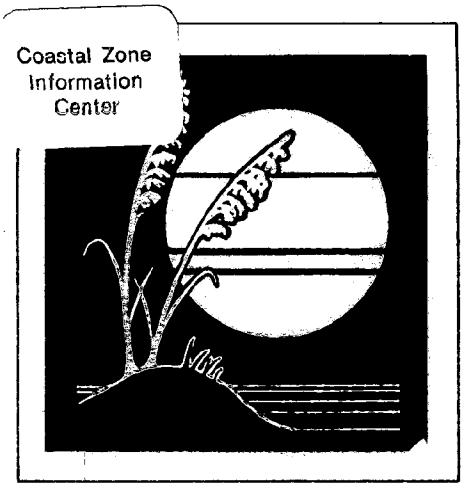
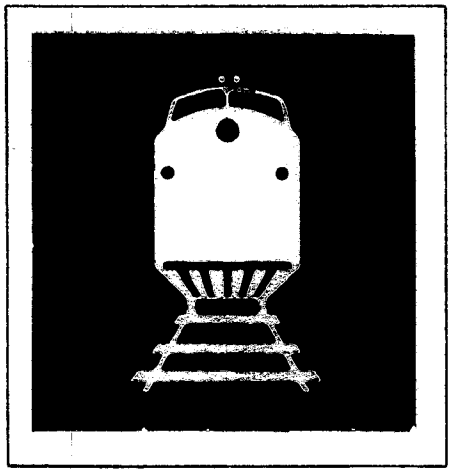
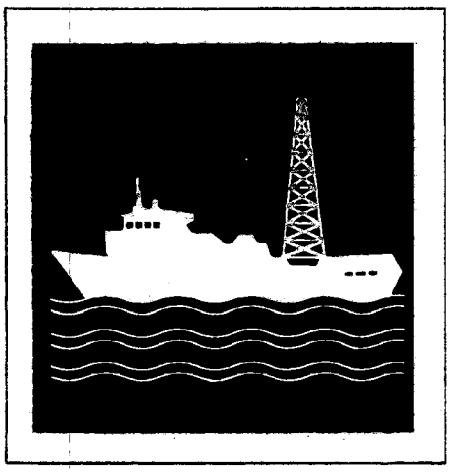
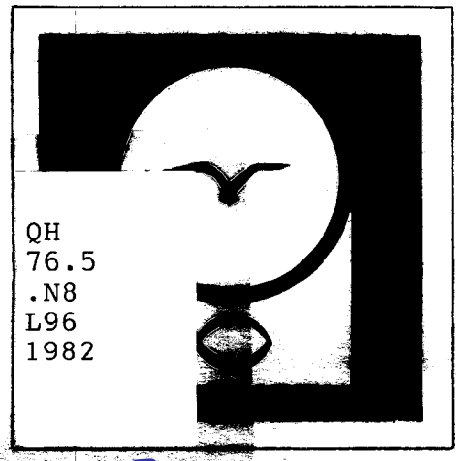
Coastal Zone
Information
Center









QH
76.5
.N8
L96
1982

Natural Areas Inventory of Washington County, North Carolina

COASTAL ZONE

INFORMATION CENTER

J. Merrill Lynch
S. Lance Peacock

OCTOBER 1982

North Carolina
Coastal Energy Impact Program
Office of Coastal Management
North Carolina Department of Natural Resources
and Community Development

CEIP REPORT NO. 30

U.S. GOVERNMENT
INFORMATION
GPO

To order:

Residents of North Carolina may receive a single copy of a publication free upon request. Non-residents may purchase publications for the prices listed. Because of the production costs involved, some of the publications carry a minimal charge regardless of residency. Prices for these are indicated in the price list as being "for all requests".

When ordering publications please provide the publication number and title and enclose a check made payable to DNRCD. For a complete list of CEIP publications - or to place an order - contact:

Coastal Energy Impact Program
Office of Coastal Management
N.C. Department of Natural
Resources and Community
Development
Box 27687
Raleigh, NC 27611

Series Edited by James F. Smith
Cover Design by Jill Miller

NATURAL AREA INVENTORY OF WASHINGTON COUNTY, NORTH CAROLINA

COASTAL ZONE
INFORMATION CENTER

BY

J. Merrill Lynch[1]

S. Lance Peacock[2]

The preparation of this report was financed through a Coastal Energy Impact Program grant provided by the North Carolina Coastal Management Program, through funds provided by the Coastal Zone Management Act of 1972, as amended, which is administered by the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration. This CEIP grant was part of NOAA NA-80-AA-D-CZ149.

