal Plain, Piedmont, or Blue Ridge. References previously noted in the subsection for large lake physiographic characteristics were used as the basis to present information.

Water Use - The present water use for each major lake falls into five categories: recreation, industrial, power, municipal, and water supply. "Water supply" was used for known withdrawals not associated with the other categories. References as previously noted in the subsection for lake codes and name were used to obtain the data.

Key Lake Gaging Stations

The gaging stations, commonly located just below lake dams, are reported where available. Each gaging station listed is identified by lake code and name, USGS gaging station number, location description, drainage area (when available), and mean, minimum, and maximum flows. The same data sources and procedures were used as discussed earlier for the streams.

SECTION 3

NAVIGATION IMPROVEMENT PROJECTS

- Summary of Findings
- Summary of Methodology

SUMMARY OF FINDINGS

Federal Navigation Projects

One of the factors considered in determining navigation classifications in the Charleston District is the presence of navigation projects. The significant navigation projects throughout the district since the late 1800's are those authorized by the U. S. Congress and constructed under the direction of the U. S. Army Corps of Engineers. Table 4 presents a summary of all navigation projects in the Charleston District. The table identifies the type of work authorized, project location, and current status.

Each of these projects is discussed in more detail in the individual basin reports. As shown in Table 4, the Edisto (03), Cooper (04), Black (06), and Waccamaw (07) River areas have the largest number of authorized navigation projects.

Other Navigation Projects

Several state legislative efforts to improve navigation were directed towards rivers throughout the 19th Century; however, for the most part, little evidence of these projects exists today. There are two navigation projects located in the district, other than the Federal projects cited above, which are still in operating condition.

One of these projects, the Columbia Canal, was initially constructed in the early 1800's. The Canal is still in operation, however, primarily for hydroelectric use. It is no longer used for navigation.

In 1939, work began on a plan known as the Santee-Cooper project. This project was primarily constructed for hydroelectric power. However, upon its completion in 1942, there was added to the two newly-created lakes (Lake Marion and Lake Moultrie) a ship lock intended to handle any waterborne commerce traveling up or down the Cooper River. In addition, a 10 foot deep channel was provided in the wide Congaree Swamp down to the deep water channel of the lower Cooper River.

Other navigation projects initially undertaken by the state during this early period have been improved and are now maintained under Federal jurisdiction.

TABLE 4

SUMMARY OF AUTHORIZED FEDERAL NAVIGATION PROJECTS

Waterbody	Report No.	Work Authorized	Project Location	Status
Atlantic Intra-coastal Waterway	01, 02 03, 04 05 & 07	12 ft deep and 90 ft wide navigation channel, 3 bridges, and 125 ft wide, 335 ft long, and 12 ft deep anchorage	Between Norfolk, Va. and the St. Johns River, Fla.	Completed 1940 except for anchorage
Village Creek	01	8 ft deep and 80 ft wide navigation channel	From Morgan River 2.2 miles upstream	Completed 1965
Archers Creek	01	6 ft deep and 75 ft wide navigation channel	From Beaufort River a distance of 2 miles	Completed 1914
Port Royal Harbor	01	27 ft deep and 500 ft wide navigation channel	Across ocean bar, into Port Royal Sound for 13.2 miles	Completed 1956
		24 ft deep and 300 ft wide navigation channel	From Beaufort River and and Battery Creek for 7.5 miles	Completed 1956
		27 ft deep and 600 ft wide turning basin	Located opposite wharf of S.C. State Ports Authority	Completed 1956
Combahee River	02	Channel clearing	R.M. 22.0 to R.M. 66.5	Completed 1896
Edisto River	03	Channel clearing for rafts and steamers	R.M. 0.0 to R.M. 175.0	Completed 1896
North Fork Edisto River	03	Aquatic Plant Control	R.M. 0.0 to R.M. 27.0	Suspended 1975

TABLE 4 (continued)

SUMMARY OF AUTHORIZED FEDERAL NAVIGATION PROJECTS

Waterbody	Report No.	Work Authorized	Project Location	Status
Ashley River	03	30 ft deep and 300 ft wide navigation channel	R.M. 0.0 to R.M. 7.4	Completed 1940
Abbapoola Creek	03	4 ft deep and 60 ft wide navigation channel	R.M. 0.0 to R.M. 5.0	Work not started
Russell Creek	03	5 ft deep and 60 ft wide navigation channel	R.M. 0.0 to R.M. 4.2	Work not started
Adams Creek	03	10 ft deep and 80 ft wide navigation channel and turning basin	R.M. 0.0 to R.M. 1.5	Completed 1973
Charleston Harbor	03 & 04	Channelization of harbor and tributary streams, construction of two stone jetties, and additional channelization of Naval Commandants Wharf and anchorage basin	R.M. 0.0 to R.M. 26.3 and reaches of surrounding tributaries	Jetties completed 1895; channelization completed 1965 except naval channel and anchorage basin
Cooper River	04, 05 & 18	Diversion canal from Lake Moultrie to the Santee River with 84,000 Kw hydroelectric generating plant	St. Stephens, S. C.	Work started 1977
Shipyard River	04	Channelization with two turning basins	R.M. 0.0 to R.M. 1.2	Completed 1951

TABLE 4 (continued)

SUMMARY OF AUTHORIZED FEDERAL NAVIGATION PROJECTS

Waterbody	Report No.	Work Authorized	Project Location	Status
Beresford Creek	04	6 ft deep and 60 ft wide navigation channel, with widening at bends	To R.M. 1.8 via Clouter Creek	Work not started
Santee River	05	Snagging entire river	R.M. 0.0 to R.M. 143.0 (above present Lake Marion)*	No data
Town Creek	05	10 ft deep and 80 ft wide navigation channel	Bulls Bay, Town Creek	Completed 1974
Black River	06	Aquatic plant control	R.M. 0.0 to R.M. 90.0	Suspended 1974
Black Mingo Creek	06	8 ft deep and 60 ft wide navigation channel	R.M. 0.0 to R.M. 9.9	Completed 1913
Black Mingo Creek	06	Aquatic plant control	R.M. 0.0 to R.M. 10.0	Suspended 1974
Georgetown Harbor	06	27 ft deep and 400 ft to 600 ft varying width channel with turning basin in Sampit River, and 2,400 ft long side channel 18 ft deep and 400 ft wide	From Atlantic Ocean through Winyah Bay with turning basin in Sampit River	Completed 1951

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* This distance does not correspond to river miling developed as a part of this study, which shows a distance of about 124 miles.

TABLE 4 (continued)

SUMMARY OF AUTHORIZED FEDERAL NAVIGATION PROJECTS

Waterbody	Report No.	Work Authorized	Project Location	Status
Waccamaw River	07	12 ft deep and 80 ft wide navigation channel	R.M. 0.0 to R.M. 41.5	Completed 1924
Waccamaw River	07	4 ft deep and 50 ft wide navigation channel	R.M. 41.5 to R.M. 67.0	Completed 1931
Waccamaw River	07	Channel clearing	R.M. 67.0 to R.M. 139.9	No data
Waccamaw River & Seven Creeks	07	Channel snagging and clearing	Waccamaw: R.M. 103.0 to R.M. 108.5 Waccamaw: R.M. 134.5 to R.M. 140.0 Seven Creeks: R.M. 0.0 to R.M. 2.5	Completed 1961
Murrells Inlet	07	Channelization of harbor and tributary streams, construction of two stone jetties	Murrells Inlet	Construction Started 1977
Little River Inlet	07	Channelization of harbor and tributary streams, construction of two stone jetties	Little River Inlet	Planning stage
Congaree River	08	4 ft deep navigation channel with lock and dam	R.M. 125.0 to R.M. 175.9	71% complete as of last report in 1946

TABLE 4 (continued)

SUMMARY OF AUTHORIZED FEDERAL NAVIGATION PROJECTS

Waterbody	Report No.	Work Authorized	Project Location	Status
Wateree River	09	4 ft deep navigation channel	R.M. 0.0 to R.M. 67.0	Abandonment recommended 1939
Clark Creek	10	3 ft deep and 40 ft wide navigation channel	R.M. 0.0 to R.M. 6.1	Completed 1892
Lynches River, Clark Creek System	10	Removal of logs and snags	R.M. 0.0 to R.M. 6.1 (Lawrence Cut)	Completed 1910
Great Pee Dee R.	11	9 to 3.5 ft deep navigation channel	R.M. 27.8 to R.M. 165.0	Completed 1909
Little Pee Dee R	12	4 ft deep navigation channel	R.M. 0.0 to R.M. 99.0	Abandonment recommended 1926
Little Pee Dee R.	12	Aquatic plant control	R.M. 0.0 to R.M. 15.0	Suspended 1975
Lumber River	13	Channel snagging and clearing	R.M. 0.0 to R.M. 63.0	Completed 1897
Yadkin River	17	2.5 ft deep navigation channel	R.M. 286.0 to R.M. 319.0	Abandonment recommended 1926

SUMMARY OF METHODOLOGY

Federal Navigation Projects

The primary document used to identify authorized navigation projects in the Charleston District was the Corps of Engineers' publication Project Maps, Charleston District 1975. Where data was lacking or additional explanation was required, reference was made to the Corps' Annual Report Extracts and, in some cases, to the Corps' Annual Reports.

Information listed on each project generally includes waterbody, type of work authorized, completion date, project location, and authorized legislation. In some cases, project location river mileage did not conform with mileage used during this study (see Obstructions to Navigation subsection). The mileage presented in the reports generally is based on the river miles developed during this study.

Other Navigation Projects

Inquiries were made at various state and local governmental agencies to identify other projects currently in operation, planned, or under construction which would improve or substantially benefit navigation in the district. Two were identified as significant projects in operation today: the Santee-Cooper project, used for hydroelectric power generation and navigation purposes; and the Columbia Canal, presently being used for hydroelectric power. Discussion of these projects can be found in the Summary of Findings section and in the individual basin reports.

Several of the historical non-Federal navigation projects are identified in the interstate commerce sections of the individual basin reports.

SECTION 4

INTERSTATE COMMERCE

- Summary of Findings
- Summary of Methodology

SUMMARY OF FINDINGS

One of the several factors considered in establishing navigation classifications is the use of waterbodies for interstate commerce activities in the past, present, and future.

Generally, the interpretation of historical records indicates navigational use of waterbodies in the Charleston District existed from colonial times through the late 19th Century. Many waterbodies were used extensively for transportation of goods and people to and from the inland regions. This use continued until the arrival of additional railway lines in the post-Civil War years of the 1880's and 1890's. These railroads gradually lured the waterborne traffic away from the rivers. Practically all the waterborne traffic was diverted to railroad and highway transportation with the building of the paved highway system in the period between 1925 and 1950.

Interstate commerce activity is presently confined to a few harbors, coastal inland waterways, and portions of other coastal plain waterbodies as indicated in the individual navigation reports. The construction of the interstate highway system has in recent years caused a reduction in the use of waterways in the area.

Future potential use of streams for interstate commerce is affected by numerous economic and social variables which make predictions difficult. As regional and national economic trends change, the degree of commerce activity on the waterbodies in the Charleston District may also change.

The extent of use of streams for interstate commerce is summarized in Section 6.

SUMMARY OF METHODOLOGY

To determine the extent of past and present interstate commerce on waterbodies in the Charleston District, it was necessary to research various published records, papers, and books by historical writers. Dr. John W. Gordon, Assistant Professor, Department of History, The Citadel, assisted in research of the past and present interstate commerce activities. Dr. Gordon's experience on similar work involved research of Corps of Engineers' records, newspaper clipping files, records of the 6th Naval District, shipping company reports, state archives, the files of the State Ports Authority, and various monographs containing transportation records.

Information gathered for the historical analysis included research of the following legal holdings, archival holdings, and scholarly collections: National Archives, Washington, D. C.; National Archives Southeastern Regional Records Center, Atlanta Georgia; Library of Congress, Washington D. C.; Corps of Engineers Records (National Archives), Washington, D. C.; South Carolina State Archives, Columbia, South Carolina; North Carolina State Archives, Raleigh, North Carolina; Corps of Engineers District Office, Charleston, South Carolina; and the Duke University Library.

An interstate commerce file was established for each of the eighteen reports within the navigation study. Data was placed in a chronological order, as it became available for each of the basins. When sufficient data accumulated, it was developed into a narrative form for the navigation reports.

It was necessary to make some analysis and judgments of potential future interstate commerce to assist in establishing navigation classifications. Since a comprehensive analysis of regional economics was beyond the scope of the navigation study, available research information was obtained by contacting the various Federal, state, and local agencies. State, regional, and local planning agencies provided a great deal of data (i.e., population, economic, transportation, and employment) for decisions.

SECTION 5

LEGAL AUTHORITY

- Summary of Findings
- Summary of Methodology

SUMMARY OF FINDINGS

General

One of the factors considered in determining navigation classifications for waterbodies in the Charleston District is the implication of court decisions.

Table 5 presents the results of a search of court case records to identify the Federal and state legal actions which relate to navigation of waterbodies in the district. Table 5 identifies specific Federal cases, South Carolina state cases, North Carolina state cases, and recent Federal litigation. The waterbodies affected and the case references are summarized. As shown in Table 5, the Edisto River area (03) and the Waccamaw River basin (07) have had the largest number of court actions.

Subsequent subsections in this "Summary of Findings" present a synopsis of the legal interpretations concerning navigation as recorded in both Federal and state court decisions. References to the principal court actions are provided. In addition, the authority for Federal agency jurisdiction concerning navigation is presented. The individual basin reports provide a brief summary of the allegations and the conclusions drawn for each of the court decisions listed in Table 5 to further indicate the legal authority for navigation.

Navigability Interpretations

Definitions - The term "navigable waters of the U. S." is used to define the scope and extent of the regulatory powers of the Federal government. Precise definitions of "navigable waters" or "navigability" are ultimately dependent on judicial interpretation, and cannot be made conclusively by administrative agencies.

Definitions of "navigability" are used for a wide variety of purposes, and vary substantially between Federal and state courts. Primary emphasis must therefore be given to the tests of navigability which are used by the Federal courts to delineate Federal powers. Statements made by state courts, if in reference to state tests of navigability, are not authoritative for Federal purposes. [See

TABLE 5

SUMMARY OF COURT CASES

Type of Case	Report No.	Waterbodies Affected	Case Reference
Federal	05	Kinlock Creek, tributary of the Santee River, opposite Minim Creek and the North Santee River	Manigault v. Springs, 199 U.S. 473, 26 Sup. Ct. 127 (1905)
	07	Winyah Bay, Jones Creek, Town Creek, and Bread and Butter Creek, leading from the Atlantic Ocean, via North Inlet, into Winyah Bay	Chisolm v. Caines, 67 Fed. 285 (Circuit Court, D. South Carolina, 1895)
	08, 15	Columbia Canal - Congaree and Broad Rivers	State of South Carolina ex rel. Maybank v. South Carolina Electric and Gas Co., 41 F. Supp. 111 (1941)
	09, 16	Catawba River	In re Houser's Petition, 227 F. Supp. 81 (W.D.N.C. 1964)
	09, 16	Catawba River	United States v. Mecklenburg Abattoir and Locker Plant, Inc. (W.D.N.C. 1972)
	14, 18	Lake Murray	Thompson v. South Carolina Electric and Gas Co. 122 F. Supp. 313 (1954)
State-South Carolina	01, 02	Palmer's Creek, Haulover Creek, Horse Island Creek, Sheephead or Fish Creek, South Wimbee Creek, Chisholm's Creek and Big Creek, off Coosaw River, in Beaufort County	State v. Pacific Guano Co., 22 S.C. 50 (1884)

TABLE 5 (continued)

SUMMARY OF COURT CASES

Type of Case	Report No.	Waterbodies Affected	Case Reference
State-South Carolina (cont.)	01, 02	Beaufort County tidal area, near Coosaw River, Parrot Creek, Morgan River and St. Helena Sound	State v. Pickney, 22 S.C. 484 (1884)
	01, 02	Shingle Creek, tributary of Coosaw River in Beaufort County	Heyward v. Farmer's Mining Co., 42 S.C. 138, 19 S.E. 963 (1894)
	03	McTier Creek, branch of the South Edisto River	State v. Collum, 2 Spears 581 (S.C. 1844)
	03	Shaw Creek, tributary of the Edisto River	State v. Hickson, 5 Rich. 447 (S.C. 1844)
	04, 05	Bull's Bay tidal area	Cape Romain Land and Improvement Co. v. Georgia-Carolina Canning Co., 148 S.C. 428, 146 S.E. 434 (1926)
	04, 05	Santee and Cooper Rivers	Rice Hope Plantation v. South Carolina Public Service Authority, 216 S.C. 500, 59 S.E. 2d 132 (1950)
	04, 05 08, 09	Santee, Cooper, Congaree, and Wateree Rivers	Early v. South Carolina Public Service Authority, 228 S.C. 392, 90 S.E. 2d 472 (1955)
	07	Murrells Inlet	State v. Murrells Inlet Camp and Marina, Inc., 259 S.C. 404, 192 S.E. 2d 199 (1972)

TABLE 5 (continued)

SUMMARY OF COURT CASES

Type of Case	Report No.	Waterbodies Affected	Case Reference
State-South Carolina (cont.)	07	Salt Creek, on Pawleys Island	State v. Hardee, 193 S.E. 2d 497 (1972)
	08	Congaree River	Boatwright v. Bookman, Rice 447 (S.C. 1839)
	08	Congaree River	State v. City of Columbia, 27 S.C. 137, 3 S.E. 55 (1887)
	08, 15	Columbia Canal, Broad and Congaree Rivers	State v. Columbia Water Power Co., 82 S.C. 181, 63 S.E. 884 (1909)
	15	Enoree River	Cates v. Wadlington, 1 McCord 580, 10 Am. Dec. 699 (S.C. 1822)
	15	Little River, tributary of the Broad River	Noble v. Cunningham, McMul, Eq. 289 (S.C. 1841)
	15	Pacolet River	State v. Thompson, 2 Strobe 12 (S.C. 1847)
	15	Tyger River	Shands v. Triplet, 5 Rich Eq. 76 (S.C. 1852)
	16	Catawba River	Jackson v. Lewis, Cheves 259 (S.C. 1840)
	16	Catawba River	McCullough v. Wall, 4 Rich. 68, 53 Am. Dec. 715 (S.C. 1850)

TABLE 5 (continued)

SUMMARY OF COURT CASES

Type of Case	Report No.	Waterbodies Affected	Case Reference
State-North Carolina	11	Great Pee Dee River	Dunlop v. Carolina Power and Light Co., 212 N.C. 814, 195 S.E. 43 (1938)
	16	Catawba and Johns Rivers	Commissioners of Burke County v. Catawba Lumber Co., 116 N.C. 731, 21 S.E. 941 (1895)
Recent Federal Litigation	01	Atlantic Ocean and Harbor River	United States v. Davis O. Heniford, Jr., U.S.D.C., South Carolina, Civil Action No. 74-865
	02	Fish Creek at South Fenwick Island	United States v. William S. Baldwin and Hugh H. Lee, U.S.D.C., South Carolina, Civil Action No. 75-1772
	02, 03	Mosquito and Musselboro Creeks, tributaries of Ashepoo River	United States v. Hugh H. Lee and R. T. Lee, U.S.D.C., South Carolina Civil Action No. 75-1844
	03, 04	Charleston Harbor	Milton P. Demetre v. Howard Callaway and Harry S. Wilson, Jr., U.S.D.C., South Carolina, Civil Action No. 74-553
	03	Church Creek at Wadmalaw Island	United States v. Fred H. Horlbeck, U.S.D.C., South Carolina, Civil Action No. 75-952

TABLE 5 (continued)

SUMMARY OF COURT CASES

Type of Case	Report No.	Waterbodies Affected	Case Reference
Recent Federal Litigation (cont.)	03	Ashley River	United States v. Thomas M. Evans and Magellan R. Brunson, U.S.D.C., South Carolina, Civil Action No. 75-1094
	03	Steamboat and Russell Creeks, tributaries of North Edisto River	United States v. Anthony P. Cecil, U.S.D.C., South Carolina, Civil Action No. 76-69
	03	Oak Island Canal, off Folly Creek	Oak Island Environmental Protection Association etc. v. United States of America, et al., U.S.D.C., South Carolina, Civil Action No. 76-358
	04	The Cove, connected to the Atlantic Intracoastal Waterway and Charleston Harbor	John D. Cappelmann, Jr., et al, v. Gary E. Everhardt, National Park Service Director, et al, U.S.D.C., South Carolina, Civil Action No. 76-387
	04	Inlet Creek, off Atlantic Intracoastal Waterway and tributary of Breach Inlet	United States v. E. Stanley Barnhill, U.S.D.C., South Carolina, Civil Action No. 76-883
	07	Cherry Grove tidal area	United States v. Phil Permenter, U.S.D.C., South Carolina, Civil Action No. 74-593

TABLE 5 (continued)

SUMMARY OF COURT CASES

Type of Case	Report No.	Waterbodies Affected	Case Reference
Recent Federal Litigation (cont.)	07	Waccamaw River, Thoroughfare and Barrack Creeks	Sandy Island Development Corp. v. Col. Robert Nelson and the United States Army Corps of Engineers, U.S.D.C., South Carolina, Civil Action No. 74-640
	07	Pawleys Island Creek	United States v. Winford Johnson, U.S.D.C., South Carolina, Civil Action No. 74-1936
	07	House Creek, Cherry Grove area	United States v. Phillip R. Permenter, U.S.D.C., South Carolina, Civil Action No. 75-542
	07	Waccamaw River	United States v. E. A. Dorman, U.S.D.C., South Carolina Criminal No. 76-250
	18	Lake Marion	United States v. Edward M. Mitchell, U.S.D.C., South Carolina, Civil Action No. 73-1125

Wisconsin v. Federal Power Commission, 214 F. 2d 334, 336-37 (7th Cir. 1954), cert. den. 348 U.S. 883 (1954), discussing regulatory powers; cf. Brewer-Elliott Oil & Gas Co., v. United States 260 U.S. 77, 87 (1922); and United States v. Utah, 283 U.S. 64, 75 (1931), regarding title questions.]