The natural area inventory was supervised by the North Carolina Natural Heritage Program (Division of Parks and Recreation, N.C. Department of Natural Resources and Community Development).

October 1982

CEIP Report No. 30

Property of CSC Library

[1]Route 2, Box 222-B
Enfield, NC 27823

[2]P. O. Box 6006
Raleigh, NC 27628

QH76.5.N8 L96 1982
9779244
JUL 1 6 1997

U.S. DEPARTMENT OF COMMERCE NOAA
COASTAL SERVICES CENTER
2234 SOUTH HOBSON AVENUE
CHARLESTON, SC 29405-2413

PREFACE

The North Carolina Office of Coastal Management and the North Carolina Natural Heritage Program, both units of the Department of Natural Resources and Community Development, have commissioned a series of natural areas inventories for ten counties in the coastal zone of this state. The Washington County inventory was conducted in 1982 and was financed by a Coastal Energy Impact Program (CEIP) grant. CEIP funded the Washington County survey because of the potential environmental impacts of peat mining and other energy-related development.

The recommendations made in this report by J. Merrill Lynch and S. Lance Peacock are advisory. Their inventory and recommendations are designed to help state and federal agencies, county officials, resource managers, landowners and developers work out effective land management and preservation mechanisms to protect the six outstanding or exemplary natural areas described in this report. Agencies such as the N.C. Division of Environmental Management, Division of Land Resources, Division of Marine Fisheries, Wildlife Resources Commission, the U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, National Marine Fisheries Service, and Environmental Protection Agency should find this report useful, as may university researchers, private consultants, and private conservation groups. The Office of Coastal Management will use the report in assessing permit applications and for federal and state consistency reviews.

Merrill Lynch and Lance Peacock are experienced field biologists, who have previously been employed with the N.C. Natural Heritage Program and are most familiar with natural habitats throughout the North Carolina coastal plain region. The investigators were exceptionally well qualified to identify, describe, and evaluate the most outstanding natural areas of the project region.

Project investigators were instructed to identify those natural areas that contain highly unique, endangered, or rare natural features, or highest quality representations of relatively undisturbed natural habitats, and which may be vulnerable to threats and damage from land use changes. The investigators were advised not to report on Lake Phelps or Lake Pungo, which are both in protected status.

(1) Pungo Lake. The 10,000-acre Pungo National Wildlife Refuge includes the 2,800-acre lake. The lake hosts a large wintering population of waterfowl. The lake is bordered on the northern shore by a band of mature swamp tupelo forest and on the east by a disturbed area of pocosin. The lake and portions of swamp forest and pocosin is recognized on the State Registry of Natural Heritage Areas.

(2) Lake Phelps. The 16,000-acre lake is the second largest natural lake in North Carolina. It is administered by the N.C. Division of Parks and Recreation. The lake contains several rare aquatic plant species and is a documented site for the endangered Waccamaw killifish (*Fundulus waccamensis*). The lake is also recognized on the State Registry of Natural Heritage Areas.

The Office of Coastal Management, and the Coastal Resources Commission which it serves, implement the Coastal Area Management Act of 1974 (CAMA). Under this statute, the North Carolina Coastal Management Plan has been prepared and approved. It includes the definition and designation of various Areas of Environmental Concern (AEC). In many cases, AECs coincide with natural areas that are herein recommended for preservation or special management.

Peat mining has particular implications for these natural areas, some of which overlay exploitable peat deposits. Mining will remove natural vegetation, permanently alter the hydrology of the region, lower surface soil types from high organic histosoils to the clayey, sandy, and loamy soils typical of other parts of the outer coastal plain. Thus, natural communities, once mining is complete, almost certainly could never be re-established or reclaimed on mined-out land. Preservation of the best natural areas, and appropriate hydrological management is necessary prior to and during active peat mining.

The Natural Heritage Program is most pleased to have had this opportunity to conduct this project for the Office of Coastal Management. The inventory has documented a number of high-quality natural areas that possess natural elements of statewide priority and are important parts of North Carolina's natural diversity. Most of the identified sites were previously unknown and undocumented by the state's scientific community. The Natural Heritage Program hopes that these areas will be protected for the benefits of present and future generations of North Carolina and for the preservation of the state's truly exceptional natural heritage.

Charles E. Roe, Coordinator
N.C. Natural Heritage Program
November 16, 1982

ABSTRACT. Six natural areas are described and delineated for Washington County as a result of a field survey December 1981-September 1982. The natural areas contain almost 14,200 acres and at least 36 significant features. The great majority of the natural area acreage is privately owned (98%). The only publicly owned natural areas are contained in Pettigrew State Park. A large fraction of the natural area acreage is comprised of wetland forests.

ACKNOWLEDGEMENTS

The assistance of the following individuals is gratefully acknowledged:

1. Chuck Roe and Julie Moore of the North Carolina Natural Heritage Program, for the preparation of a workable set of inventory specifications, advice, and guidance throughout the project.

2. Rod McClanahan, District Biologist, North Carolina Wildlife Resources Commission and Everett Coates, Soil Scientist, Soil Conservation Service, Washington County, for their assistance in helping to identify and document the significant natural areas of the county.

3. Pat White, private consulting forester, Plymouth, for his invaluable aid in locating natural areas, identifying landowners, and providing a wealth of information on all aspects of the county's natural diversity.

4. Earl Faison, Roanoke Rapids, our pilot during the reconnaissance flights, who aided our survey immeasurably.

5. Lee Otte, East Carolina University, Department of Geology, who provided valuable comments on pocosin ecology and peat information.

TABLE OF CONTENTS

	PAGE
PREFACE	ii
ABSTRACT	iv
ACKNOWLEDGEMENTS	v
LIST OF FIGURES	vii
LIST OF TABLES	vii
INTRODUCTION	1
NATURAL AREA INVENTORIES	
Van Swamp	12
East Dismal Swamp	43
Pettigrew State Park	62
Conaby Creek - Roanoke River	95
Bull's Neck Swamp	117
Chapel Swamp	147
BIBLIOGRAPHY	170
GLOSSARY	172

LIST OF FIGURES

Page

1. Natural Areas of Washington County viii
2. Access information map, Van Swamp 13
3. Peat distribution map, Van Swamp 19
4. Significant features map, Van Swamp 27
5. Access information map, East Dismal Swamp 44
6. Significant features map, East Dismal Swamp 52
7. Access information map, Pettigrew State Park 63
8. Significant features map, Pettigrew State Park-North Shore Baldcypress Stand 71
9. Significant features map, Pettigrew State Park-South Shore Freshwater Marsh 74
10. Access information map, Conaby Creek-Roanoke River 96
11. Significant features map, Conaby Creek-Roanoke River 104
12. Access information map, Bull's Neck Swamp 118
13. Significant features map, Bull's Neck Swamp 129
14. Access information map, Chapel Swamp 148
15. Significant features map, Chapel Swamp 155