Tests - Federal courts may recognize variations in the definition or its application where different Federal powers are under consideration. For instance, tests of navigability can be distinguished:

1. Where the test is used to determine questions of title to beds underlying navigable waters and a Federal question is involved, e.g., United States v. Holt State Bank, 270 U.S. 55-56 (1926);
2. Admiralty jurisdiction, which is not dependent upon commerce but nevertheless utilizes similar terminology, e.g., In re Garnett, 141 U.S. 1, 12, 15 (1891), The Lucky Lindy, 76 F. 2d 561 (5th Cir. 1935), George v. Beavark, 402 F. 2d 977 (8th Cir. 1968);
3. Federal regulatory powers, as concern this study, United States v. Appalachian Electric Power Co., 311 U.S. 377, at 408 (1941).

Unfortunately, courts often fail to distinguish between the tests, and instead rely on precedents which are inapplicable to the facts before them. The most notable example occurs when waters are considered "not navigable" on the basis of a state court decision in an action brought to determine a title question between private landowners. Such a decision would have no direct impact on the question of existence of Federal regulatory jurisdiction, except insofar as the state court were to have adopted Federal tests as part of its test of navigability. Similarly, a finding that waters are "navigable" may have a somewhat different meaning than "navigable waters of the U. S."

Application in this Study - In implementation of this study, the term, "navigable waters of the U. S.", is used to define the extent and scope of certain regulatory powers of the Federal government. This term is distinguished from the term "waters of the U. S." ("navigable waters"), which defines the extent and scope of certain other regulatory powers of the Federal government.

Administratively, the term, "navigable waters of the U. S.", has been defined to mean waters that have been used in the past, are now used, or are susceptible to use as a means to transport interstate commerce landward to their ordinary high water mark and up to the head of navigation as determined by the Chief of Engineers, and also waters subject to the ebb and flow of the tide shoreward to their mean high water mark. These waters are deemed subject to a Federal "navigation servitude". This term, "navigable waters of the U. S.", defines the more restricted jurisdiction which has in the past pertained and will continue to pertain to the River and Harbor Act of 1899. In contrast, the term "waters of the U. S." ("navigable waters") defines the new broader jurisdiction with respect to Section 404 of the Federal Water Pollution Control Act Amendments of 1972. Accordingly, "waters of the U. S." not only include those waters subject to the navigation servitude, but adjacent or contiguous wetlands, tributaries, and other waters, as more fully defined in Corps of Engineers Regulations published in the Federal Register 19 July 1977.

Although this navigability study embraces both "navigable waters of the U. S." and "navigable waters", the legal analyses presented in this Section and in the individual river and lake reports have focused only upon determining "navigable waters of the U. S." to the head of navigation. In other words, the legal analyses will provide input to the Charleston District's recommendations, from which the Chief of Engineers can make administrative determinations as to the delineation of "navigable waters of the U. S." However, due to common usages, the terms, "navigability" or "navigable waters", may appear in this Section interchangeably with the term, "navigable waters of the U. S." It must be recognized that the scope and purpose of this legal summary is to embrace and ascertain traditional notions of navigability which could apply to the Federal regulatory jurisdiction of the River and Harbor Acts, and not necessarily regulatory jurisdiction under the Federal Water Pollution Control Act.

General Federal Case Law

The power of the Federal government over navigable waters stems from the Commerce Clause, U. S. Constitution, Art. I, §8 [Gibbons v. Ogden, 22 U.S. (9 Weat.) 1, 189-90 (1824); Levy v. United States, 177 U.S. 621, 632 (1900); United States v. Appalachian Elec. Power Co., 311 U.S. 377, 404 (1940)]. The River and Harbor Act of 1899 was enacted by Congress pursuant to its powers under the Commerce Clause [Economy Light and Power Co. v. United States, 256 U.S. 113, 121, (1921)]. The constitutionality of Section 10 of the River and Harbor Act of 1899, 33 U.S.C. §403, has never been opened to serious question [Louisville Bridge Co. v. United States, 242 U.S. 409, 421 (1917); Wisconsin v. Illinois, 278 U.S. 367, 414 (1929)].

Stream Use - The well-established Federal test of navigability is whether a body of water is used or is capable of being used in conjunction with other bodies of water to form a continuous highway upon which commerce with other states or countries might be conducted. The classic statement of the definition is found in The Daniel Ball, 77 U.S. (10 Wall) 557, 563 (1870):

> "Rivers are navigable in fact when they are used or are suseceptible of being used, in their ordinary condition, as highways for commerce, over which trade and travel are or may be conducted in customary modes of trade and travel on water. And they constitute 'navigable waters of the U. S.' within the meaning of the Act of Congress, in contradistinction from the 'navigable waters of the U. S.', when they form in their uniting with other waters, a continued highway over which commerce is or may be carried on with other states or foreign countries in the customary modes in which such commerce is conducted by water."

In decisions following The Daniel Ball, supra, make it clear that a waterway which was navigable in its natural or improved state retains its character as "navigable in law" even though it is not presently used for commerce. The basic rule of "indelible navigability" was established by Economy Light & Power Co. v. United States, 256 U.S. 113, 123, (1921), and has been followed on numerous occasions: United States v. Appalachian Electric Power Co., 311 U.S. 377, 408 (1941); Oklahoma ex rel Phillips v. Guy F. Atkinson Co., 313 U.S. 508, 523 (1941); Puente de Reynosa, S.A. v. McAllen, 357 F. 2d 43, 50

(C.A. 5, 1966); George v. Beavark, Inc., 402 F. 2d 977, 978 (C.A. 8, 1969).

The decided cases since The Daniel Ball, supra, are uniform that the test of navigability is not whether the particular body of water is in fact being used for any form of commerce but rather whether it has the capacity for being used for some type of commerce. "To appraise the evidence of navigability on the natural condition only of the water is erroneous. Its availability for navigation must also be considered." [See United States v. Appalachian Elec. Power Co., 311 U.S. 377, 407 (1940)]. As noted in United States v. The Montello, 87 U.S. (20 Wall) 430, 441 (1874):

> "The capability of use by the public for purposes of transportation and commerce affords the true criterion of the navigability of a river, rather than the extent and manner of that use. If it be capable ... of being used for purposes of commerce, no matter in what mode the commerce may be conducted, it is navigable in fact, and becomes in law a public river highway."

The cases holding that navigation in fact follows from susceptibility for navigation as well as present use are legion. [See, e.g., Levy v. United States, 177 U.S. 621, 631 (1900); Economy Light & Power Co. v. United States, 256 U.S. 113, 121-22 (1921); United States v. Utah 283 U.S. 64, 82 (1931); United States v. Rio Grande Dam & Irrigation Co. 174 U.S. 690, 698 (1898); United States v. Banister Realty Co., 155 F. 583, 590 (E.D.N.Y. 1907)].

Tide Ebb and Flow - Another test, the ebb and flow of the tide, remains a constant rule of navigability in tidal areas. Use of the ebb and flow rule, although commonly applied in the nation's early history, as in The Steamboat Thomas Jefferson, 23 U.S. (10 Wheaton) 248, has often been disfavored as a test of Federal jurisdiction because of the court's comment in The Daniel Ball, 77 U.S. (10 Wall) 557 at 563, that "the ebb and flow of the tide do not constitute any test at all of the navigability of waters". That remark has been used by a later court in Pitship Duck Club v. Town of Sequim, 315 F. Supp. 309 (1970), to hold that tidal ebb and flow is not a Federal test of navigability. However, The Daniel Ball dictum was in reference to fresh water inland rivers and was based on a rather broad reading of the case, Propeller Genesses Chief v. Fitzhugh, 53 U.S. (12 Howard) 443. In the latter case, continued use of the ebb and flow test was abandoned insofar as the effect of that test would be to limit jurisdiction only to tidal waters, and thereby exclude other inland waters which were clearly navigable in fact, but not tidal. Thus, the court noted that jurisdiction extended to all "public navigable waters", and that the ebb and flow test had incorrectly been "substituted in the place of the thing intended to be described". (Id. at 455). The Genesses Chief, therefore, by dropping reliance on ebb and flow as the sole criteria of navigability, made possible the extension of Federal jurisdiction into the major non-tidal inland waters, adopting instead an examination of the waters "navigable character". The ebb and flow test, however, remains valid as a rule of navigability in tidal areas; it is merely no longer a restriction for non-tidal areas. For bays and estuaries, this would extend to the entire surface and bed of all waterbodies subject to tidal action, even though portions of the waterbody may be extremely shallow or obstructed by shoals, vegetation, or other barriers so long as such obstructions are seaward of the mean high water line [United States v. Baker 2 ERC 1849, (S.C. N.Y. 1971); United States v. Banister Realty Company, 155 F. 583, 595 (1907); United States v. Turner, 175 F. 2d 644, 647 (1949), cert. den. 338 U.S. 851 (1949)]. Marshlands and similar areas are thus considered "navigable in law" insofar as they are subject to inundation by the mean high waters. The relevant test is therefore the presence of the mean high tidal waters. "Navigable waters" are considered navigable laterally over the entire surface regardless of depth. Thus in Greenleaf-Johnson Lumber Company v. Garrison, 237 U.S. 251, 253 (1915), the court noted that the Congressional power extends "to the whole expanse of the stream, and is not dependent upon the depth or shallowness of the water. To recognize such distinction would be to limit the power when and where its exercise might be most needed."

"The dominant power of the Federal government has been repeatedly held, extends to the entire bed of a stream, which includes the land below the ordinary high-water mark," [United States v. Chi., M., St. P. & P.R.R. Co., 312 U.S. 592, 596-97 (1941)]. That the mean high water is the terminating boundary of "navigable" waters is uniformly accepted [United States v. Virginia Elec. & Power Co., 365 U.S. 624, 629 (1961); United States v. Kansas City Life Insurance Co., 339 U.S. 799, 804-05 (1950); United States v. Moretti, 331 F. Supp. 151, 158 (S.D. Fla. 1971) rev. on other grounds, 478 F. 2d 418 (C.A. 5, May 15, 1973); United States v. 2,899.17 Acres of Land in Brevard County, Fla. 269 F. Supp. 903, 909 (N.D. Fla. 1967)].

The ordinary high water mark has been viewed by Federal courts as that line which separates fast land from the river bed [United States v. Kansas City Life Insurance Company, 339 U.S. 799 (1950); United States v. Virginia Electric and Power Company, 365 U.S. 624, 627-28 (1961); United States v. Twin City Power Company, 350 U.S. 222 (1956), and extends to the area where the soil has been covered by water for sufficient periods of time to destroy terrestrial vegetation [United States v. Chicago, B. & O.R. Company, 90 F. 2d 645, 647-48 (C.A. 3, 1965), cert. den 382 U.S. 902 (1965); Oklahoma v. Texas, 260 U.S. 606, 632 (1923)].

Assertion of regulatory jurisdiction over tidal areas deemed navigable was upheld in United States v. Baker, 2 ERC 1849 (S.D.N.Y. 1971) Zabel v. Tabb, 430 F. 2d 199 (1970) cert. den., 401 U.S. 910 (1971); and United States v. Lewis, 355 F. Supp. 1132 (1973). [See also, United States v. Bannister Realty Co., 155 F. 583, 595 (1907); United States v. Turner, 175 F. 2d 644, 647 (1947) cert. den. 338 U.S. 851, (1949) cited with approval in United States v. California, 381 U.S. 139, 171 (1965).]

A number of cases have recognized that low-lying wetlands which are subject to the ebb and flow of the tide from a navigable water are themselves navigable waters [United States v. Baker 2 ERC 1849, 1850 (S.D.N.Y. 1971) (wetland marsh in tidal area); cf. Zabel v. Tabb, 430 F. 2d 199, 203 (1970), cert. den. 401 U.S. 910 (1971) (Private riparian submerged land); Texas v. Chuoke, 154 F. 2d 1, 3, cert. den. 329 U.S. 714 (1946) (bayous)].

Stream Characteristics - Navigable waters are considered navigable laterally over their entire surface regardless of depth. Thus, in Greenleaf-Johnson Lumber Co. v. Garrison, 237 U.S. 251, 263 (1915), the court noted that the Congressional power extends "to the whole expanse of the stream, and is not dependent upon the depth or shallowness of the water. To recognize such distinction would be to limit the power when and where its exercise might be most needed". [See also, United States v. Ray, 423 F. 2d 16, 19 (5th Cir. 1970); Miami Beach Jocky Club v. Dern, 93 F. 2d 715, 718 (D.C. Cir. 1936) cert. den. 299 U.S. 556 (1936); Scranton v. Wheeler, 179 U.S. 141, 163 (1900); Allen Gun Club v. U.S., 180 Ct. Cl. 423, 429 (1967); cf. Hoopengarner v. United States, 270 F. 2d 465, 470 (6th Cir. 1959); cf. Swan Island Club v. White, 114 F. Supp. 95, 98 (E.D.N.C. 1953) affirmed 209 F. 2d 698 (4th Cir. 1954).]

Whatever title a party may claim under state law, the private ownership of the underlying lands has no bearing on the existence or extent of the dominant Federal jurisdiction over "navigable waters of the U. S." [United States v. Chicago, M., St. P. and P.R.R. Co., 312 U.S. 592, 596 (1941)].

Ownership of a river or lake bed will vary according to state law; however, the Supreme Court has consistently held that title to the bottomlands is subordinate to the public right of navigation. The bench mark decision remains that of the Supreme Court in United States v. Chandler-Dunbar Water Power Co., 229 U.S. 53, 62 (1913):

> "This title of the owner of fast land up the shore of a navigable river to the bed of the river is, at best, a qualified one ... It is subordinate to the public right of navigation, and however helpful in protecting the owner against the acts of third parties, is of no avail against the exercise of the great and absolute power of Congress over the improvement of navigable rivers. That power of use and control comes from the power to regulate commerce between the states and with foreign nations. It includes navigation and subjects every navigable river to the control of Congress."

[See also Lewis Blue Point Oyster Cultivation Co. v. Briggs, 227 U.S. 82, 87-88 (1913).] Moreover, the Federal government's navigation servitude may be exercised "without payment of compensation to one who under state law may hold 'technical' legal title (as between himself and others than the government) to a part of the navigable stream's bed" [United States v. Commodore Park, Inc., 324 U.S. 386, 390 (1945)].

It is important that a court may take judicical notice of the navigability of waters ("navigable waters of the U.S.") within its jurisdiction, Arizona v. California, 283 U.S. 423 (1931).

Reservoirs - Finally, the question has been raised as to permit authority on reservoirs created by private hydropower dams. The presumption is made that the stream, prior to formation of a pool, was (and continues to be) a "navigable water of the U. S." When a reservoir on a "navigable water of the U. S." raises the level of the water to heights above those of the former riverbed, the dam also raises the ordinary highwater mark. This authority is supported in Borough of Ford City v. United States, 345 F. 2d 645 (3rd Cir. 1965), which mentioned pre-dam high water marks and post-dam high water marks. In Philadelphia Co. v. Stimson, 223 U.S. 605, 634-35 (1912), the Supreme Court said:

> "The alterations produced in the course of years by the action of the water do not restrict the exercise of Federal control in the regulation of commerce. Its bed may vary and its banks change, but the Federal power remains paramount over the stream. The public right of navigation follows the stream ... and the authority of Congress goes with it ..."

Although the preceding case did not distinguish between natural and man-made fluctuations in the water level, when the case is read in conjunction with Beaver v. United States, 350 F. 2d 4, 11 (9th Cir. 1965), Burns v. Forbes, 412 F. 2d 995, 997 (3rd Cir. 1969), and United States v. Claridge, 416 F. 2d 933, 935 (9th Cir. 1969), the implication is that there would be no jurisdictional difference whether the stream change is natural or artificial. The latter cases held that, in applying the accretion doctrine to navigable waters, whether the changes are the result of natural or artificial causes does not matter. Accordingly, when navigable waters are artificially modified, the plane of the ordinary high water mark is also modified. Corps of Engineers' jurisdiction under the River and Harbor Acts extends, minimally, to the new limits of ordinary high water.

Federal - Navigability, in the sense of actual usability for navigation, or navigability in fact, as a legal concept embracing both public and private interests, is not susceptible to identification or determination of a precise formula which fits every type of stream or body of water under all circumstances and at all times (United States v. Appalachian Electric Power Co., 311 U.S. 377, 85 L. Ed. 243, 61 S. Ct. 291, reh den 312 U.S. 712, 85 L. Ed. 1143, 61 S. Ct. 548). A general definition or test which has been formulated for Federal purposes is that rivers or other bodies of water are navigable when they are used, or are susceptible of being used, in their ordinary condition, as highways for commerce, over which trade and travel are or may be conducted in the customary modes of trade and travel on water (Utah v. United States, 403 U.S. 29 L. Ed. 2d 279, 91 S. Ct. 1775; United States v. Utah, 283 U.S. 64, 75 L. Ed. 844, 51 S. Ct. 438; United States v. Holt State Bank, 270 U.S. 49, 70 L. Ed. 465, 46 S. Ct. 197).

The question of navigability of water when asserted as a basis of a right arising under the constitution of the United States, as is the case with "navigable waters of the U. S.", is necessarily a question of Federal law to be determined according to the general rule recognized and applied in the Federal courts (United States v. Holt State Bank, 270 U.S. 49, 70 L. Ed. 465, 46 S. Ct. 197).

Table 5 presents a summary of the Federal court cases relating to specific waterbodies in the Charleston District. A detailed summary of each case appears in the individual report dealing with the appropriate streams and lakes.

Specific Court Cases

South Carolina - The current South Carolina legislative enactment defining navigability and requiring freedom from obstruction may be found in Section 70-1 of the South Carolina Code of Laws, South Carolina Code Ann. §70-1 (1962), which provides:

"All streams which have been rendered or can be rendered capable of being navigated by rafts of lumber or timber by the removal of accidental obstructions and all navigable watercourses and cuts are hereby declared navigable streams and such streams shall be common highways and forever free, as well to the inhabitants of this state as to citizens of the United States, without any tax or impost therefor, unless such tax or impost be expressly provided for by the General Assembly. If any person shall obstruct any such stream, otherwise than as in this Title provided, such person shall be guilty of a nuisance and such obstruction may be abated as other public nuisances are by law."

The issue of navigability has arisen in a number of civil and criminal actions in the state courts of South Carolina concerning waterbodies within the current boundary of the Charleston District of the Corps of Engineers. The state cases in which navigability became an issue are summarized in Table 5. More detailed summaries are found in the individual river and lake reports.

It must be recognized that many of the South Carolina state cases reported are primarily concerned with state ownership questions. In this regard, the original states, upon achieving their independence, succeeded to the rights which the prior sovereign had in waters as well as other property. Thus, the control over streams used by the public as well as ownership in the beds of such streams is vested in the sovereign states [3 American Law of Property 249 (A. Casner ed. 1952); 1 Waters and Water Rights 206 (R. Clark et. 1967)]. While the states exercised control over their navigable waters, the ultimate authority was granted to the Federal government by the Commerce Clause of the Constitution (U.S. Const. Art. 1 §8). Even so, the actual ownership of the streams remains in the states [Martin v. Waddell, 41 U.S. 367 (1842)].

The general rule, then, is that the states both own and control the navigable streams within their borders, subject to exercise of the superior right of control in the U. S. [3 American Law of Property 245 (A. Casner ed. 1952); 1 Waters and Water Rights 207 (R. Clark ed. 1967)]. State and Federal concepts of navigability may not agree, but when Federal interests are at stake, the Federal test will govern.

That test was laid down in an 1870 case, The Daniel Ball, 77 U.S. 557, 563 (1870)]:

> "Those rivers must be regarded as public navigable rivers in law which are navigable in fact. And they are navigable in fact when they are used, or are susceptible of being used, in their ordinary condition, as highways for commerce, over which trade and travel are, or may be, conducted in the customary modes of trade or travel on water. And they constitute 'navigable waters of the U. S.', within the meaning of the acts of Congress, in contradistinction from the 'navigable waters of the States' when they form in their ordinary condition, by themselves, or by uniting with other waters, a continued highway over which commerce is or may be, carried on with other states or foreign countries, in the customary modes in which such commerce is conducted by water."

This test, as refined and interpreted, is still the Federal rule (1 Waters and Water Rights 206, R. Clark ed. 1967).

In The Daniel Ball [77 U.S. 557 (1870)], the Supreme Court rejected the common law rule existing at the time of independence. In England, as well as in civil law countries, only tidewaters, those waters where the tide ebbs and flows, were considered navigable [3 American Law of Property 252 (A. Casner ed. 1952); 1 Waters and Water Rights 208 (R. Clark ed. 1967)]. Most states, following in the Federal footsteps, rejected the common law rule and even assumed title of both tidal and non-tidal stream beds susceptible of actual navigation [3 American Law of Property 252 (A. Casner ed. 1952); 1 Waters and Water Rights 207-08 (R. Clark ed. 1967)].

There are exceptions, however, to the "overwhelming majority rule of state ownership of lands beneath navigable waters," [1 Waters and Water Rights 208 (R. Clark ed. 1967)] and South Carolina is in the minority. In the minority states, it was considered that property rights were vested at the time of succession to sovereignty and that the state took title only to tidal-navigable streams while riparian owners took title to all stream beds, both navigable and non-navigable, if non-tidal [3 American Law of Property 252 (A. Casner ed. 1952)]. Even in the minority states, however, the private ownership of the bed will not affect the rights of the public to use navigable waters.

North Carolina - The issue of navigability has arisen in a number of actions in the state courts of North Carolina. However, most of these cases concern coastal areas not within the boundary of the Charleston District which embraces the (non-coastal) west-central portion of the state.

Basically, the English common-law rule that streams are navigable only as far as tidewater extends is not the rule in North Carolina. Thus, unlike South Carolina previously discussed, North Carolina conforms to the majority rule within the U. S.

Relevant North Carolina state cases concerning waterbodies within the Charleston District are summarized in Table 5. Detailed discussions of the specific cases are found in the individual river and lake reports.

Recent Federal Litigation - Table 5 presents a summary of recent Federal litigation concerning the Charleston District, Corps of Engineers. The cases are presented in more depth in the individual reports. The litigation summaries indicate jurisdictional "navigable waters of the U. S." wherein recent activities have entailed court actions.

Federal Agency Jurisdiction

The delineation of "navigable waters of the U. S." as enumerated in the previous subsection "General Federal Case Law", in essence, defines the Federal navigation servitude and is applicable to Federal jurisdiction generally (not merely the Corps of Engineers). No matter which Federal agency or activity may be involved, the assertion of "navigability" ("navigable waters of the U. S.") arises under the Federal Constitution, or under application of Federal statute.

By virtue of the Commerce Clause of the Federal Constitution, and the clause empowering Congress to make all laws necessary to carry into execution the Federal judicial power in admiralty and maritime matters, "navigable waters of the U. S." are under the control of Congress, which has the power to legislate with respect thereto. It is for Congress to determine when and to what extent its power shall be brought into activity (Gilman v. Philadelphia, 3 Wall 713, 18 L. Ed.

96), and it may be exercised through general or special laws (Economy Light, etc., Co. v. United States, 41 S. Ct. 409, 256 U.S. 113, 65 L. Ed. 847), and by Congressional enactments or by delegation of authority (United States v. Republic Steel, 264 F. 2d 289, reversed on other grounds 80 S. Ct. 884, 362 U.S. 482, 4 L. Ed. 2d 903, rehearing denied 80 S. Ct. 1605, 363 U.S. 858, 4 L. Ed. 2d 1739, on reward 286 F. 2d 875).

Thus, Congress has power which is paramount to that of the states (Winston Bros. Co. v. Galloway, 121 P. 2d 457, 168 Or. 109) to make improvements in the navigable streams of the U. S. (United States v. Chicago, M. St. P. & P. R. R. Co., 61 S. Ct. 772, 312 U. S. 592, 313 U. S. 543, 85 2 Ed. 1064) and for this purpose to determine and declare what waters are navigable (Continental Land Co. v. U. S., 88 F. 2d 104, certiorari denied, 58 S. Ct. 36, 302 U. S. 715, 82 2 Ed. 552). The Federal government also has the power to regulate the use of, and navigation on, navigable waters (Southern Pc. Co. v. Western Pac. R. Co., 114 F. 160, reversed on other grounds 151 F. 376).

The foregoing basis upon which Federal jurisdiction is established is a basic definition or jurisdictional concept of "navigable waters of the U. S." which remains consistent, irrespective of which department or office of the Federal government may be delegated particular responsibility. For instance, the safety, inspection, and marine working functions of the U. S. Coast Guard embrace vessel traffic within "navigable waters of the U. S."

With specific reference to Federal agency regulation of construction or work within "navigable waters of the U. S.", other than by the Corps of Engineers, the Department of Transportation Act of 15 October 1966 (P. L. 89-670) transferred to and vested in the Secretary of Transportation, certain functions, powers, and duties previously vested in the Secretary of the Army and the Chief of Engineers. By delegation of authority from the Secretary of Transportation [49 CFR 1.46(c.)], the Commandant, U. S. Coast Guard, has been authorized to exercise certain of these functions, powers, and duties relating to bridges and causeways conferred by the law relating generally to the location and clearances of bridges and causeways in the "navigable waters of the U. S." (33 U.S.C. 491 Et. seq., 33 U.S.C. 525 et. seq.).

An additional agency involved in work or construction within "navigable waters of the U. S." is the Federal Power Commission. The Federal Power Act, (Title 16, U. S. Code, Sections 791 et. seq.) contemplates the construction and operation of water power projects on navigable waters in pursuance of licenses granted by the Federal Power Commission (First Iowa Hydro-Electric Cooperative v. Federal Power Commission, 66 S. Ct. 906, 328 U. S. 152, 90 2 Ed. 1143; Northern States Power Co. v. Federal Power Commission, 118 F. 2d 141). The statute was enacted to develop, conserve, and utilize the navigation and water power resources of the nation (U. S. ex rel. Chapman v. Federal Power Commission, 191 F. 2d 796, affirmed 73 S. Ct. 609, 345 U. S. 153, 972 Ed. 918; Georgia Power Company v. Federal Power Commission, 152 F. 2d 908); to provide for the improvement of navigation, the development of water power, and the use of public lands in relation thereto (Montana Power Company v. Federal Power Commission, 330 F. 2d 781), and to make progress with the development of the water power resources of the nation (City of Tacoma v. Taxpayers of Tacoma, 78 S. Ct. 1209, 375 U. S. 320, 2 2 Ed. 2d 1345; First Iowa Hydro-Electric Co-op v. Federal Power Commission, 66 S. Ct. 906, 328 U. S. 152, 90 2 Ed. 1143, rehearing denied 66 S. Ct. 1336, 328 U. S. 879, 90 2 Ed. 1647).

SUMMARY OF METHODOLOGY

The research of court case history for the navigability study was conducted by Mr. James E. Epstein, Assistant District Counsel, Charleston District. Text for this Summary Report and the eighteen basin reports was prepared in draft form by Mr. Epstein and edited by Stanley Consultants for inclusion herein.

In compiling and preparing this study, Mr. Epstein sought to explore a general body of law relating to navigable bodies of water within the Charleston District by setting out the ramification of currently existing law within the framework of five separate and distinct headings:

1. Delineation of "navigable waters of the U. S."
2. Federal cases relating to specific waterbodies within the Charleston District.
3. State cases relating to navigability of specific South Carolina waterbodies within the Charleston District.
4. State cases relating to navigability of specific North Carolina waterbodies within the Charleston District.
5. Status of recent Federal litigation within the Charleston District.

The first category involved legal research dealing with those seminal cases which are the benchmark of Federal law in the area. This required extensive research into the various legal terms and periodicals on the subject, such as books, law review articles, and esoteric journals.

The next subject required that all the available indices, such as West's Federal Practice Digest, Moore's Federal Practice Digest, etc., be consulted and all cases dealing with waterways within the Charleston District collected. After studying these cases, Mr. Epstein summarized them and drew the necessary inference for inclusion in the several reports which are a part of the navigability study.

In dealing with the South Carolina cases on navigable waters, all the relevant material cases from the Southeastern Digest, the South Carolina Code, and journals such as the South Carolina Law Review were collected. For the North Carolina waterways, the same procedures noted immediately above were employed, using material on North Carolina.

SECTION 6

NAVIGATION OBSTRUCTIONS AND CLASSIFICATIONS

- Summary of Findings
- Summary of Methodology

SUMMARY OF FINDINGS

General

This "Summary of Findings" presents the classification of all waterbodies in the Charleston District based upon the analyses performed. One of the factors involved in the classification process is an evaluation of obstructions to navigation. A summary of obstructions is also presented.

Obstructions

Table 6 presents a summary of the number and type of obstructions and length of river in which they are located, for each basin in the district. (Obstructions in waters between the tidal limit and practical limit of "navigable waters of the U. S.", as defined in the "Summary of Methodology" part of Section 6, were the principal ones investigated as a part of this study.) A complete tabulation of all obstruction data (including flows and stream slopes) is presented in the eighteen individual reports. In addition, photographs of all obstructions are presented in each of the individual basin reports.

Classification

Table 7 presents a summary of recommended classifications for all of the applicable rivers and lakes within the district. River mileages shown in the table are from the mouth of the corresponding waterbody unless otherwise noted. In some cases, stream classifications continue upstream of specific report areas (i.e., Wateree). The table presents limits for these specific rivers and report areas and references the continuation of the classification upstream of that area. A dash or blank river mile indicates a limit has not been established. Rivers and lakes not shown in the table, if tidally influenced, are classified "navigable waters of the U. S." All other waterbodies in the district are class fi d " at rs ‹ f the U. S." (formerly "navigable waters"). Plate 3 graphically shows all of these navigation classifications with the exception of small streams recommended as "practically navigable waters of the U. S." and "navigable waters of the U. S." These streams are shown in Table 7 only. Additional background information, analyses, and discussion of classification limits are presented in the individual reports for specific waterbodies.

TABLE 6

OBSTRUCTION SUMMARY

Report Number	Basin/Area Name	River Miles Between Tidal & Recommended Practical Limits	Bridges	Utility Crossings
01	Coosawhatchie	0.0	--	--
02	Combahee	6.0	3	5
03	Edisto	112.9	17	34
04	Cooper	3.1[2)]	2	4
05	Santee	50.7[2)]	2	3
06	Black	77.6	8	13
07	Waccamaw	69.5	6	7
08	Congaree	50.6	5	9
09	Wateree	76.1	7	13
10	Lynches	114.3	19	16
11	Great Pee Dee	155.2	12	30
12	Little Pee Dee	59.0	4	5
13	Lumber	63.4	11	20
14	Saluda	0.0	--	--
15	Broad	0.0	--	--
16	Catawba	0.0	--	--
17	Yadkin	0.0	--	--
18	Lake Marion	--[3)]	3	1
	Lake Moultrie	--[3)]	1	--

1) Within waterbody mileage noted.

2) Upstream areas are also practically navigable. See Reports 08, 09, and 18.

3) Navigable throughout.

TABLE 7
SUMMARY OF NAVIGATION CLASSIFICATIONS[1]

Waterbody	Report Number	Present Limit of Navigable Waters of the U.S. (R.M.)	Historic Limit of Navigation (R.M.)	Recommended Practical Limit of Navigation (R.M.)	Recommended Limit of Navigable Waters of the U.S. (R.M.)
Coosawhatchie River Area	01				
Coosawhatchie River		9.0	9.0	--	9.0
Combahee River Area	02				
Combahee River		49.4	49.4	43.0	49.4
Salkehatchie River		17.1	17.1	Not Practical	17.1
Edisto River Area	03				
Edisto River		113.0	113.0	113.0	113.0
South Fork Edisto R.		41.0	60.0	23.6	41.0
North Fork Edisto R.		27.2	50.0	9.8	27.2
Four Hole Swamp		5.0	5.0	3.5	5.0
Cooper River Area	04				
Cooper River		48.1[2]	See Reports 14, 15 & 16	48.1[2]	48.1[2]
Santee River Basin	05				
Santee River		125.3[3]	See Reports 14, 15 & 16	87.7[4]	87.7[4]
Black River Area	06				
Black River		49.6	100.0	107.7	107.7
Black Mingo Creek		9.9	31.0	9.9	9.9

TABLE 7 (continued)
SUMMARY OF NAVIGATION CLASSIFICATIONS[1)]

Waterbody	Report Number	Present Limit of Navigable Waters of the U.S. (R.M.)	Historic Limit of Navigation (R.M.)	Recommended Practical Limit of Navigation (R.M.)	Recommended Limit of Navigable Waters of the U.S. (R.M.)
Black River Area (continued)	06				
Secondary channel near R.M. 42.5		Not Classified	--	0.4	0.4
Secondary channel and lake near R.M. 43.5		Not Classified	--	0.2	0.2
Lester Creek		Not Classified	--	0.8	0.8
McGinney Creek		Not Classified	--	0.2	0.2
Waccamaw River Basin	07				
Waccamaw River		140.0	147.0[5)]	129.5	140.0
Secondary channel near Big Savannah Bluff		Not Classified	--	0.4	0.4
Big Savannah Lake		Not Classified	--	0.2	0.2
Secondary channel near R.M. 97.5		Not Classified	--	0.3	0.3
Gore Lake		Not Classified	--	1.0	1.0
Congaree River Basin	08				
Congaree River		50.6	See Reports 14 & 15	50.6	50.6
Wateree River Basin	09				
Wateree River		76.1[5)]	See Report 16	76.1	76.1[5)]
Little River		Not Classified	--	0.3	0.3

TABLE 7 (continued)
SUMMARY OF NAVIGATION CLASSIFICATIONS[1)]

Waterbody	Report Number	Present Limit of Navigable Waters of the U.S. (R.M.)	Historic Limit of Navigation (R.M.)	Recommended Practical Limit of Navigation (R.M.)	Recommended Limit of Navigable Waters of the U.S. (R.M.)
Lynches River Basin	10				
Lynches River		42.5	121.2	114.3	114.3
Clark Creek		6.0	6.0	1.0	6.0
Muddy Creek		3.0	--	Not Practical	3.0
Tie Lake		Not Classified	--	0.6	0.6
Great Pee Dee River Basin	11				
Great Pee Dee R.		165.0	165.0	188.2	188.2
Clark Creek			(See Lynches River)		
Jacobs Creek		0.5	--	Not Practical	0.5
Jordan Creek		1.0	--	0.6	1.0
Jordan Lake		1.0	--	1.0	1.0
Staple Lake		Not Classified	--	0.5	0.5
Byrds Island (trib)		Not Classified	--	0.2	0.2
Little Pee Dee River Basin	12				
Little Pee Dee R.		99.0	99.0	59.0	99.0
Russ Creek		1.0	--	1.0	1.0
Russ Lake		1.5	--	1.5	1.5
Dead River		Not Classified	--	1.1	1.1
Jiles Creek		Not Classified	--	0.5	0.5
Tributary near R.M. 4.2		Not Classified	--	0.4	0.4
Byrd Island (trib)		Not Classified	--	0.6	0.6

TABLE 7 (continued)
SUMMARY OF NAVIGATION CLASSIFICATIONS[1]

Waterbody	Report Number	Present Limit of Navigable Waters of the U.S. (R.M.)	Historic Limit of Navigation (R.M.)	Recommended Practical Limit of Navigation (R.M.)	Recommended Limit of Navigable Waters of the U.S. (R.M.)
Little Pee Dee River Basin (continued)	12				
Johnson Big Lake		Not Classified	--	0.5	0.5
Gunter Lake		Not Classified	--	0.5	0.5
The Falls		Not Classified	--	1.5	1.5
Carmichael Lake		Not Classified	--	0.4	0.4
Broad Lake		Not Classified	--	0.2	0.2
Bass Lake		Not Classified	--	0.2	0.2
Smokey Lake		Not Classified	--	0.5	0.5
Tributary near R.M. 51.9		Not Classified	--	0.1	0.1
Tributary near R.M. 55.7		Not Classified	--	0.2	0.2
Lumber River Basin	13				
Lumber River		63.4	106.0	63.4	63.4
Secondary channel near R.M. 10.1		Not Classified	--	0.1	0.1
Secondary channel near R.M. 10.3		Not Classified	--	0.1	0.1
Saluda River Basin	14				
Saluda River		10.0 to 50.0[6]	143.0	Not Practical	10.0 to 64.0
Broad River Basin	15				
Broad River		Not Classified	From 263.0 to 330.0[7]	Not Practical	Not Navigable

TABLE 7 (continued)
SUMMARY OF NAVIGATION CLASSIFICATIONS[1)]

Waterbody	Report Number	Present Limit of Navigable Waters of the U.S. (R.M.)	Historic Limit of Navigation (R.M.)	Recommended Practical Limit of Navigation (R.M.)	Recommended Limit of Navigable Waters of the U.S. (R.M.)
Catawba River Basin	16				
Catawba River		110.0[8)] to 163.5	257.0	Not Practical	163.5
Yadkin River Basin	17				
Yadkin River		Not classified	From 286.0[9)] to 319.0	Not Practical	Not Navigable
Lakes	18				
Lake Moultrie		Upstream of Lake	Upstream of Lake	Upstream of Lake	Upstream of Lake
Lake Marion		Upstream of Lake	Upstream of Lake	Upstream of Lake	Upstream of Lake
Lake Murray		Upstream end of Lake	Upstream of Lake	Not Practical	Upstream of Lake
Wateree Lake		Upstream of Lake	Upstream of Lake	Not Practical	Upstream of Lake
Fishing Creek Res.		Upstream of Lake	Upstream of Lake	Not Practical	Upstream of Lake
Lake Wylie		Upstream end of Lake	Upstream of Lake	Not Practical	Upstream end of Lake

1) All river miles are from mouth of each respective waterbody unless otherwise noted.
2) Pinopolis Lock and Dam is considered the end of Cooper River. See Reports 08, 09, and 18 for upstream classifications.
3) Includes Lake Marion. Classification extends into upstream report areas (see Reports 08, 09, 15).
4) No navigable entrance through Santee Dam (R.M. 87.7); however, upstream areas to R.M. 125.3 are navigable via Cooper River.
5) Classification extends to upstream report areas.
6) Lake Murray.
7) River mileage here has been extended through the Santee River, Lake Marion, and Congaree River.
8) River mileage here has been extended through the Wateree River, Wateree Lake, and Fishing Creek Lake.
9) River mileage here has been extended through the Great Pee Dee River.

SUMMARY OF METHODOLOGY

General

This part of Section 6 presents the classification categories and definitions, references, data acquisition techniques, and procedures used in evaluating both regulatory and practical navigation classification limits. Portions of this "Summary of Methodology" also reviews information presented in the individual basin reports and provides a more detailed explanation of field work, data development, and computational procedures.

Navigation Classification Categories

This study classifies streams into the following categories:

1. Present "navigable waters of the U. S." (by present regulatory procedures).
2. Recommended "navigable waters of the U. S." (comparing regulatory and practical limits).
3. Recommended "practical navigable waters of the U. S." (non-regulatory practical limits).
4. Headwaters for all waterbodies (identifies waters generally requiring permit application).
5. Historically navigable waters for interstate commerce purposes (based on literature review).

Figure 9 presents these categories and the factors used in their development. The following subsections discuss these factors in detail.

Navigation Classification Procedures

As noted in Section 5, definition of navigability is not subject to a single precise formula which applies to every circumstance. Many factors including stream physical characteristics (depth, width, flow, slope, etc.), presence of obstructions, court decisions, authorized navigation projects, potential for reasonable improvements, and susceptibility of a stream to interstate commerce activities, play a role in the decision-making process for classifying waterbodies in the Charleston District. In an effort to make the analytical process concerning stream classifications as systematic as possible, a "Navigability Decision Diagram" has been developed and is presented as Figure 9. This diagram has been utilized as a guide in assessing the various navigation classifications for streams in the Charleston District.

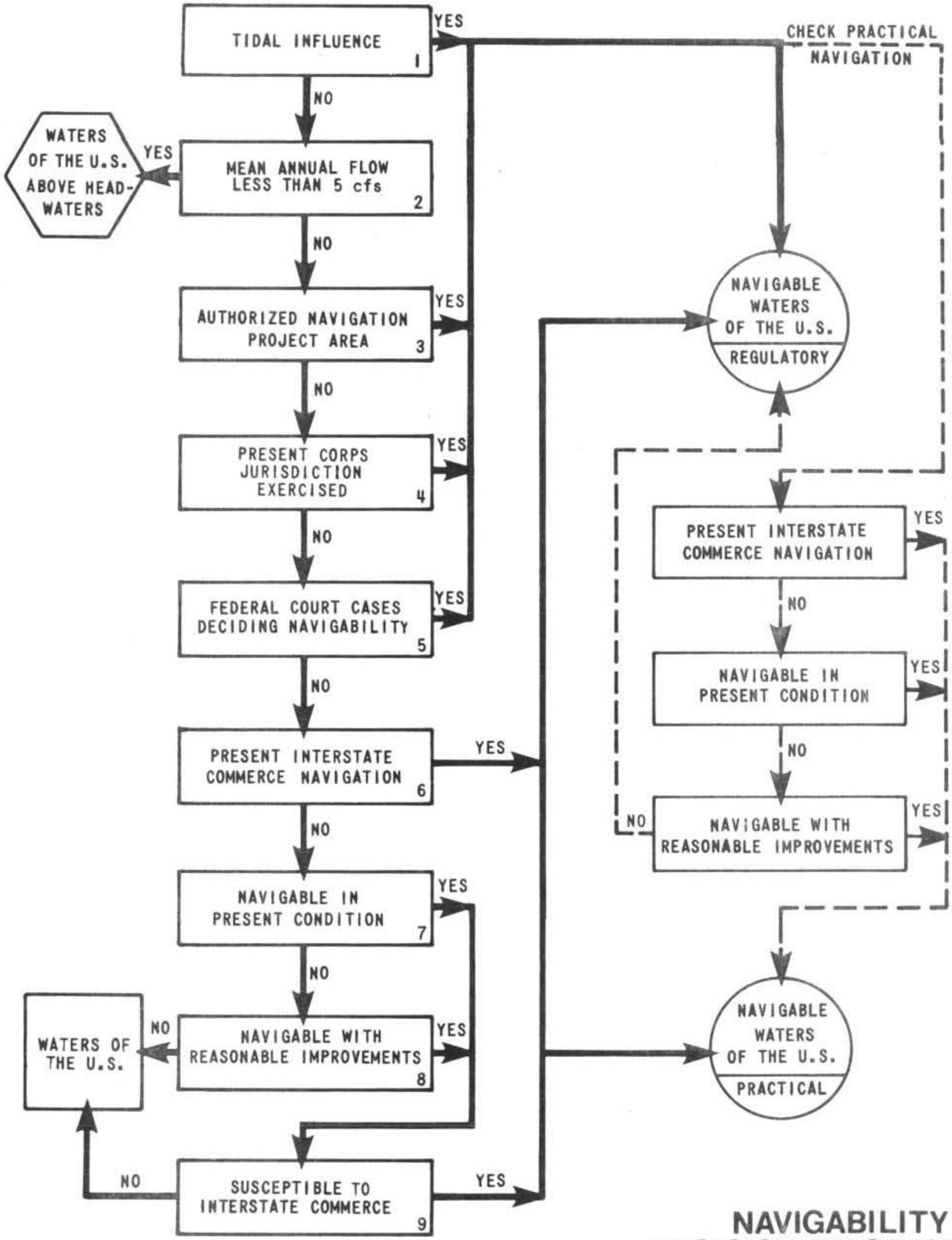
As shown in the figure, several factors have been investigated to determine both regulatory and practical classification limits. The first five factors involve review of hydrological, legal, and Corps project and procedure data. As shown in Figure 9, if a positive response is obtained in these first steps on the Decision Diagram, the waterbody is classified "navigable waters of the U. S." for regulatory purposes. Although this classification is governing and will be upheld by law, an additional investigation into the practical ability of such waterbodies to support present-day navigation has also been made (Figure 9).