LIST OF TABLES

1. Selected Characteristics of Otte's Pocosin Types... 7

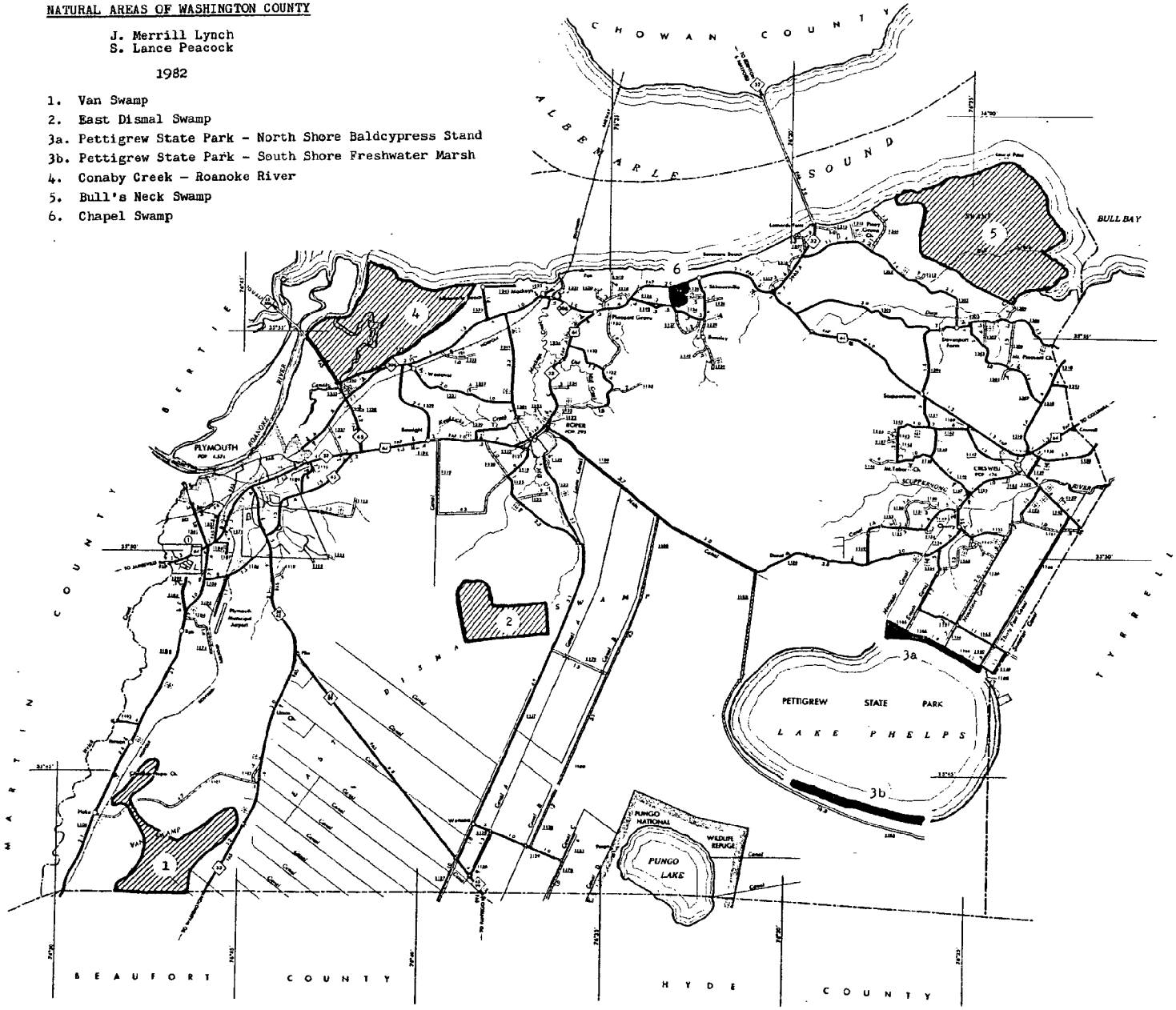
Fig. 1

NATURAL AREAS OF WASHINGTON COUNTY

J. Merrill Lynch
S. Lance Peacock

1982

1. Van Swamp
2. East Dismal Swamp
3a. Pettigrew State Park - North Shore Baldcypress Stand
3b. Pettigrew State Park - South Shore Freshwater Marsh
4. Conaby Creek - Roanoke River
5. Bull's Neck Swamp
6. Chapel Swamp



INTRODUCTION

Washington County is in the northeastern section of North Carolina situated in the coastal plain province. The county has a total area of 420 square miles, including 336 square miles of land and 84 square miles of water. The 269,000 acres encompass a variety of habitats, ranging from open lakes and sounds to freshwater marshes, wooded swamps and pocosins, to upland hardwood, pine, and mixed forests.

Washington County is primarily a rural county with only two municipalities, Plymouth, the county seat, and Roper. The 1970 census reported a county-wide population of 14,114, one of the least populated counties in the state. In addition to Albemarle Sound, it has contiguous boundaries with Tyrrell, Hyde, Beaufort, Martin, and Bertie Counties (Figure 1).

The county lies across the divides of two major river basins. The northwestern part drains into the Roanoke River Basin, and the southern part drains into the Pungo River Basin. The rest of the county drains into Albemarle Sound. Elevation ranges from sea level at the Albemarle Sound to about 50 feet near the town of Hoke in the southwest corner. Geomorphologically, the county is divided into two coastal plain marine terraces, separated by two parallel scarps, which run northeast-southwest across the extreme western side. The Suffolk Scarp, otherwise known as the Pinetown Scarp, is a distinct sand ridge which marks an old ocean shoreline formed during a higher Pleistocene sea level. The toe, or base, of this scarp is about 25 feet and the marine terrace to the east is known as the Pamlico Terrace. West of the scarp is another relatively flat marine surface known as the Talbot Terrace, an older feature formed by an even higher Pleistocene sea.