If negative responses are obtained through Item 5, the remaining tests are applied to determine the waterbody classification -- both regulatory as well as practical limits.

Throughout the analysis, judgment was required in applying the Decision Diagram. The remainder of this section discusses each of these factors beginning with those associated with regulatory jurisdiction and continuing through those dealing with practical limits. In addition, for waters found to be practically navigable, data and plates have been prepared and are presented as a part of this study. Discussion of these developments is also presented in this section.

<u>Tidal Influenced Areas</u>

All tidal areas which are affected by mean high water are classified, both present and recommended, "navigable waters of the U. S." (Item 1 in Figure 9) according to various legislative and judicial actions. All "navigable waters of the U. S." are subject to regulatory jurisdiction by the Corps of Engineers and other agencies. The methodology used in determining the upstream extent of tidal influence on major streams is presented in Section 2.



NAVIGABILITY DECISION DIAGRAM
Figure 9

After the tidal influence limits were defined on major streams, the elevations were extrapolated between major rivers to determine the approximate limit of tidal influence on smaller streams and lakes. This attempt to determine approximate tidal influence limits for all streams and lakes was used primarily to define waterbodies requiring five cfs point location (see Section 7 and subsequent parts of Section 6 for additional detail).

Many streams are clearly located within the zone of tidal influence. However, marginal cases do exist where additional investigation will be required for determining the exact limit. These results were not intended to precisely define the point to which marginal streams are subject to Corps jurisdiction under the River and Harbor Acts. Instead, they were meant to provide a convenient reference and large scale classification boundary to waterbodies in the district. Likewise, classification limits extending only to tidal limits are estimates and may require detailed hydraulic analysis to precisely define them. Charleston District staff are aware of the need to undertake field surveys when a specific area is in question on tidal influence.

Although all tidal areas are classified "navigable waters of the U. S." and subject to regulatory procedures, many are not practically navigable based upon past and/or present requirements for vessels. Figure 9 shows that some additional "check" analyses are necessary to distinguish those tidal waters which are actually capable of practical navigation. Investigation of the tidal areas was beyond the scope of this study; however, drawings showing the "plan" of major rivers to the mouth, often tidal influenced, and the coastal area, are presented in individual basin reports and the Coastal Supplement.

Waters of the U. S. Above Headwaters

If a stream or lake is located outside of the tidal limits, as defined in the previous section, it was investigated to determine if its flow is greater than five cfs. The Corps of Engineers is considering all streams or parts of streams with a mean annual flow of less than five cfs as "waters of the U. S.", not generally requiring individual or general permits under Section 404 of PL 92-500 (control of dredged or fill material) provided the proposed work meets certain conditions. Item 2 in Figure 9 shows this testing procedure for the five cfs point which is considered to be the "headwaters" for all "waters of the U. S." Tabulations of five cfs points (headwater locations) are found in Appendix A - Stream Catalog in each basin report (01 through 18). The following discussion describes the steps that were used to determine and identify five cfs points.

Development of Lines of Equal Average Yield (LEAY) - LEAY show graphically the average yield per unit area (cfs/sq.mi.), or "productivity factor", by means of an iso-line. Values within the district ranged from 0.6 to 4.0 cfs/sq.mi. A LEAY map for North Carolina was available from the North Carolina Department of Water and Air Resources. No map showing LEAY for South Carolina was available so one was developed using USGS stream gage information. Figure 10 is a schematic representation of the actual map developed. The LEAY was determined by calculating the average unit yield of the gage drainage area and connecting gage locations having the same yields. This process is similar to development of a topographic contour map with points of equal average yield being used in lieu of elevation points. Considerable judgment was required in developing the map, particularly in the coastal area between the last gaging station and the ocean. The LEAY were also coordinated with the North Carolina map so the lines would match. LEAY for the entire report study area were transferred to 1:24,000 and 1:62,500 USGS quadrangle maps for working purposes. State county maps (1:126,720) were used when USGS map coverage was not available.

Delineation of Major and Tributary Stream Drainage Basins - All major streams and tributary drainage basins were outlined on the same USGS quadrangle maps or county maps with LEAY.

Location of Five cfs Points on Streams - To facilitate the task of estimating the approximate size drainage area needed to yield an average discharge of five cfs as a function of LEAY, clear acetate templates of various shapes and scales were prepared. These templates were placed on USGS quadrangle maps or county maps to estimate the point on each stream in the study area which has a drainage area approximately equal to the size area necessary to produce a mean annual flow of five cfs. In some areas planimeters were used in lieu of the templates.

FIGURE 10
LINES OF EQUAL AVERAGE YIELD (LEAY) FOR
SOUTH CAROLINA

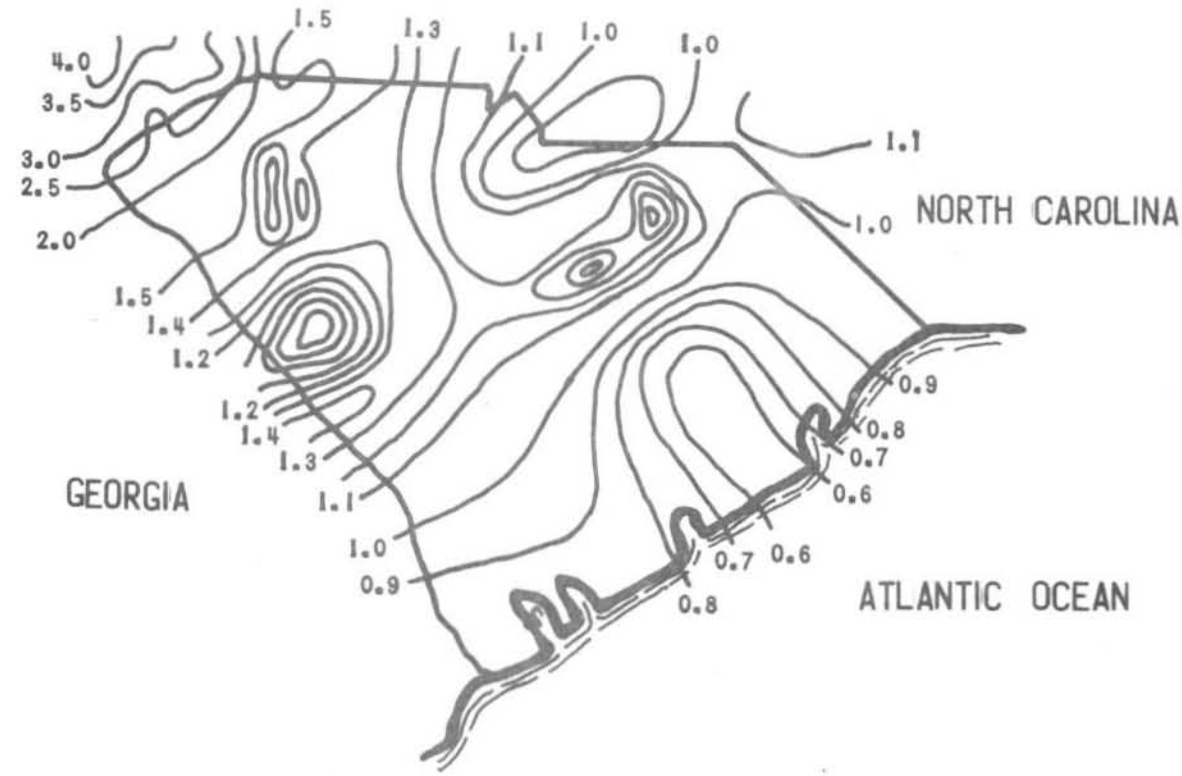
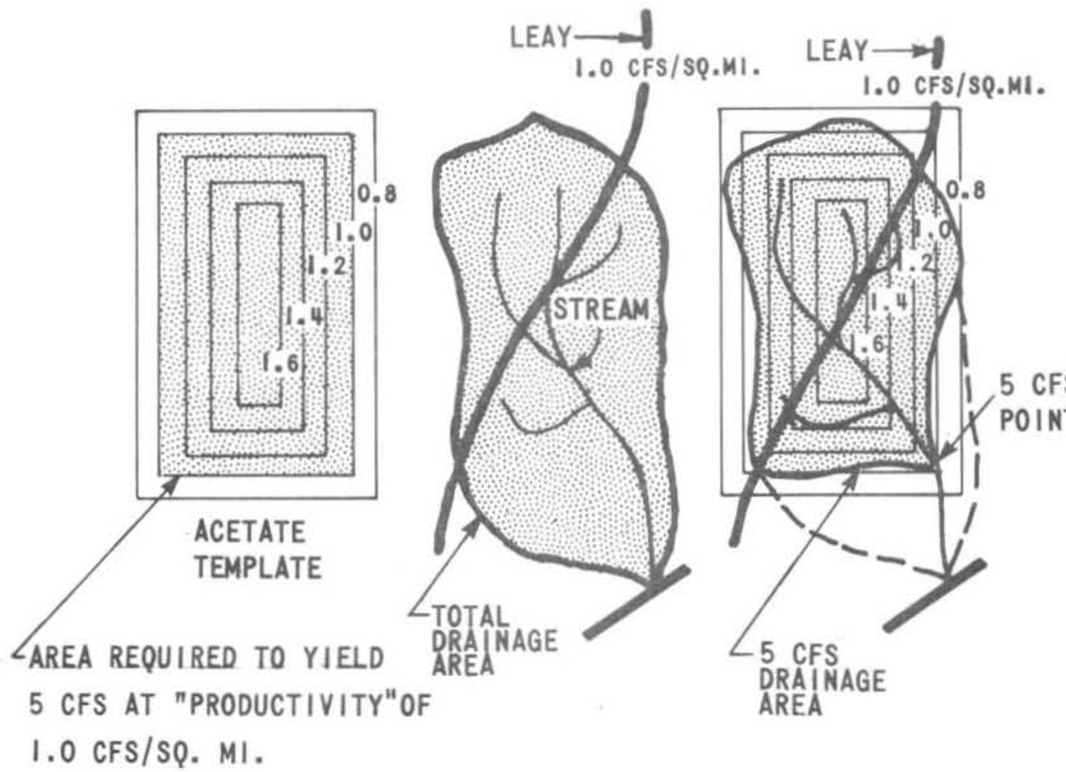


Figure 11 illustrates the use of the template for estimating the five cfs point.

FIGURE 11
DRAINAGE AREA DETERMINATION FOR
FIVE CFS POINT LOCATION



Five cfs Point - As previously noted, all five cfs point locations are tabulated in the respective basin reports in Appendix A - Stream Catalog and are marked on the USGS or county working maps (for reference purposes). In the Stream Catalog (see Section 7) the points are identified by numerical stream code, stream name, latitude and longitude (to the nearest 5 seconds), and distance upstream or downstream from the nearest named tributary, highway, railroad, or similar reference point.

As previously mentioned, five cfs points were only developed for streams outside the tidal influence area. These streams are entirely within "waters of the U. S." The five cfs points identify the location upstream of which individual or general permits are generally not required provided the proposed work will meet certain conditions, although the Corps still has legal jurisdiction over these waters under Section 404 of PL 92-500. Additional discussion of all waters with less than five cfs mean annual flow is presented later in this section.

As evidenced from the foregoing discussion, the methodology for determining the five cfs points produces only approximate results. The LEAY can provide a reasonable estimate of typical conditions but do not reflect unusual local situations which can occur on small watersheds. The Charleston District staff is aware of the potential need to undertake field surveys for certain areas that may be questionable for permits. However, in most instances the points presented in the individual basin reports will serve as an adequate guide to the location of five cfs points for permit processing.

Authorized Navigation Project Area

Any streams or lakes which have current or previously authorized Federal projects to aid navigation are classified as regulatory "navigable waters of the U. S." up to the project limits (Item 3 in Figure 9). Those waterbodies outside the tidal zone have been further investigated to determine the practicality of present-day navigation. (These investigations are discussed later in this section.)

The primary procedure used for determining the authorized navigation project area was to review the Project Maps - Charleston District 1975 (U. S. Army Corps of Engineers, Office of the District Engineer, Charleston, South Carolina, 1975), and the 1974 Annual Report Extract of the Chief of Engineers. Additional extracts of annual reports, some as early as 1896, were obtained from the Charleston District; however, in some cases the river mileages cited in these references differed from the river mileages used in this study (river mile procedures are presented later in this section).

Present Corps Jurisdiction Exercised

The Corps of Engineers is exercising jurisdiction on a few non-tidal waterbodies which are not covered by authorized projects (Item 4 in

Figure 9). Determinations previously made on these waterbodies under the River and Harbor Act indicated use for interstate commerce and hence the current classification as "navigable waters of the U. S." Some of these streams and lakes are not currently navigable by present-day commercial vessels and thus have been investigated to determine their practical limits. Figure 9 shows the "check" used to assess the practical limits of "navigable waters of the U. S."

The Charleston District, Corps of Engineers provided a tabulation entitled RCS ENGCW-ON (OT) 725, "Incomplete List of Navigable Waters", identifying these waterbodies and their limits. The limits of these waters are presented in Table 7 of this report, as well as in the individual basins and lake reports.

Federal Court Decisions

As noted in Section 5, Federal case law is the predominant indicator which is to be used for establishing Federal jurisdiction over waterbodies in the Charleston District (Item 5 in Figure 9). Several decisions have been rendered which classify certain streams and lakes in the district as "navigable waters of the U. S." Section 5 and the individual basin reports summarize these court actions; Section 5 outlines the methodology used to develop the information. Figure 9 shows the additional "checks" used to determine the practical navigation on the waterbodies judicially classified as "navigable waters of the U. S."

Present Interstate Commerce Navigation

Any rivers and lakes currently involved in interstate commerce activities are classified as "navigable waters of the U. S." from both the regulatory and practical standpoint (Item 6 in Figure 9). Section 4 previously outlined the procedures for determining the use of waterbodies for interstate commerce purposes.

Navigable in Present or Improved Condition

To assess the capability of various waterbodies to support navigation in a present or improved condition, several tests were developed. The tests were applied to determine both regulatory and practical navigation classifications. For those waterbodies which receive a "no" response to the first six steps in the Decision Diagram (Figure 9), the tests developed determine both the regulatory and practical navigation. For those waterbodies which receive a "yes" response to Items 1, 3, 4, and 5 in Figure 9, the tests establish the practical navigation potential.

The following steps, including field work and computational analysis, were involved in testing the navigable condition of streams. The methodology presented herein was developed because no existing data or guidelines were available to assess the potential for river navigation.

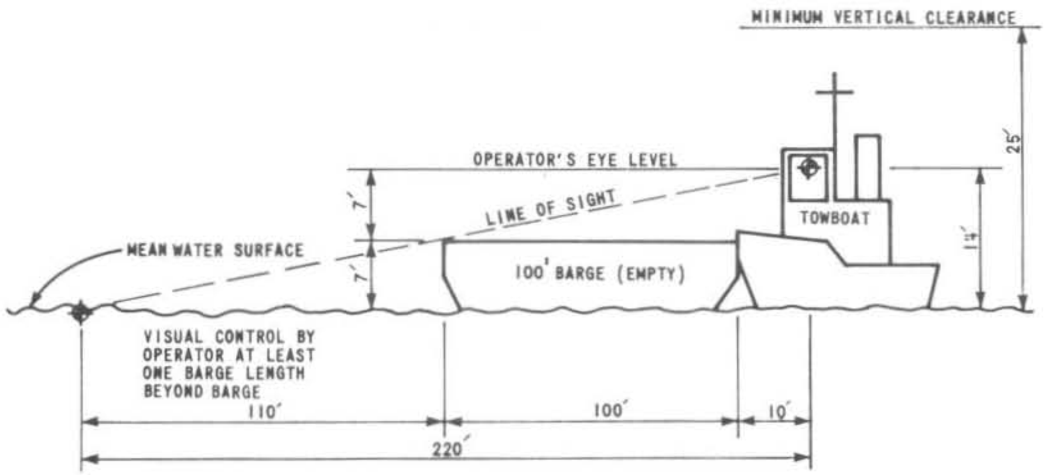
Dimensional Criteria - A set of channel dimension and slope criteria was developed for this study. The criteria were based on information collected from towing companies in the Charleston area and other reports and technical literature. The following information concerning practical commercial navigation requirements was obtained.

1. The towing companies generally indicated a 500-ton (payload) barge was the practical minimum for river traffic in the region. These barges are about 32 feet wide by 100 feet long and draw 6 feet of water when loaded. LASH (lightering aboard ship) vessels are a relatively new concept in water transportation. These vessels are simply small box-like barges that may be towed individually or in groups and may also be stacked aboard ships for ocean travel. LASH barges are about 31 feet wide by 62 feet long and draw nearly 9 feet when loaded.
2. Navigable waters should have a stream gradient no greater than 1 foot per mile and preferably no more than 1/2 foot per mile. Velocities are too great for safe commercial traffic on streams with steeper slopes.
3. Most channels in the U. S. are 9 feet deep and the trend is for even greater depths. Minimum dimensions across a stream for suitable navigation range from 300 feet to slightly under 100 feet. Two-way tow traffic should have at least

25 feet bank clearance and about 35 feet between tows. Vertical clearances of around 50 feet are common.

4. For practical reasons and safety, it is desirable that the operator of a vessel pushing barges be able to see at least a distance of one barge length in front. Figure 12 shows the minimum vertical clearance of 25 feet required for such a sight distance using 100-foot barges.

FIGURE 12
RELATIONSHIP OF SIGHT DISTANCE TO
VERTICAL CLEARANCE



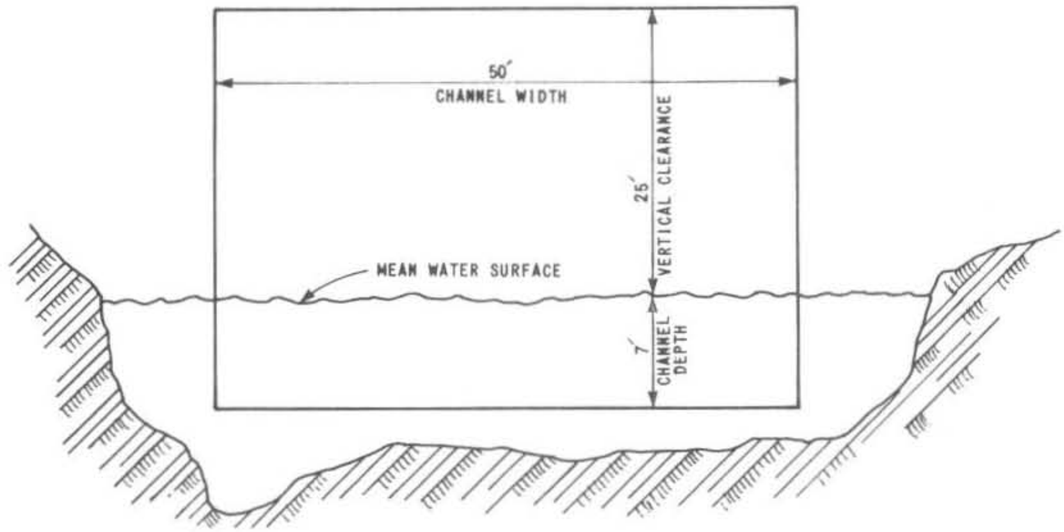
Based upon the above discussion and some assumptions concerning practical limits, the following dimensions were utilized as a guide in defining "navigable waters of the U. S." in the Charleston District:

1. Channel clearance width for vessels: 50 feet.
2. Vertical clearance above mean water level: 25 feet.
3. Water depth at mean flow: 7 feet.

Figure 13 shows these clearance dimensions on a channel cross section.

The 50-foot width provides approximately 9-foot clearance on either side of a single barge (either conventional or LASH type). Any smaller clearance would likely be a safety hazard, particularly when navigating through bridge openings.

FIGURE 13
DIMENSIONAL GUIDANCE CRITERIA



A vertical clearance of 25 feet under mean water conditions provides a relatively tight clearance as noted previously. The 25-foot clearance would be required across the entire 50-foot channel width.

The 7-foot water depth at mean flow would provide only 1 foot clearance for the 500-ton barges. This will be a relatively tight constraint since power costs for navigation increase when barges operate close to the bottom of a stream. The 7-foot depth would be a constraint to the LASH barges but would be sufficient for the 500-ton conventional units. The 7-foot depth would be required across the entire 50-foot channel width.

Reasonable Improvements - Many waterways will not meet the dimensional criteria presented above due to channel configuration (steep slope, narrow channel, shallow depth, meandering conditions, etc.), hydrological conditions (low mean flow, high velocities, etc.) and obstructions (bridges, dams, utility lines, rocks and shoals, etc.).

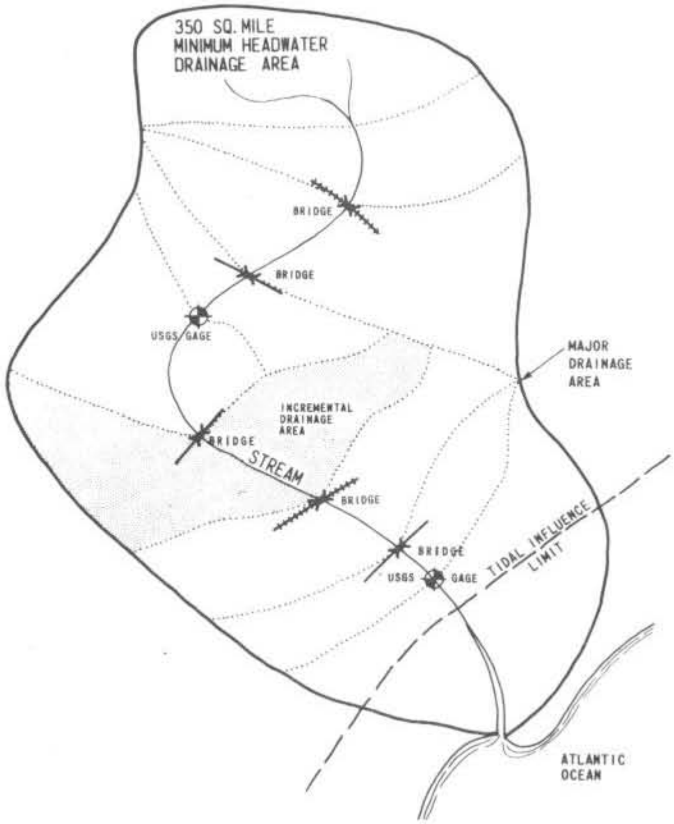
There are many "possible" improvements that can be made to provide a suitable waterway for navigation purposes including locks and dams to minimize steep slopes; inter- or intra-basin transfers of water to improve hydrological drawbacks; canals around dams and rocky areas; snagging, clearing, dredging, channelizing, and straightening to improve channel configurations; and removing or raising bridges and utilities. All of these possibilities were considered in the navigation classification analysis, but the main emphasis was placed on "practical" and "planned" improvement projects, rather than "possible" improvements.

Therefore, the "reasonable" improvements used in the evaluations were those judged prudent to consider for current engineering and economic conditions. In most instances in the Charleston District, this approach resulted in considerable allowance for raising bridges and for clearing and dredging channels, but no justification for major lock, dam, or basin transfer to aid navigation. The district should re-evaluate the navigation improvement considerations in future years to assess any change in the engineering or economic factors.

Procedure for Selecting Streams for Field Investigation - Streams selected for field investigation to provide data for assessing dimensional criteria and reasonable improvements were based upon current classification and/or predicted mean flow. USGS maps (1:250,000) were used as an aid in the selection, as was USGS gaging station information. Drainage areas for streams were delineated on the USGS maps. Preliminary field surveys for this study showed some velocities around the 1 foot per second (fps) range. Also, the LEAY map (Figure 10) showed typical yields around 1 cfs/sq.mi. Therefore, to provide a rough guideline of drainage area which would support the flow depth and width in Figure 13, about 350 square miles [drainage area = (1 fps x 50 ft x 7 ft)/(1 cfs/sq.mi.)] was used. All streams with drainage areas significantly less than this were initially eliminated from field investigation since flow would be limiting and basin transfer of water was not considered practical.

In order to provide guidance to field investigation personnel, incremental drainage areas were determined at all bridges and gages located on streams with around 350 square miles or larger, and on those streams currently classified "navigable waters of the U. S." (See Figure 14). A calculation was made to determine mean flow at each

FIGURE 14
USGS MAP ANNOTATIONS FOR
PREDICTED MEAN FLOW DETERMINATION



bridge crossing along the stream using USGS gaging station flow data, drainage area information, and the LEAY maps.

Bridge and utility line crossings to be investigated were each assigned an index number for field work purposes. Bridge and utility line crossings were also annotated on county highway maps of North and South Carolina (1 inch = 2 miles) for use while driving to and from structures crossing streams. A field identification tabulation was made for each stream to be investigated, showing stream name, bridge identification, county map reference, upstream drainage area, and predicted mean flow. Utility line crossings were included; however, in most instances, utility lines were inaccessible.

In addition to identifying large rivers; several small streams, parts of streams, and lakes were identified from USGS quadrangle maps (1:24,000 and 1:62,500) as potentially navigable. Generally, the drainage areas of these waterbodies were smaller than 350 square miles.

However, due to topographic conditions, subsurface flows, widened confluence areas, and proximity to navigable waters, these streams and lakes appeared potentially navigable for distances ranging from approximately 0.5 to 6 miles and consequently required field investigation. Many of these waterbodies did not have bridge or utility crossings and no incremental areas or mean flows were calculated.

Field Investigation Procedure - The field investigation was carried out over a period of several months by two- and three-man teams from Stanley Consultants, with some assistance by personnel from the Charleston District. Three different types of field efforts were made:

1. Bridge Survey - Measurements from bridges on all major streams.
2. Boat Survey - Measurements on small streams and lakes from a boat.
3. Aerial Survey - Observations of all obstructions on major streams.

Equipment used included the following:

1. Safety equipment
   - A. "Men working" signs
   - B. Hard hats, orange vests, boots, etc.
   - C. First aid/snake bite kit
   - D. Life preservers
2. Field notebooks
3. Velocity measurement device
4. 200 ft. fiberglass tape reel
5. Sounding line with weights
6. Lumber crayons
7. Plotting equipment
   - A. Graph paper
   - B. Drawing Board (lap) with plotting instruments.
   - C. Battery operated transducer (boat mounted)*
8. Maps, obstruction lists, compass, etc.
9. Camera (35 mm)
10. Stopwatch
11. Two-way radio*

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* Provided by the Charleston District.

12. 14-foot aluminum boat with outboard motor*

13. Boat trailer*

14. Single engine, overhead wing airplane and pilot*

Figures 15 and 16 show some of the equipment being used in the field. Typical measurements taken at each structure are shown in Figure 17. For the most part, measurements correspond to values required to develop mean water levels (described in the following subsection).

The work on the bridge survey consisted of measuring and marking stations at points along the structure, including piers, channel edges, and tops of banks. Soundings were taken at points between piers. Vertical distances from low steel to water surface, banks, and high water marks were obtained. Surface velocity was estimated at each structure using a float procedure. (The width of the structure was measured along the direction of main flow and a retrievable float was used to find the time of travel of the stream across the width; then distance divided by time yielded surface velocity.) Photographs were taken of each structure from the most practical and accessible vantage points. Field notes, which included all measurements, datum (usually top of rail), remarks, location information, photograph identification numbers, and sketches, were standardized and kept for each structure. Cross sections of each structure were plotted (using field note data) at the end of each work day, during inclement weather, and in the office for determining mean water level.

On the boat survey of small streams and lakes (those with no bridge crossings) the work consisted of traveling along major rivers (previously investigated at structures) and investigating potentially navigable tributaries. The boat was equipped with an electronic transducer which plotted profiles of the stream or lake bed. USGS maps were used for guidance in the field. An estimate of mean water level was made by observing water marks on banks and trees. Readings at USGS gages were made, if available, and visual observations of stream and lake widths were made. In some instances, the boat was also used to determine water depths for large streams near tidal limits, where no structure crossings were available. Use of the small boat worked well for

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* Provided by the Charleston District.

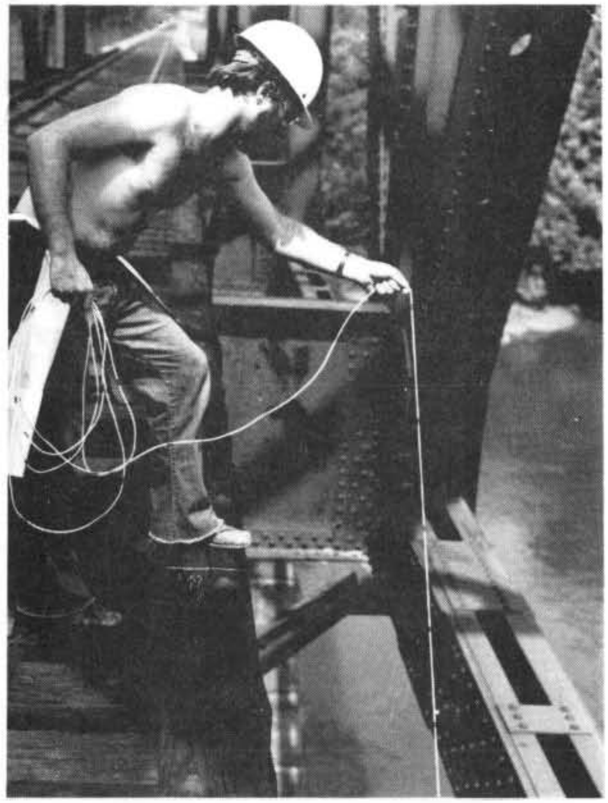
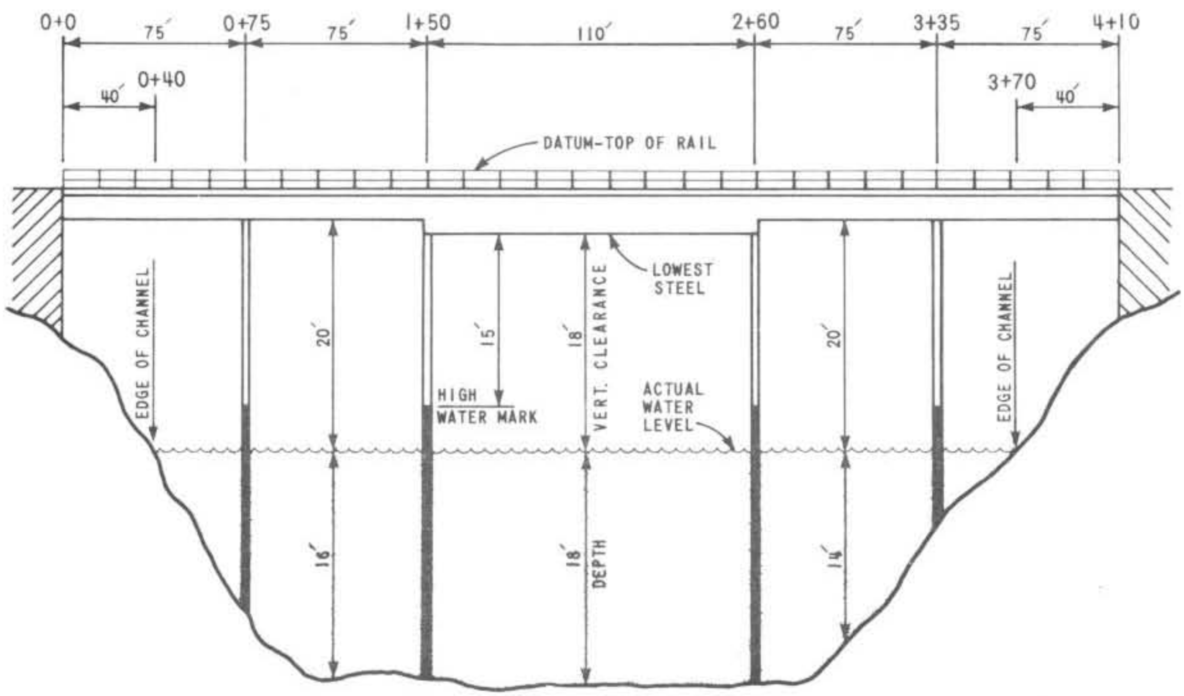


FIGURE 15 - BRIDGE SURVEY

FIGURE 16 - BOAT SURVEY

identifying stream dimensional criteria but would not have been effective for obtaining structure clearance information.

FIGURE 17
TYPICAL FIELD INVESTIGATION MEASUREMENTS



The primary purpose of the aerial survey was to confirm location of and photograph utility crossings identified through visits to electric, gas, water, and telephone companies. A secondary purpose was to spot any bridges or other channel obstructions which were not seen from the bridge survey. The airplane flights were at low altitude to enable close observation and photography. The preliminary plan and profile drawings (discussed later) were marked up during the flights to indicate crossings and to record the photographs. Utility lines mounted on bridges were not included since the structure is a more critical obstruction than the utility line.

Mean Water Level Determination - The mean water level at a structure was needed in order to determine the depth and vertical clearance at mean flow. Using the mean flow calculated prior to the field investigation, the actual surface velocity measured at the structure, and the channel cross sectional area from field data, the water level at mean flow could be calculated. A programmable calculator was used for this computation since several iterations of the Manning equation were required for each structure. The basic mathematical steps used for the mean water determination are as follows:

1. Find actual flow at time of field investigation.

   Where: Q_a = Actual flow
   A_a = Area at actual flow
   R_a = Hydraulic radius at actual flow
   V_s = Measured velocity at water surface
   V_a = Average velocity for the cross section

   Using: $V_a = V_s\ (0.732 + 0.053 \text{ Log } R_a - 0.082/R_a)$*

   And: $Q_a = (A_a)(V_a)$

2. Find hydraulic gradient (water slope).

   Where: S = Hydraulic gradient
   n = Manning coefficient (0.033 used throughout)

   Using: $$S = \left[\frac{Q_a}{\frac{1.486}{n}(A_a)(R_a)^{2/3}}\right]^2$$

3. Assume S and n remain constant for the normal range of flows (including mean flow). Find area and hydraulic radius corresponding to the water level at mean flow.

   Where: A_m = Area at mean flow
   R_m = Hydraulic radius at mean flow
   Q_m = Mean flow (developed from maps and gage data)

   Using: $$(A_m)(R_m)^{2/3} = \frac{Q_m}{\frac{1.486}{n}(S)^{1/2}}$$

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* Griffith, Journal Inst. C. E. 1941.

The solution to the above equation, in terms of water level, is an iterative process. It is found by successively adjusting the water level and corresponding cross section (from field information) until the product of the mean area and hydraulic radius equal the right hand side of the equation (see Figure 18). It is emphasized that the values obtained in this analysis are only approximate. Some judgment was utilized when unusual variations occurred from structure-to-structure on a stream. Although several assumptions are required in these calculations, the results are considered within the accuracy needed for classifying waterbodies in the study.

FIGURE 18
FLOW CHART OF PROGRAM USED FOR
MEAN WATER LEVEL DETERMINATION

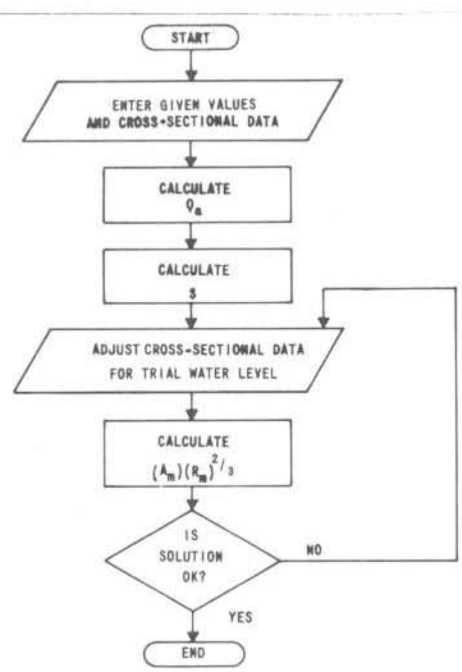
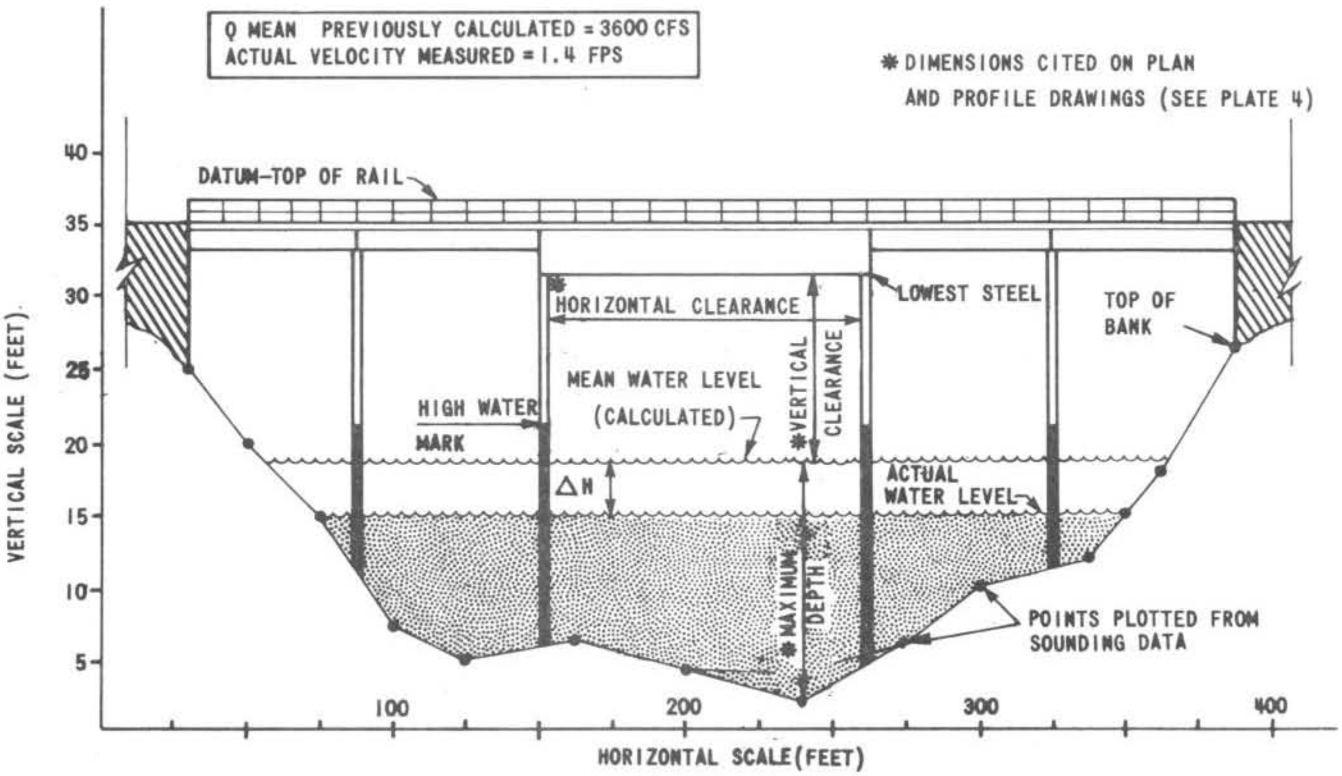


Figure 19 shows a typical stream section used for calculating mean water level. Once the mean water level has been determined, a comparison between the average depth of the river and the dimensional guidelines defining navigability can be made. On a particular stream when a few downstream structures did not meet the criteria but several upstream ones did, it was generally presumed that raising bridges were reasonable improvements and the navigation limits were extended. However, in general, on streams which have numerous structures which fail to meet the criteria and also have other limiting conditions (shallow depth and limited use for interstate commerce, for instance) then the navigation limits were not extended.

FIGURE 19
SAMPLE CHANNEL SECTION USED IN MEAN FLOW DETERMINATION



Interstate Commerce

Some non-tidal waters in the district are not now subject to authorized projects, court decisions, or interstate commerce navigation, but can be navigated under present or reasonably improved conditions. (That is, they fail to meet items 1 through 6 on the Decision Diagram,

Figure 9, but do meet Items 7 and 8.) These waterbodies may be considered for classification as "navigable waters of the U. S." if they are susceptible to interstate commerce activities (past, present, or future as discussed in Section 4). A combined judgment considering both "reasonable improvement" factors (Item 8 in Figure 9) and "interstate commerce" factors (Item 9 in Figure 9) has often been utilized in arriving at the conclusions and recommendations concerning navigability of waterbodies in the Charleston District.

Waters of the U. S.

Finally, in discussion of Figure 9, if the waterbody is not judged to be navigable in its present state or with reasonable improvements, then it is beyond the limit of "navigable waters of the U. S." and is termed "waters of the U. S." ("navigable waters"). "Waters of the U. S." are subject to Corps of Engineers jurisdiction under Section 404 of PL 92-500. Up to the five cfs point (headwaters) the waterbodies require a permit to be filed for all activities covered under Section 404. Activities involving "waters of the U. S." upstream of the five cfs point are nationally permitted by law and do not require an individual application for dredge or fill discharge permits provided the proposed work will meet certain conditions.

Recommended Navigation Limits

When all of the investigative steps discussed to this point (Figure 9) in the "Summary of Methodology" have been applied, conclusions and recommendations on navigation classifications can be made. The stream classifications and limits are presented, along with particular influencing factors, for all applicable rivers and lakes in the individual basin reports. The limits were previously summarized in Table 7 of this report.

The present "navigable waters of the U. S." limits are based on current regulatory status of waterbodies identified from Charleston District file data (Section 3). The historical limits are based on a literature review of archives and history papers as discussed in Section 4. The recommended "navigable waters of the U. S." limits are those regulatory limits arrived at after review and comparison of present regulatory limits with practical limits as developed for this report. The "practical navigable waters of the U. S." and "waters of the U. S." limits are based on the analyses discussed in the preceeding sections.

In the individual basin reports, data developed during the investigation of "practical navigable waters of the U. S." is summarized. This includes obstruction clearances and stream characteristics. The remainder of Section 6 discusses the data development as it relates to the tables, figures, and plates presented in the individual reports.