Two major freshwater lakes are a dominant part of the county landscape. Lake Phelps is 16,600 acres in size and is located in the southeastern portion of the county south of Creswell. It is the second largest natural lake in North Carolina. Pungo Lake, 2560 acres, is located in the southeastern portion of the county about three miles southwest of Lake Phelps.

GEOLOGY

The generalized geology of Washington County dates from the Cretaceous Period to the Recent. The county is underlain by a thick section of sedimentary deposits which consist mainly of sand, clay, marl, and limestone. Occurring throughout most of

the county is the Eocene Castle Hayne limestone, a chalky-white sandy-shell limestone or dense silicified gray limestone. Outcrops of this formation are not known for the county. Overlying the Castle Hayne are various deposits of the Miocene Yorktown formation consisting of blue-gray marls, sands, and shell beds interbedded with massive, dark, sandy clays. Overlying the Yorktown are the undifferentiated deposits of interbedded sands and clays of Pleistocene and Recent age which form the Talbot and Pamlico terraces mentioned earlier.

SOILS AND VEGETATION

The soils of Washington County are fairly diverse and play a major role in the geographical distribution and ecology of the major vegetation associations. The county has been mapped into seven basic soil associations each of which represent a distinct pattern of drainage, soils, relief and vegetation. Each unit is a unique natural landscape with a corresponding assemblage of vegetation types.

Soils information is taken from Soil Survey of Washington County, N.C., Soil Conservation Service, 1981.

1) Augusta-Altavista-Wahee Association: These are nearly level, somewhat poorly drained and moderately well-drained soils that have a loamy surface layer and a loamy or clayey subsoil; on low ridges or stream terraces along small streams which drain into the Roanoke River or Albemarle Sound.

Natural Area represented: Chapel Swamp
Percentage of land area of county = 13%

Because of their better drainage and location along the Roanoke River and Albemarle Sound, these soils were among the first to be cleared and placed in cultivation. The earliest settlements in the county around the present-day towns of Plymouth and Roper arose in areas dominated by this soilscape. Original vegetation probably consisted of a mixture of upland oaks, such as white, southern red, and black, with American beech, loblolly and shortleaf pines, and mockernut and pignut hickories. The Chapel Swamp natural area contains the best remaining example of this soilscape.

2) Cape Fear-Portsmouth-Roanoke Association: These are nearly level, very poorly drained and poorly drained soils that have a loamy surface layer and a loamy or clayey subsoil; on stream or marine terraces along interstream divides.

Natural Areas Represented: Pettigrew State Park (Lake Phelps)
Percentage of land area of county: 40%

This landscape occupies much of the county in the poorly drained interior situated between the upper reaches of the drainages and the peat-dominated wetlands in the central and southeastern sections. Essentially these are flat upland non-alluvial wetlands dominated by mineral soils. Most of the soilscape has been drained, cleared and converted to agriculture. Much of the remaining acreage, owned by large timber corporations, has been or is in the process of being drained and converted to large scale loblolly pine tree farms.

Even though this landscape occupies a substantial part of the county, very little natural vegetation remains and that which is left has been subjected to extensive logging operations. The Lake Phelps baldcypress natural area, although included in this association unit, is probably not a typical vegetation type, because of the influence of adjacent Lake Phelps.

The natural vegetation probably consisted of a number of wetland hardwood and softwood species, including baldcypress, swamp blackgum, loblolly pine, tulip-poplar, American beech (locally), swamp chestnut, laurel, willow, water, and cherrybark oaks, red maple, and sweetgum. Ashe (1894) mentioned the occurrence of oak flats in coastal plain lowlands slightly drier than more typical swamps dominated by cypress and gum. Perhaps this landscape could best fit into his oak flats vegetation type.

3) Dorovan association: These are nearly level, very poorly drained soils that are dominantly muck throughout; on low-lying alluvial floodplains and in large undrained swamps.

Natural Areas Represented: 1) Conaby Creek-Roanoke River
2) Bull's Neck Swamp
Percentage of land area in county: 9%

This landscape is restricted primarily to the Roanoke River basin and the Bull's Neck Swamp along Albemarle Sound. Minor areas occur along the Welch, Deep, and Mackey's Creek drainages and along the Scuppernong River.