Obstructions to Navigation

Listings of the structural obstructions (bridges and utility lines) and corresponding data are presented for "practical navigable waters of the U. S." in each of the basin reports. The obstructions were identified by reviewing USGS quadrangle maps and county highway maps; interviewing utility companies, municipal and state agencies; reviewing Corps permits; and aerial observations. Figure 20 shows the type of information presented in the obstruction tabulations including structure description, river mile location, mean discharge, mean water slope, and vertical clearances. The following subsections outline the sources for this data.

River Miles - Throughout the navigability reports "river mile" locations are noted. For South Carolina streams, data was obtained from the Columbia Office of the USGS. Just prior to the start of this study, USGS had measured the mileage of most major rivers using dividers and other procedures outlined in River Mileage Measurement Bulletin No. 14 (Water Resources Council, May 1967). These maps and mileages provided more coverage and consistency than any other available source and consequently were used throughout the reports. In South Carolina areas that were not covered by quadrangles obtained from USGS and in all North Carolina areas, river mileage was developed as a part of this study. A procedure similar to that of USGS was used.

FIGURE 20

EXAMPLE OBSTRUCTION TABLE

OBSTRUCTION LISTING FROM TIDAL INFLUENCE LIMIT
TO RECOMMENDED PRACTICAL LIMIT OF NAVIGATION

Waccamaw River Mile	Description	Mean Discharge (cfs)	Mean Water Slope (ft/mi)	Approximate Vertical Clearance To Obstruction (ft)
62.7	Utility Line (power)	--	0.12	70.0[1)]
62.7	S. C. Secondary 105 Highway Bridge	1,340	0.12	11.5
70.4	S. C. Secondary 31 Highway Bridge	1,240	0.30	10.0
70.5	Utility Line (power)	--	0.30	38.0
81.8	Utility Line (power)	--	0.38	34.5
85.1	Utility Line (power)	--	0.42	40.0
85.4	S. C. 9 Highway Bridge	1,210	0.42	7.5
102.1	N. C. 904 Highway Bridge	1,090	0.58	8.5
102.1	Utility Line (power)	--	0.58	38.0
118.3	N. C. 130 Highway Bridge	790	0.68	9.5
118.3	Utility Line (power)	--	0.68	43.0
129.5	Utility Line (power)	--	0.68	45.0
129.5	N. C. Secondary 1928 Highway Bridge	600	0.68	7.5

1) Vertical clearance at high water.

In some cases, particularly in the historical data, significant differences existed between reported river miles at specific locations and those developed by USGS or Stanley Consultants. For such situations, the reference reports were used to identify landmarks to coordinate and/or adjust the river mileage to the basis used in this study.

Mean Discharge - The mean discharge at bridge locations is presented in each basin report for "practical navigable waters of the U. S." The mean discharge was developed to aid in determining approximate vertical clearances between mean water surface and bridges. The discharge data also provides general flow relationships throughout the district. Previous subsections outline the methodology used to derive these values.

Mean Water Slope - The mean water slope is an approximation of the average fall per mile of water surface within a stream basin. The slopes are presented in the obstruction listing to indicate the average gradient for navigation. The mean water slope was determined by noting points where contour lines crossed streams (on 15 and 7-1/2 minute USGS maps) and measuring the river miles between such points.

The USGS maps are generally developed by aerial photography and the contours shown cross a stream at the water surface. An assumption made in calculating the fall per mile using the above approach is that streams were at "normal" or "mean annual" flow conditions when the maps were developed. This probably is not the case since many of the maps are developed in different years. However, the use of the data was not intended to be extremely accurate for purposes of classifying water-bodies for navigation.

Vertical Clearance - The vertical clearance in Figure 20 represents the approximate distance between the mean water surface elevation and the lowest point of the obstruction. The vertical clearance of bridges represents the distance between low steel and mean water surface. The vertical clearance of utility lines is reported from data supplied from permits filed with the Corps of Engineers and from interviews and correspondence with utility companies. Many utility companies made field observations to estimate clearances of their lines. In the case of underground pipe lines, the clearance was given from the top of the pipe to the stream bed at the time of construction and was usually obtained from permit information or interviews. It should be recognized that the clearance data for utilities is less accurate than for the bridges.

Photographs

Photographs of all obstructions are presented in the detailed reports. Examples are shown in Figures 21 through 24. Photographs of utility lines are aerial views highlighted with accent lines, indicating direction and location, on the side of the photograph. Photographs of bridges are shown from the ground or from the air, or both. An attempt was made to present both an aerial and ground photograph of each bridge where available. In some cases, the bridge was shown in conjunction with a utility line and noted in parentheses on the photograph.

Stream Plan and Profile Drawings

Drawings showing a plan and profile of all "practically navigable waters of the U. S." within the Charleston District are presented with the individual basin reports. Plate 4 is an example of these drawings.

The plan views were traced from USGS quadrangle maps. The USGS maps were updated for bridges, utility crossings, and road numbers, using county highway maps and utility company maps as discussed in the previous section. Interstate highways and U. S. highways are designated by shields around the road number, state primary highways are indicated by circles, and state secondary roads are indicated by squares or rectangles. All county and most city, town, and other political boundaries are also shown to help identify geographical vicinities. Stream codes for major and primary streams are also presented for all plan and profiles. Additional discussion on stream code development is presented in Section 7. River mileage development is discussed in the Obstructions to Navigation subsection.

The profile view presents the approximate mean water surface profile of the river. The mean water surface was approximated using the contour elevations shown on USGS 7-1/2 and 15 minute quadrangle

FIGURE 21 - TWO UTILITY LINES (R.M. 71.4)
(FROM REPORT 09)

FIGURE 22 - UTILITY LINE (R.M. 49.2)
(WITH U. S. 17A HIGHWAY BRIDGE)
(FROM REPORT 03)

FIGURE 23 - U. S. 17A, S. C. 41 HIGHWAY BRIDGE (R.M. 36.4)
(FROM REPORT 05)

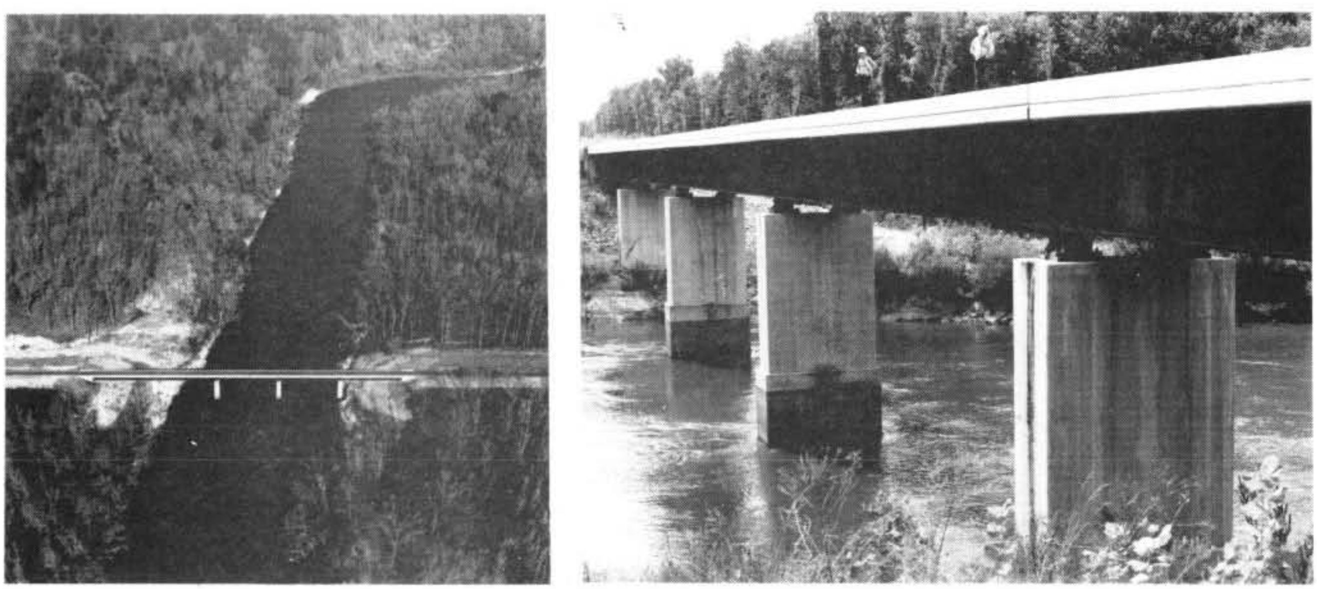


FIGURE 24 - SEABOARD COAST LINE RAILROAD BRIDGE (R.M. 14.8)
(FROM REPORT 09)

maps. As noted earlier, for purposes of this study, it was assumed that the mean water level on the USGS maps was representative of mean flow conditions. Once the water profile was plotted on the drawings, all structures and channel bottoms were plotted using field data and the mean water elevation computations discussed previously. The stream bed between structures is shown as a straight line even though no soundings were taken to establish the depth or to identify location of shoals, rocks, or other navigation impediments. Neither the stream bed nor the mean water surface have been developed for tidal areas and consequently are not shown on the plan and profile drawings.

On the drawings, horizontal clearance in the main channel (see Plate 4) represents the distance between bridge piers as determined from field investigation (see Figure 19).

The vertical clearance to structures is the same vertical clearance presented in the obstructions table (Figure 20). The clearance represents the distance between low steel and the water surface as adjusted to average flow conditions (see Figure 19). The maximum depth at mean flow is the depth between the mean water surface and the deepest sounding as shown in Figure 19. The maximum depth of a 50-foot wide channel at mean flow represents the deepest 50-foot wide clear channel section. The hash marks on the stream bed (Plate 4) represent locations where soundings were taken.

Some four lane highways have two bridges crossing the river at one location. These bridges are indicated by two closely spaced overhead structure symbols. In many cases, the bridges are identical and only one set of data is presented. In other cases where data varies between bridges, both sets of data are included.

Four navigation classification categories and tidal influence limits are also shown on the appropriate plan and profile drawings. The limits and classifications are generally identified at a specific river mile location. However, in some cases, the limits are beyond the area shown on the drawings; these are indicated by an arrow and river mile notation.

Plan and profiles of small streams and lakes greater than 1 mile long tributary to "navigable waters of the U. S." and classified "practical navigable waters of the U. S." are shown either as insets on major river drawings or on the last sheet of the plan and profile drawings presented with the individual basin reports. Generally these tributaries were short and no major obstructions were located along them. Utility line clearances were observed in the field during the boat survey; no major obstructions were noted. Small streams and lakes less than one mile long are shown only in the plan view.

Lake Plan Drawings

Plan views of all lakes greater than 1,000 acres and located within the Charleston District were also prepared as a part of this study. Plate 5 is an example of these drawings. A number of data sources were used to prepare the lake plans. In most instances, maps from the owners and operators of the lakes (reservoirs) were obtained; however, USGS 1:250,000 maps were employed for several of the lakes. Navigation classifications are also presented for all lakes.

Coastal Area Drawings

As a supplement to the navigation study, drawings showing waterbody coding (discussed in Section 7) along the coastline of the Charleston District were prepared. Plate 6 shows an example. These drawings serve as a graphical link between the individual basin reports covering streams which empty to the ocean. The coastal area drawings were traced from nautical charts (1:80,000, National Oceanic and Atmospheric Administration, National Ocean Survey).

SECTION 7

STREAM CATALOG AND SMALL LAKE SUMMARY

- Summary of Findings
- Summary of Methodology

SUMMARY OF FINDINGS

As a major part of this study effort all non-tidal streams with a mean annual flow greater than five cfs within the Charleston District were identified, coded, and tabulated in the individual reports. The points on these streams where the flow is estimated to equal five cfs (headwater locations) are identified. In addition, essentially all streams in tidal areas were coded and tabulated. As discussed in the following subsection, some non-tidal streams with flows greater than five cfs were coded, but due to a change in name further upstream, these coded waterbodies did not have a five cfs point. Table 8 presents a summary of the stream catalog data by report (01-18) for the entire Charleston District.

A separate coding of all harbors, inlets, bays, and sounds adjacent to the ocean was also prepared and included in a separate "Coastal Supplement" document.

All lakes having a surface area of 10 to 1,000 acres were also coded and tabulated in individual basin reports. Table 9 presents the total for each report (01-18).

Summary values of five cfs points and small lakes (10 to 1,000 acres) located on streams tributary to the 25 major lakes in Report 18 are presented in Table 10.

In the course of compiling the stream catalogs and small lake summaries for this study, the relationship between the two major physiographic areas in the district, Coastal Plain and the Piedmont Plateau, was noted. In the Coastal Plain area, a larger number of 10 to 1,000 acre lakes were found (1,054) than five cfs points (697). Above the fall line, on the Piedmont Plateau, the reverse was observed: more five cfs points (1,040) than 10 to 1,000 acre lakes (471). It was also noted that of all the major lakes (greater than 1,000 acres), the only natural lake (Lake Waccamaw) is found on the Coastal Plain. The above comparisons are indicative of the general characteristics of the geologic provinces involved. The mountainous regions yield more direct runoff from rainfall than do the coastal areas, but have fewer natural lakes due to an apparent lack of suitable topography. The Coastal Plain, on the other hand, yields less direct runoff from rainfall, but has more swamps and natural lakes.

TABLE 8

FIVE CFS POINTS AND TIDAL STREAMS CODED BY REPORT

Report Number	Title	Streams Coded With 5 cfs Pts.	Non-Tidal Streams Coded With Flow 5 cfs	Tidal Streams Coded	Total Streams Coded
01	Coosawhatchie River Area	12	--	269	281
02	Combahee River Area	43	2	97	142
03	Edisto River Area	131	18	348	497
04	Cooper River Area	7	1	268	276
05	Santee River Basin	8	14	201	223
06	Black River Area	70	10	62	142
07	Waccamaw River Basin	49	8	285	342
08	Congaree River Basin	36	6	--	42
09	Wateree River Basin	42	15	--	57
10	Lynches River Basin	53	7	--	60
11	Great Pee Dee River Basin	203	19	13	235
12	Little Pee Dee River Basin	54	10	1	65
13	Lumber River Basin	70	5	--	75
14	Saluda River Basin	71	4	--	75
15	Broad River Basin	296	18	--	314
16	Catawba River Basin	101	12	--	113
17	Yadkin River Basin	184	19	--	203
18	Lakes-Greater Than 1,000 Acres	307	22	--	329
	TOTALS	1,737	190	1,544	3,471

TABLE 9

LAKES (10 TO 1,000 ACRES) CODED BY REPORT

Report Number	Title	Lakes 10 to 1,000 Acres
01	Coosawhatchie River Area	47
02	Combahee River Area	66
03	Edisto River Area	273
04	Cooper River Area	56
05	Santee River Basin	54
06	Black River Area	55
07	Waccamaw River Basin	45
08	Congaree River Basin	87
09	Wateree River Basin	62
10	Lynches River Basin	47
11	Great Pee Dee River Basin	175
12	Little Pee Dee River Basin	50
13	Lumber River Basin	80
14	Saluda River Basin	42
15	Broad River Basin	125
16	Catawba River Basin	42
17	Yadkin River Basin	78
18	Lakes - Greater Than 1,000 Acres	141
	TOTAL	1,525

TABLE 10

FIVE CFS POINTS AND LAKES
(10 TO 1,000 ACRES)
TRIBUTARY TO MAJOR LAKES

Lake Code	Lake Name	Tributary Lakes 10 to 1,000 Acres	Tributary Streams Coded With 5 cfs Pts.
18-01	Moultrie	--	--
18-02	Waccamaw	2	3
18-03	Marion	26	9
18-04	Murray	15	35
18-05	Parr Reservoir	1	7
18-06	Wateree	25	48
18-07	Robinson	16	9
18-08	Fishing Creek Reservoir	--	--
18-09	Blewett Falls	1	5
18-10	Greenwood	10	28
18-11	Wylie	15	45
18-12	Mountain Island	--	3
18-13	Tillery	12	24
18-14	Badin	--	1
18-15	Tuckertown	--	5
18-16	Poinsett Reservoir	--	1
18-17	William C. Bowen	--	1
18-18	Buffalo	--	1
18-19	Norman	2	4
18-20	High Rock	7	27
18-21	Lookout Shoals	1	7
18-22	Hickory	4	8
18-23	Rhodhiss	1	13
18-24	James	3	14
18-25	W. Kerr Scott Reservoir	--	7
	TOTALS	141	307

SUMMARY OF METHODOLOGY

Stream Coding System

A stream coding system was developed by the Charleston District. The coding system will serve several purposes in administering Charleston District programs. The principal benefit of the system will be in data processing and retrieval.

Stream codes for streams in a report basin or area are found in Appendix A - Stream Catalog of each respective report (see Figure 25 for an example). Each stream having a mean annual flow of at least five cfs is assigned a stream code comprised of a series of two-digit numbers. The first two digits designate the report number which identifies the major drainage basin containing the stream. The second two digits indicate a major river within the designated major drainage basin or area. Additional two-digit combinations identify primary, secondary, tertiary, fourth order, and fifth order tributaries, respectively. Figure 26 shows a schematic of a typical coding application. In non-tidal areas, tributaries having a mean annual flow of at least five cfs are numbered consecutively proceeding upstream from river mile zero; in tidal areas most all streams are coded.

Major report drainage basins or areas are numbered west to east and south to north. Tributaries to bays and harbors are numbered in sequence beginning with the first tributary on the left bank (looking upstream) then proceeding inland from the ocean in a clockwise manner.

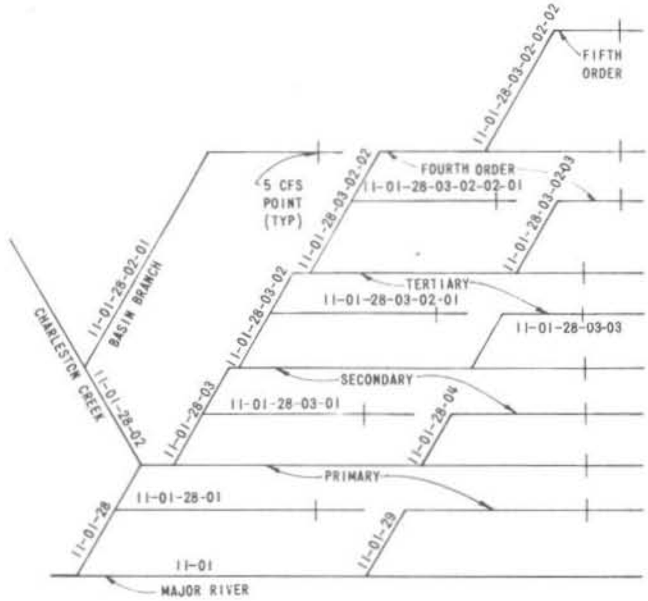
In coastal areas all inlets, harbors, sounds, and bays that are adjacent to the ocean are coded with unique two-digit numbers preceded by a "19". This catalog is presented in a separate document entitled "Coastal Supplement" and is to be used as a reference in conjunction with the other eighteen individual basin reports. Each inlet, harbor, sound, or bay is listed and numbered in sequence beginning at the southern end and proceeding northeast along the coast to the northern district boundary. Sounds and bays that are not adjacent to the ocean are accounted for in the catalogs of the individual basin reports. The "Coastal Supplement" also contains plates which graphically show the coastal waterbodies and codes.

FIGURE 25
EXAMPLE OF APPENDIX A - STREAM CATALOG

STREAM CODE							STREAM NAME	HEADWATER LOCATION (Mean Flow = 5 cfs)				
REPORT NUMBER	MAJOR RIVER	PRIMARY	SECONDARY	TERTIARY	FOURTH ORDER	FIFTH ORDER		LATITUDE (° ' ")	LONGITUDE (° ' ")	STREAM MILES UP	STREAM MILES DOWN	FROM
14	01	12					Big Creek #	34 08 25	81 33 10	1.8		Lake Murray
		13					Buffalo Creek #	34 09 00	81 29 50	1.5		Lake Murray
		14					Camping Creek #	34 11 50	81 29 05			Confluence-Susannah Branch
		15					Bear Creek #	34 09 55	81 22 45			Confluence-Rocky Br
		16					Tosity Creek	34 09 30	81 42 55	1.5		Saluda River
		17					Little River	34 33 00	82 02 25	3.7		U.S. 276 Highway Bridge
			01				Mudlick Creek					
				01			Pages Creek	34 13 35	81 52 00	2.0		Mudlick Creek
				02			Mills Creek	34 15 30	81 52 25	1.8		Mudlick Creek
				03			North Campbell Creek	34 19 35	81 57 40	1.5		S.C. 560 Highway Bridge
			02				Sandy Run Creek	34 17 05	81 47 25	2.2		Reeder Branch
			03				Garrison Creek	34 19 40	81 49 30	2.0		Quaker Creek
			04				Simmons Creek	34 23 25	81 53 00	4.9		Little River
			05				Beaverdam Creek	34 23 50	82 00 10	3.8		S.C. 72 Highway Bridge

Dual code in Report 18.