These wetlands are almost all below 5 feet in elevation and occupy deep peat or muck deposits in drainage basins. Because of their wetness, inaccessibility and flooding susceptibility, they have remained the least disturbed of the seven major soilscapes by drainage and clearing operations.

The original vegetation probably consisted of baldcypress and swamp blackgum with scattered Atlantic white cedar, loblolly and

pone pines, sweetbay, redbay, and red maple. Today selective logging has removed most of the merchantable cypress, and much of the swamp is dominated by second-growth stands of gum and maple.

Logging operations and associated roads and ditches constitute almost 100% of the disturbance to these areas, although some sand and gravel is being mined in parts of the Roanoke River basin.

4) Belhaven-Wasda-Roper Association: These are nearly level, very poorly drained soils that have a mucky surface layer and a dominantly loamy subsoil; on broad, level flats.

Natural Areas Represented: 1) Van Swamp
2) East Dismal Swamp
Percentage of land area of county: 25%

This soilscape occupies much of what once was known as the East Dismal Swamp, an interior wetland which covered most of the county west of Lake Phelps.

Up until fairly recently, most of the acreage was forested wetland. Difficulty of drainage, abundance of undecomposed cypress and cedar logs in the mucky soils, and lack of sufficient capital were the factors primarily responsible for thwarting development. All of this changed, however, in the 1950's and 1960's, when large capital investments combined with new draining and clearing technology to open up these lands to agricultural development. Since that time the majority of the soilscape has been cleared, drained, and converted to corn and soybean production.

Various blocks of natural vegetation persist in one form or another and two natural areas, Van Swamp and East Dismal Swamp, contain the best remaining examples of this once extensive wetland ecosystem.

The bulk of this landscape occurs in the central part of the county west and northwest of Lake Phelps. A smaller area lies in Van Swamp in the southwest corner. In general this association is surrounded on the north, west, and south by slightly higher, somewhat better drained mineral soils of the Cape Fear-Portsmouth-Roanoke association. To the east and southeast the mucky soils are bounded by a slightly higher "dome" of very deep peat, the Pungo association discussed next.

The natural vegetation of the soilscape was probably originally dominated by great swamp forests of cypress, swamp blackgum, and

Atlantic white cedar. Numerous other wetland species were also present in varying proportions.

Today, in the remaining forested areas, red maple and swamp blackgum predominate with sweetbay and redbay. The two natural areas contain the remaining mature second-growth and old-growth stands.

5) Pungo Association: These are nearly level, very poorly drained soils that are muck to a depth of 51 inches or more; on broad, level flats.

Natural Areas Represented: Van Swamp

Percentage of county land area: 7%

This soilscape occupies almost the entire southeast corner of the county south of Lake Phelps. A small, disjunct area lies within Van Swamp in the county's southwest corner.

This soilscape occupies the area of deepest peat accumulation, presumably along a filled-in paleo-channel of the Alligator River. About 8,000 yrs. before present, peat began filling in the former stream channel by vertical deposition, then began spreading over the adjacent landscape laterally. Eventually the mantle of peat spread out over most of central Washington County. The highest or deepest portion of this peat "dome" is the area occupied by the Pungo soilscape.

The original vegetation was probably dominated by pond pine over a dense layer of evergreen and deciduous shrubs and bay trees. During extended droughts, the upper layers of the peat would dry out, and largescale wildfires occurred. Fire resistant species such as pond pine and the shrubs were better adapted to this fire-maintained regime and so dominated the landscape. This pond pine-dense shrub vegetation type overlying peat wetlands is the classical "pocosin."

Because both Pungo and Phelps Lakes lie adjacent to the deep peat areas, it has been suggested that both formed as a result of peat fires which burned down to the underlying mineral layers. Enlargement of the burned areas occurred when water filled them and wind and water currents combined to erode the peat margins, gradually creating the large freshwater lakes which are present today.

Recently, the potential use of peat as an alternative energy source has generated interest in mining the deep deposits. The southeast corner of the county was ditched and a series of access roads were constructed in the 1960's and 1970's. Peat mining on

an experimental basis was begun by First Colony Farms, a major land development corporation. Peat Methanol Associates has leased rights to First Colony Farms peat, and proposes to mine an area about the size of Lake Phelps, and immediately adjacent to that lake, over a 30-year period. Methanol from the peat will be exported to urban centers to the north.