FIGURE 26
EXAMPLE OF STREAM CODING SYSTEM



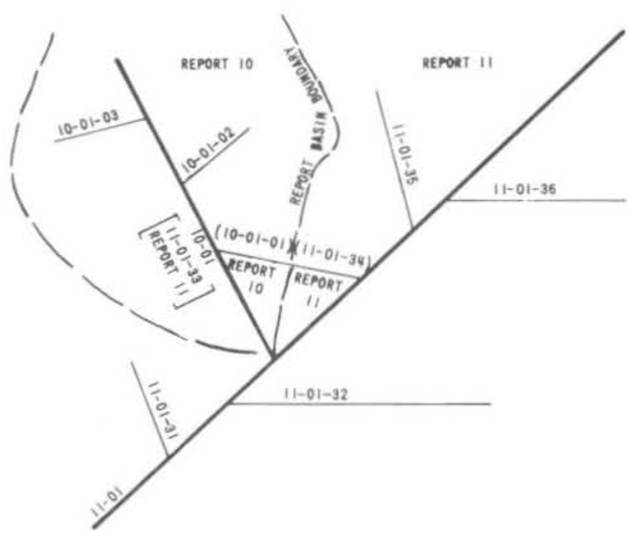
Stream Coding Procedure

In a report area or basin all non-tidal streams having a mean annual flow of at least five cfs are coded and summarized in the Appendix A - Stream Catalog of that report. For those report areas or basins which include tidal areas essentially all streams are coded whether they have a mean annual flow of at least five cfs or not. Exceptions are small, short, unnamed streams and drainage tile systems which are not coded. Streams which are all or partially subject to tidal influence are annotated in the Stream Catalog with an asterisk (*) and footnoted. Such streams do not have any headwater location information listed, and are classified "navigable waters of the U. S." to the tidal limit. Non-tidal reaches of streams classified "navigable waters of the U. S." are covered in Section 6 of each report. All other streams not tidally influenced are classified "waters of the U. S." ("navigable waters").

The points located on non-tidal streams where flow is estimated to equal five cfs (headwater locations) are identified by approximate latitude and longitude, and river miles upstream or downstream from the nearest named tributary, highway, railroad, or other similar reference point (See Figure 25). Latitude and longitude to the nearest five seconds is found using a set of acetate overlays designed to fit 1:24,000 and 1:62,500 USGS quadrangle maps. River miles are determined by using the graduated strip method or dividers, and are given only to the nearest tenth of a mile. Some streams listed in the catalog may not have headwater locations identified. This occurs when the name of a stream changes at a confluence where the flow immediately downstream is greater than five cfs. Thus, the headwater locations for streams with more than one name are associated with the appropriate upstream name found on USGS quadrangle maps or county maps. Charleston Creek on Figure 26 is an example of a stream that would be coded but would not have a five cfs point.

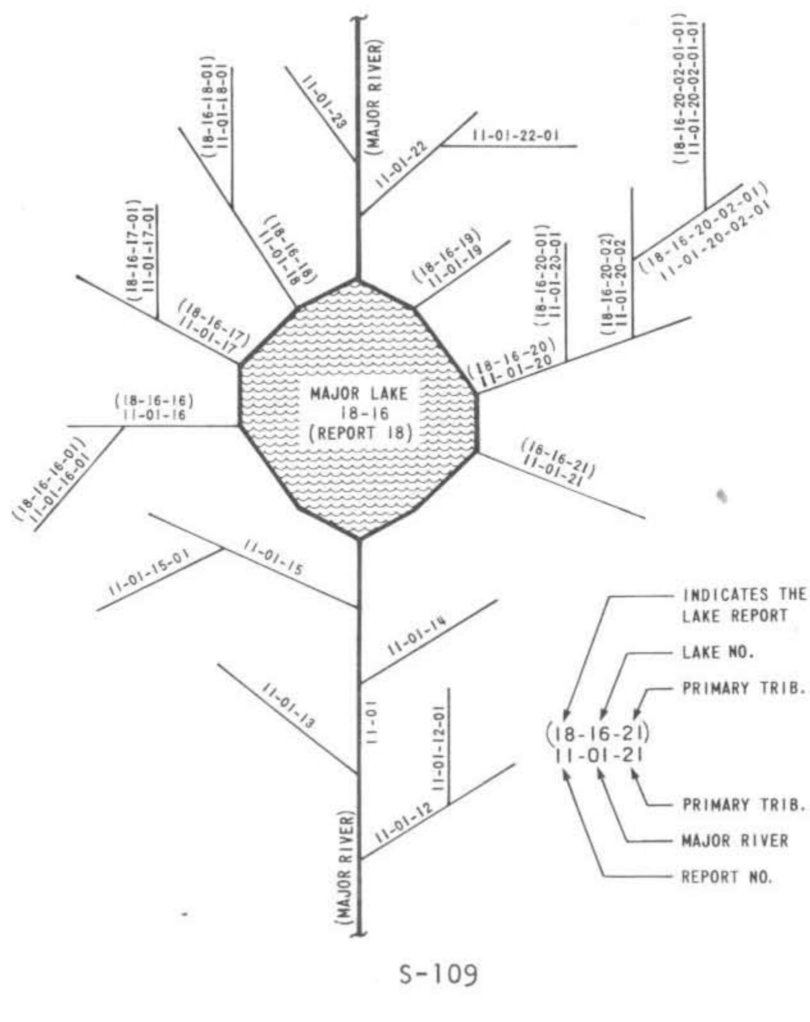
Some streams in the catalog of one report are also listed in the catalog of another report covering an adjacent or tributary basin. Figure 27 shows an example of a dual code situation between two reports. These streams are annotated in the catalog with a symbol (#) and a dual code footnote (see Figure 25). Additional dual code references on the same page of the catalog are annotated with multiple symbols (##, ###, etc.) and dual code footnote.

FIGURE 27
EXAMPLE OF DUAL CODE SITUATION
INVOLVING TWO REPORT AREAS OR BASINS



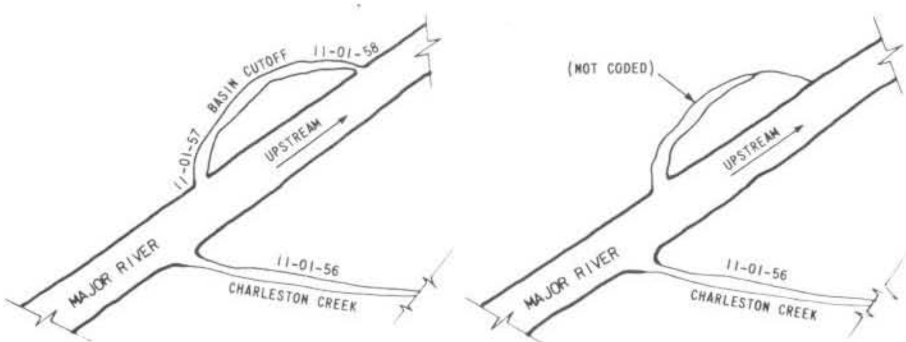
Another situation where dual coding is required occurs when major lakes (greater than 1,000 acres) are encountered while coding headwater locations on a major river. Major lakes (greater than 1,000 acres) are all found in Report 18, and each lake is assigned a two-digit number in the "major river" column of Appendix A. Tributaries to a lake are summarized clockwise around the lake beginning with the first stream on the left bank (looking upstream) above the outlet (see Figure 28). The tributaries entering directly into the major lake have the same "primary" number in either the lake or river code as shown in Figure 28. All five cfs points on streams directly tributary to major lakes are also included in the Stream Catalog of the associated major river basin or area report (see Figure 25).

FIGURE 28
EXAMPLE OF DUAL CODE SITUATION
INVOLVING A MAJOR LAKE (GREATER THAN 1,000 ACRES)



In some reports "loops" or secondary channels occurred on the major river or a large tributary as sketched in Figure 29. If such a loop appeared large enough on the USGS quadrangle maps or county maps to assume five cfs passing through it and possibly wide enough to support navigation, then it was coded at both ends, as shown in Figure 29. In these cases, dual codes refer to a later code in the same report. If a loop did not appear large enough to assume five cfs flow, then a judgment had to be made. In most cases, the drainage area was not large enough to indicate a flow of five cfs, so it was not coded as a stream. Later field investigation revealed navigability of some of these loops and tributaries, however, no code is associated with their presentation. If the area involved had a lake name and was larger than 10 acres, it was coded in Appendix B -Summary of Lakes 10 to 1,000 Acres (see following subsection).

FIGURE 29
EXAMPLE OF "LOOP" CODING

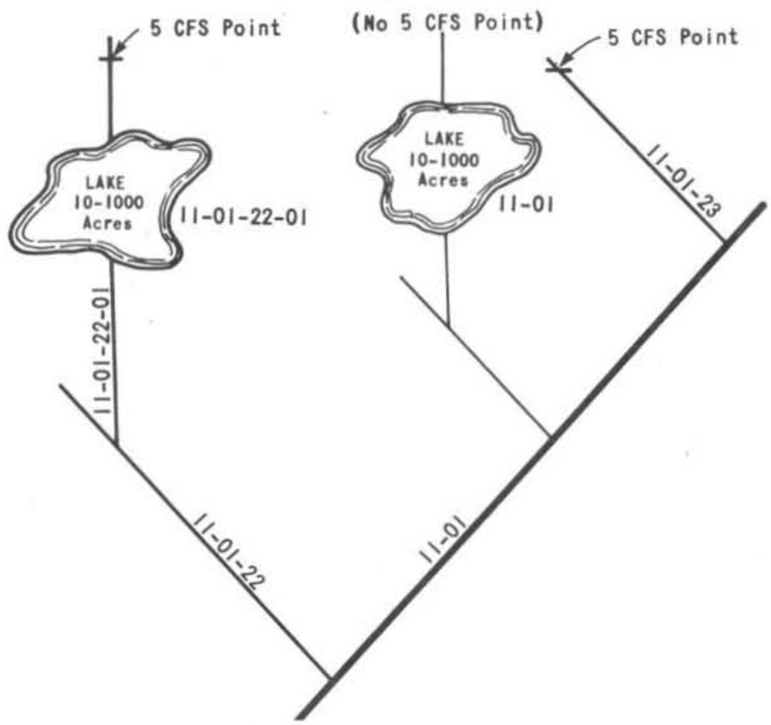


In the catalog of the "Coastal Supplement" mentioned previously, dual coding procedures were not used in reference to tributaries of coastal bays, harbors, inlets, or sounds. Instead, when a coded stream in an individual basin report enters the ocean at an inlet, harbor, sound, or bay; the ocean outlet name is included in parentheses below the stream name in the catalog. The reverse is true for the catalog in the "Coastal Supplement", where a stream name coded in an associated individual basin report is included in parentheses beside the name of the inlet, harbor, sound, or bay through which that stream enters the ocean.

Lakes (10 to 1,000 Acres) Coding System

Lakes (10 to 1,000 acres) are tabulated by report basin or area and are found in each report in Appendix B - Summary of 10 to 1,000 Acre Lakes. A sample of Appendix B is presented in Figure 31 on the following page. Lakes (10 to 1,000 acres) are coded in accordance with the stream coding system previously discussed. A graphic example is shown below in Figure 30.

FIGURE 30
EXAMPLE OF LAKE CODING SYSTEM



Lakes (10 to 1,000 Acres) Coding Procedure

The tabulation of lakes (10 to 1,000 acres) was compiled from the following sources:

1. Inventory of Lakes in South Carolina Ten Acres or More in Surface Area, State of South Carolina, Water Resources Commission, 1974.

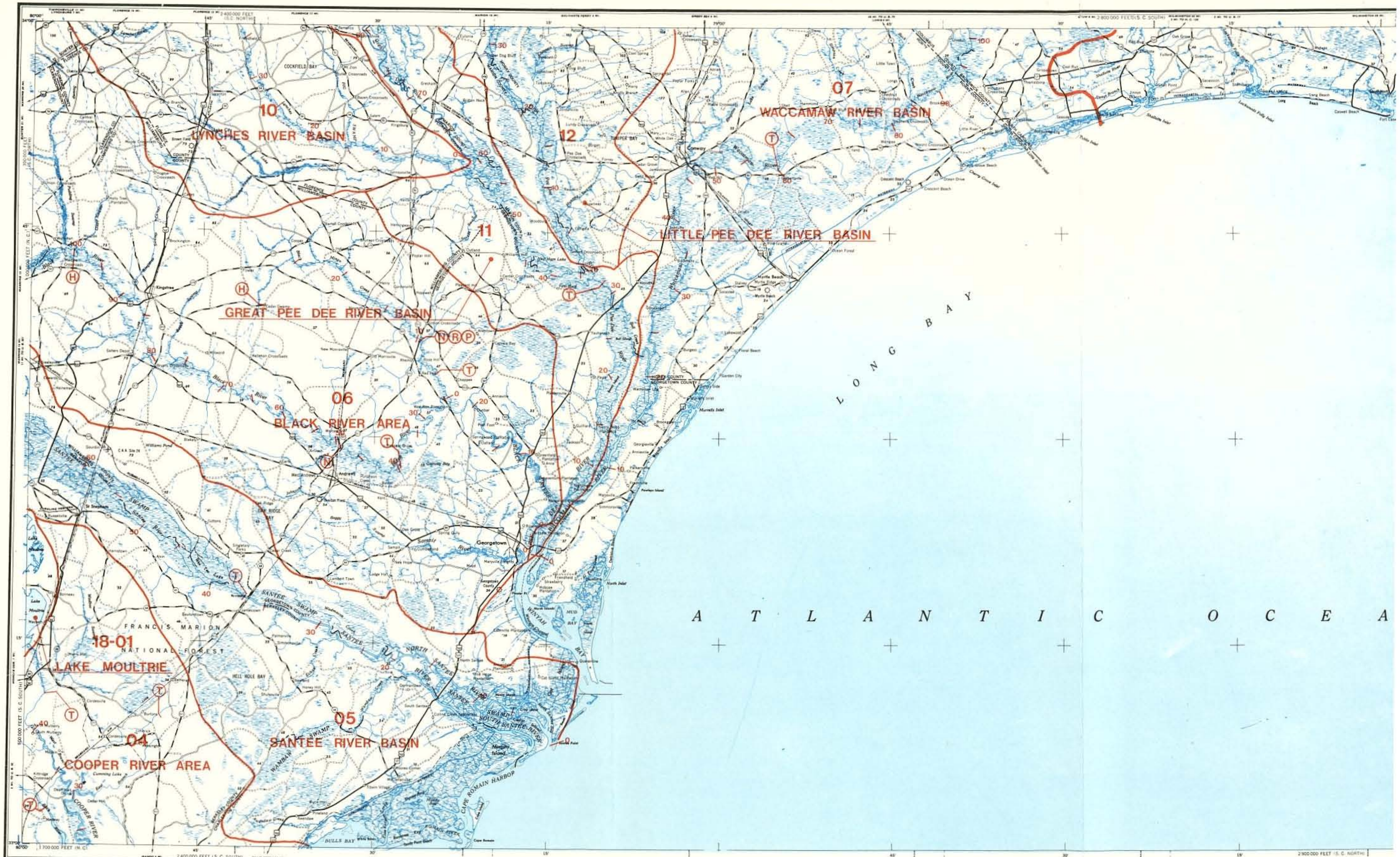
FIGURE 31
EXAMPLE OF APPENDIX B - SUMMARY OF 10 TO 1,000 ACRE LAKES

STREAM CODE: REPORT NUMBER	MAJOR RIVER	PRIMARY	SECONDARY	TERTIARY	FOURTH ORDER	FIFTH ORDER	LAKE NAME OR OWNER	SURFACE AREA (acres)	GROSS STORAGE (acre-ft)	LOCATION BY COUNTY (SOUTH CAROLINA)
14	01	07					E. D. Senn #	10	72	Lexington
14	01	09	01				Ponderosa Golf Club #	12	50	Saluda
14	01	09	01				Crouch Brothers #	14	90	Saluda
14	01	09	01				Asbill Pond #	12	96	Saluda
14	01	09	01				Harold E. Frick #	16	100	Saluda
14	01	09	01				O. T. Price, Jr. #	12	60	Saluda
14	01	09	01				R. M. Watson & Sons #	12	60	Saluda
14	01	09	01				Elijah Rodgers #	12	48	Saluda
14	01	09	01				L. S. Burton #	10	50	Saluda
14	01	09					Town of Saluda #	40	232	Saluda
14	01	09					Persimmon Hill Golf Club #	13	78	Saluda
14	01	14					Caldwells Pond #	10	51	Newberry
14	01	11					C. T. Smith	16	76	Newberry
14	01	21					Startfort Pond	30	360	Greenwood
14	01	21	01				Greenwood Mills	18	36	Greenwood
14	01	21	01				A. M. Watkins	10	60	Greenwood

Dual code in Report 18.

2. Hydrological Information Storage and Retrieval System, Register of Dams for North Carolina (computer printout), North Carolina Department of Economic and Natural Resources, Water Planning Section, 1975.
3. USGS quadrangle maps.
4. County maps for North Carolina and South Carolina.

The USGS quadrangle maps and county maps were used to locate and to detect lakes (10 to 1,000 acres) that were not listed in the above sources. Actual surface area and gross storage information is supplied where available. The map data from Source 1 above generally does not permit detailed location of small lakes, thus lakes are coded by basin only as far as the secondary order using the procedure previously presented for the stream coding (see Figure 30).



USGS BASE MAP
GEORGETOWN, S.C. ; N.C.
NI 17-9

0 5 10
scale in miles

N

LEGEND:

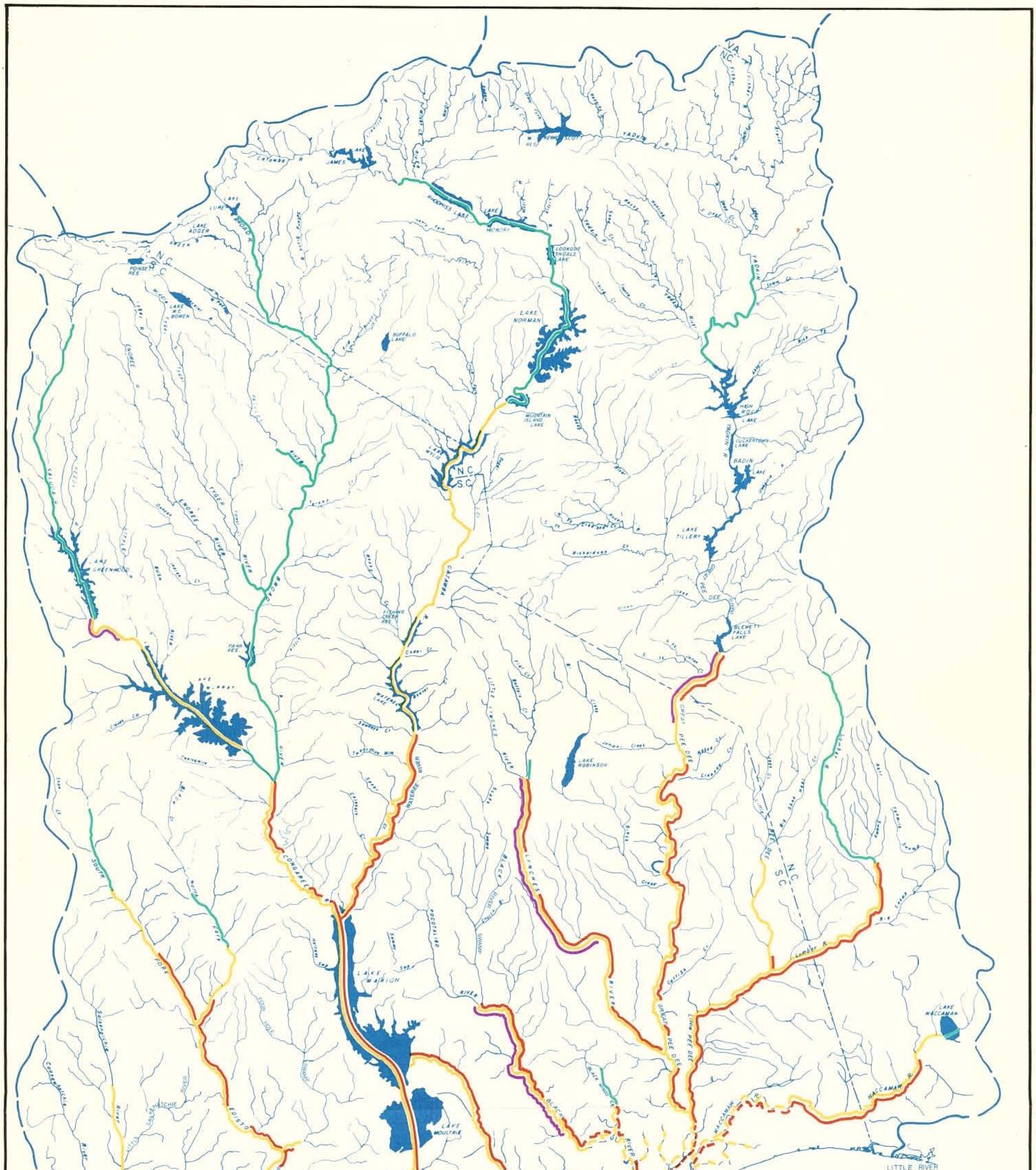
(N) PRESENT LIMIT OF NAVIGABLE WATERS OF THE U.S.
(H) HISTORIC LIMIT OF NAVIGATION
(P) PRACTICAL LIMIT OF NAVIGATION (RECOMMENDED)
(R) LIMIT OF NAVIGABLE WATERS OF THE U.S. (RECOMMENDED)
(T) APPROXIMATE LIMIT OF TIDAL INFLUENCE
20 RIVER MILE

1977

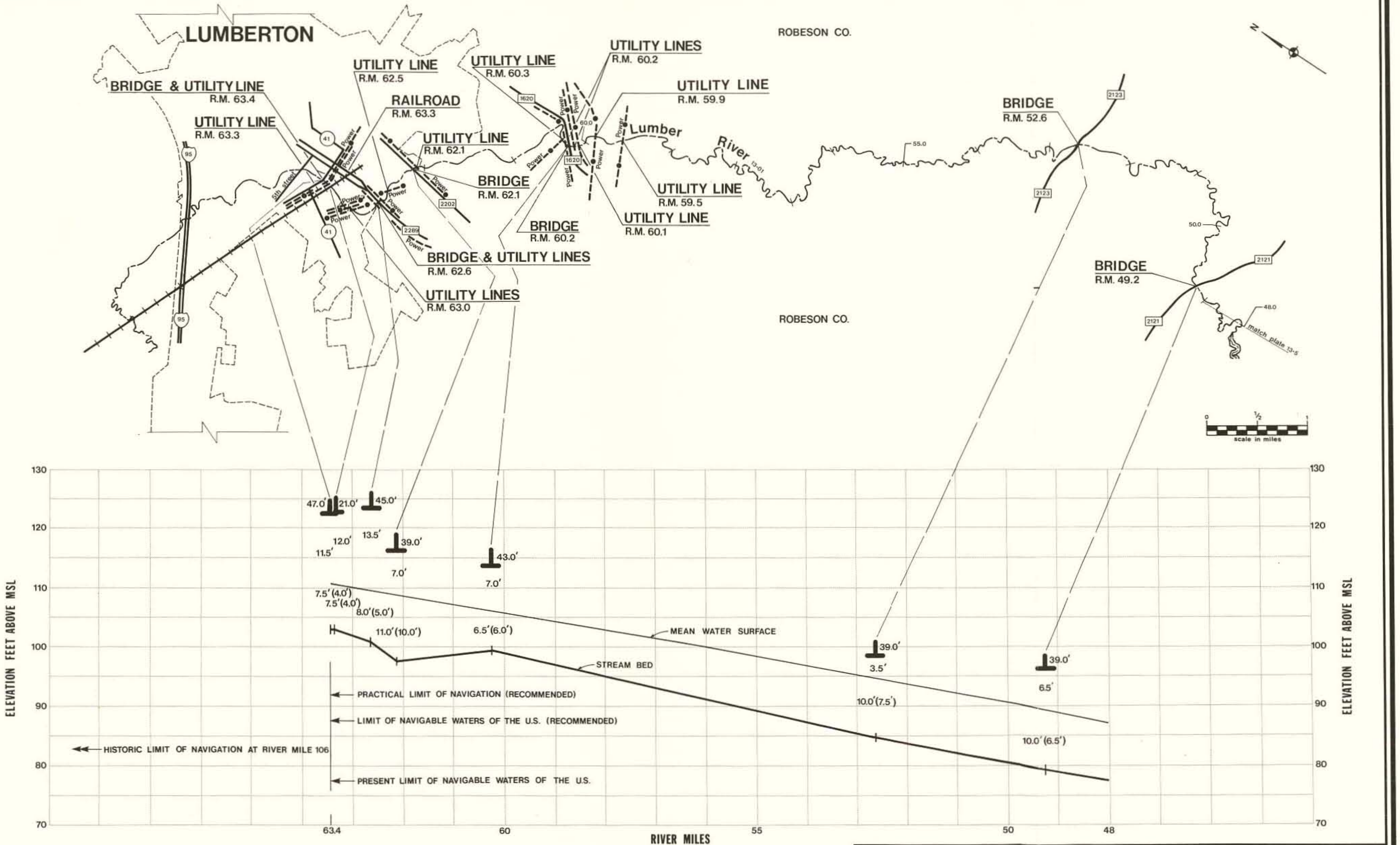
U.S. ARMY CORPS OF ENGINEERS
CHARLESTON DISTRICT
Charleston, South Carolina

STANLEY CONSULTANTS

SIGNIFICANT
BLACK RIV
Report No. 04,05,0
NAVIGABILIT
Summary Report



RECOMMENDED NAVIGABLE WATERS OF THE U.S.
RECOMMENDED NAVIGABLE WATERS OF THE U.S. BEYOND THE PRESENT LIMIT
RECOMMENDED PRACTICAL NAVIGABLE WATERS OF THE U.S.
HISTORIC NAVIGABLE WATERS BEYOND RECOMMENDED NAVIGABLE WATERS OF THE U.S.
WATERS OF THE U.S. (NAVIGABLE WATERS)
* ALL TIDAL WATERS ARE PRESENT AND RECOMMENDED NAVIGABLE WATERS OF THE U.S. AND ARE SHOWN DASHED. ALL MAJOR STREAMS INVESTIGATED IF PRACTICALLY NAVIGABLE ARE ALSO SHOWN DASHED WITHIN TIDAL ZONE. (Other Tidal Waters are Practically Navigable but were not Investigated in this Study)
LAKE JAMES
RHODHISS LAKE
HICKORY
LOOKOUT SHOALS LAKE
LAKE NORMAN
MOUNTAIN ISLAND LAKE
LAKE WYLIE
BUFFALO LAKE
LAKE LURE
LAKE ADGER
POINSETT RES.
LAKE W.C. BOWEN
LAKE GREENWOOD
LAKE MURRAY
PARR RES.
FISHING CREEK RES.
WATEREE LAKE
LAKE ROBINSON
LAKE MARION
LAKE MOULTRIE
HIGH ROCK LAKE
TUCKERTOWN LAKE
BADIN LAKE
LAKE TILLERY
BLEWETT FALLS LAKE
LAKE WACCAMAW
CONGAREE R.
WATEREE RIVER
LYNCHES RIVER
GREAT PEE DEE
LITTLE PEE DEE
LUMBER R.
WACCAMAW R.
BLACK R.
BLACK MINGO CR.
SAMPIT R.
SANTEE R.
N. SANTEE R.
S. SANTEE R.
COOPER R.
ASHLEY R.
EDISTO R.
ASHEPOO R.
COMBAHEE R.
SALKEHATCHIE RIVER
YADKIN R.
CATAWBA R.
N.C.
S.C.
VA.
LITTLE RIVER INLET
MURRELLS INLET
GEORGETOWN HARBOR (WINYAH BAY)
CHARLESTON HARBOR
ST HELENA SOUND
PORT ROYAL HARBOR
N
8 4 0 8 16
Scale in Miles
1977
U.S. ARMY CORPS OF ENGINEERS
CHARLESTON DISTRICT
Charleston, South Carolina
STANLEY CONSULTANTS
CHARLESTON DISTRICT
RECOMMENDED NAVIGATION CLASSIFICATIONS
NAVIGABILITY STUDY
Summary Report
Plate 3



LEGEND:

OVERHEAD STRUCTURE — 75' — HORIZONTAL CLEARANCE IN MAIN CHANNEL

12' — VERTICAL CLEARANCE TO STRUCTURE

MEAN WATER SURFACE — MAXIMUM DEPTH AT MEAN FLOW

STREAM BED — 8' (6') — MAXIMUM DEPTH OF 50 FOOT WIDE CHANNEL AT MEAN FLOW

STRUCTURE RIVER MILE LOCATION

NOTES:

1. ELEVATION AND SLOPE OF MEAN WATER SURFACE ARE BASED ON USGS TOPOGRAPHIC MAPS AND ARE THEREFORE ONLY APPROXIMATIONS. VERTICAL DIMENSIONS FROM STREAM BED TO OVERHEAD STRUCTURES ARE FIELD MEASUREMENTS. RELATIVE LOCATION OF MEAN WATER SURFACE IS APPROXIMATED FROM CONTOUR MAPS, MEASURED CROSS SECTIONS AND VELOCITIES. STREAM FLOW RECORDS, THE MANNING EQUATION, AND FIELD OBSERVATIONS. SEE SUMMARY REPORT FOR COMPLETE EXPLANATION.

1977

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CHARLESTON DISTRICT
Charleston, South Carolina

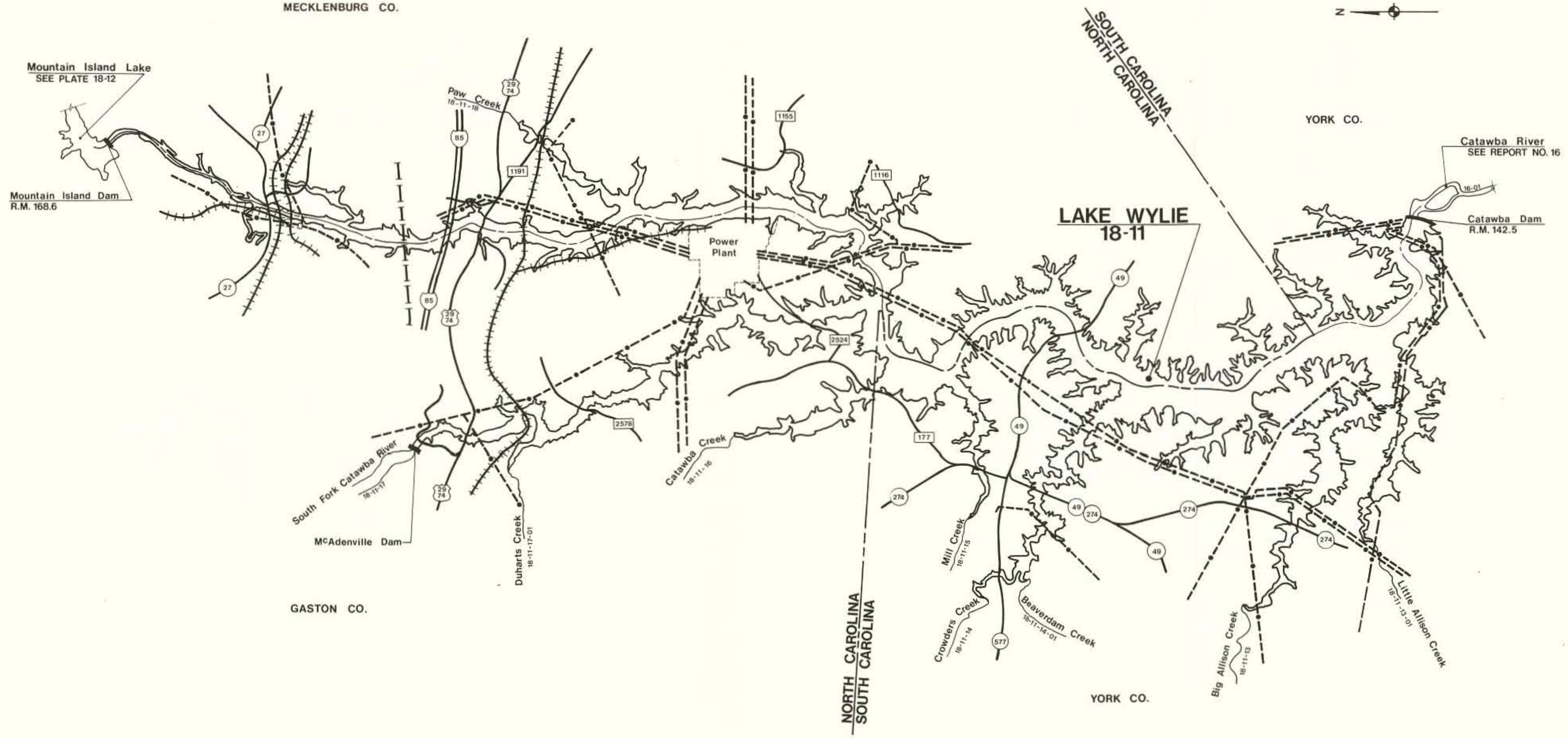
STANLEY CONSULTANTS

PLAN AND PROFILE
LUMBER RIVER (R.M. 48.0 - 63.0)
Lumber River Basin
ROBESON CO., N.C.

NAVIGABILITY STUDY

Summary Report

Plate 4



NAVIGATION CLASSIFICATIONS:

1. PRESENT NAVIGABLE WATERS OF THE U.S.
2. NAVIGABLE WATERS OF THE U.S. (RECOMMENDED)

LEGEND:

Interstate 29, U.S. 85	FEDERAL HIGHWAYS
Primary 49, Secondary 21	STATE HIGHWAYS
- - - - - • - - - -	UTILITY LINE
├─┼─┼─┤	PIPELINE
▬	DAM
— — — —	STATE BOUNDARY
——— — —	COUNTY BOUNDARY
++++++++	RAILROAD

0 4000 8000 12000
scale in feet

1977

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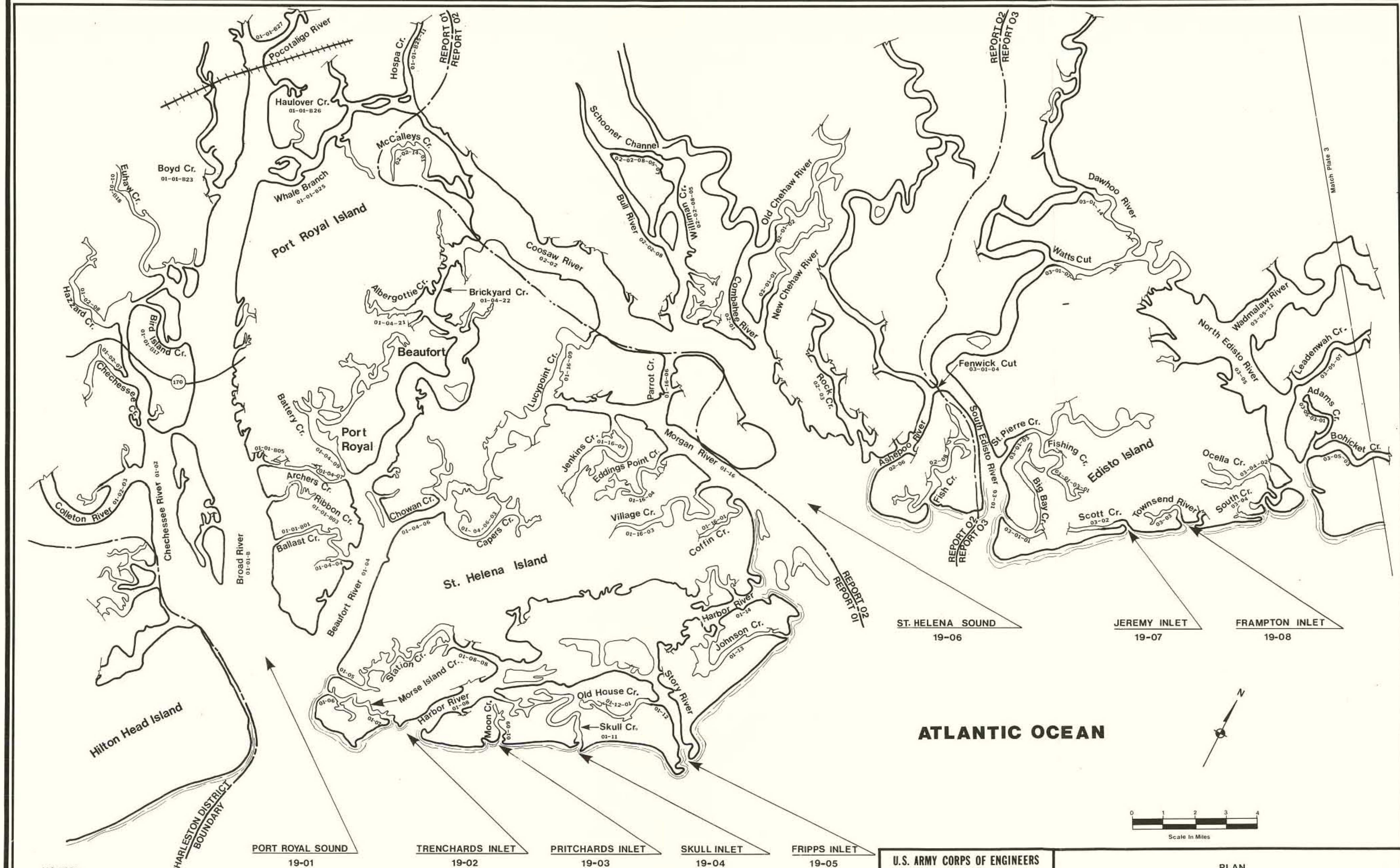
CHARLESTON DISTRICT
Charleston, South Carolina

STANLEY CONSULTANTS

LAKES REPORT
LAKE WYLIE
Catawba River Basin
YORK CO., S.C. - GASTON-MECKLENBURG CO., N.C.
NAVIGABILITY STUDY
Summary Report
Plate 5



NOTES:

1. STREAM CODES ARE SHOWN FOR LARGER WATERBODIES AND ARE PROVIDED FOR REFERENCE.
2. STREAM CODES FOR SMALLER WATERBODIES ARE NOT SHOWN AND COASTLINES ARE GENERALIZED FOR GRAPHIC PURPOSES.
3. COASTAL NAVIGATION CHARTS, USGS QUADRANGLES, AND COUNTY MAPS WERE USED FOR REFERENCE DATA.
4. IN REPORT 01"B"DESIGNATES ALL TRIBUTARIES TO BROAD RIVER BELOW CONFLUECE WITH COOSAWHATCHIE RIVER.

1977

U.S. ARMY CORPS OF ENGINEERS
CHARLESTON DISTRICT
Charleston, South Carolina

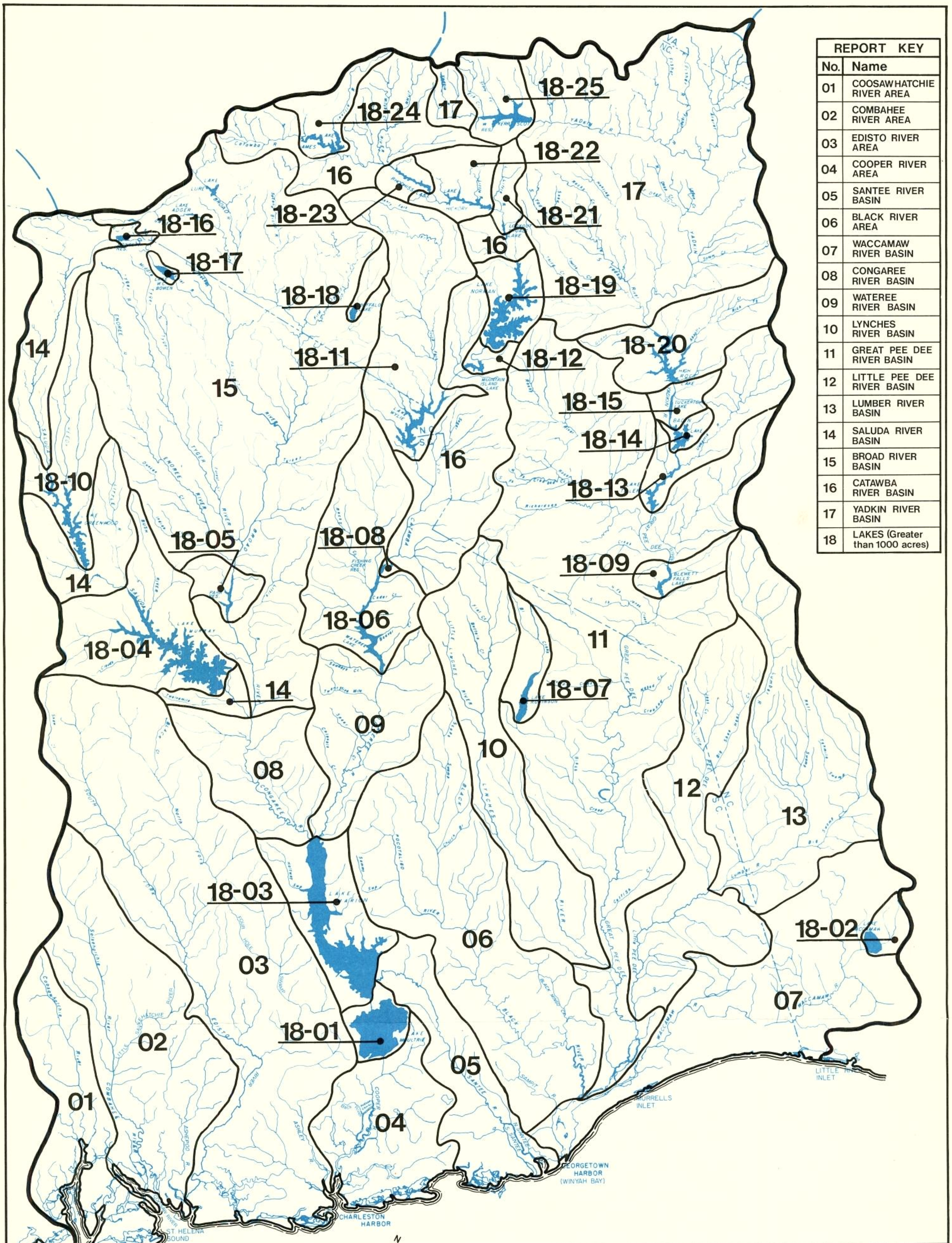
STANLEY CONSULTANTS

PLAN
COASTAL AREAS
Report No. 01, 02, 03

NAVIGABILITY STUDY

Summary Report

Plate 6



REPORT KEY	
No.	Name
01	COOSAWHATCHIE RIVER AREA
02	COMBAHEE RIVER AREA
03	EDISTO RIVER AREA
04	COOPER RIVER AREA
05	SANTEE RIVER BASIN
06	BLACK RIVER AREA
07	WACCAMAW RIVER BASIN
08	CONGAREE RIVER BASIN
09	WATEREE RIVER BASIN
10	LYNCHES RIVER BASIN
11	GREAT PEE DEE RIVER BASIN
12	LITTLE PEE DEE RIVER BASIN
13	LUMBER RIVER BASIN
14	SALUDA RIVER BASIN
15	BROAD RIVER BASIN
16	CATAWBA RIVER BASIN
17	YADKIN RIVER BASIN
18	LAKES (Greater than 1000 acres)

U.S. ARMY CORPS OF ENGINEERS
CHARLESTON DISTRICT
Charleston, South Carolina

STANLEY CONSULTANTS

CHARLESTON DISTRICT

LOCATION MAP

NAVIGABILITY STUDY

Summary Report

Plate 1