This ditching and road construction has altered what once was an excellent example of tall pond pine pocosin (high pocosin) and has degraded the natural integrity of the site. Present ditching and road construction activities in Van Swamp threaten to damage that area's significant natural features.

The sixth and seventh Soil Associations, Dragston-Conetoe-Altavista and Conetoe-Wickham-Tarboro, occupy only a minor proportion of the county, totalling 6% of the land area. No natural areas were found on either Association, due to their limited extent and generally high agricultural productivity. Original vegetation probably consisted of mesic to somewhat xeric hardwoods, with loblolly pine and possibly some longleaf pine. Some of the more steeply sloping mesic sites supported herb assemblages more characteristic of Piedmont slopes. A few such sites were sampled during this survey. Species such as bloodroot, indian cucumber root, mayapple, wild ginger, bellwort and others were present.

OTHER VEGETATION COMMUNITIES

In addition to the natural vegetation types just discussed, there are several other minor communities which exist in the county.

Along the south shore of Lake Phelps is a narrow zone of freshwater marsh. This marsh is described in the Pettigrew State Park natural areas site report. Small areas of freshwater marsh also occur at the mouth of Deep Creek along Albemarle Sound.

Floating aquatic communities of cow-lily and water lily occur along the shallow water margins of Conaby Creek and the Roanoke River.

The rest of the county is currently dominated by various agricultural and silvicultural lands.

TABLE 1

SELECTED CHARACTERISTICS OF OTTE'S POCOSIN TYPES

(from Otte, 1981)

	low pocosin	high pocosin	pond pine woodland	pond pine forest
Soils	greater than four feet of peat	two to four feet of peat	one to two feet of peat	peaty sand to one or two feet of sandy peat
Hydroperiod	abundant surface water in wet season; saturated year-round except in severe drought	flooded in wet season; water table below surface but remains within organic layer in dry season	flooded or saturated in wet season but dropping to mineral layer in dry season	saturated in wet season; water table drops into mineral sediments in dry season
Shrubs	height is two to four feet on moss mats; four to six feet on hummocks; density of lower shrubs open; of taller shrubs closed	height is four to eight feet; tallest on hummocks; density is closed	height six to fifteen feet; shrub layer usually closed	height ten to twenty feet; generally closed
Pond Pines	height to ten feet; trees widely scattered, gnarled	height to 25 feet; widely scattered	up to 60 feet tall and 2 feet dbh; scattered, less than 50% cover	mostly less than 50 feet tall, dbh to 12 inches; canopy generally closed

METHODOLOGY

The natural areas inventory of Washington County was undertaken to identify and describe the remaining sites within the county which contain significant natural values. The study was carried out from December 1981 to September 1982 and utilized other data collected by various biologists familiar with the county.

Study sites were selected by various reconnaissance methods. Most of the rural primary and secondary roads in the county were travelled in addition to many private logging and agricultural roads. A complete set of 1:24000 scale aerial orthophotoquad maps were examined along with 1:2000 scale black and white aerial photographs. Two low altitude aerial reconnaissance flights were conducted using a Cessna 172 fixed wing aircraft.

Conversations with numerous people familiar with the natural lands of the county were also conducted. Foresters, soil scientists, land surveyers, sportsmen, farmers, and others with first-hand experience were consulted.

An attempt was made to accumulate all of the scientific literature pertinent to the county's natural resources.

After all the sources of information were gathered and evaluated, a number of potential natural area sites were identified for further study. A total of about 15 field days was spent visiting and inventorying each of the potential natural area sites.

Natural areas were selected on the basic of several criteria. A primary factor used to assess an area's significance was the degree of past man-induced disturbances. Areas of old-growth timber which had been disturbed relatively little by previous logging cycles were given a high priority. The county was divided up into seven major "soilscapes" or broad vegetation associations (see preceding section on Soils and Vegetation) and an attempt was made to identify and inventory an undisturbed example representative of each major soilscape. Emphasis was not on the unique or the unusual. Rather, a representative example of all of the county's major vegetation or habitat types in an undisturbed, old-growth condition was sought for.

Another important factor used in assessing a site's significance was its "wilderness" aspect. Large roadless or near roadless areas, while maybe not containing pristine habitats, were often considered significant because of their inaccessibility and remoteness. Because areas with wilderness values are becoming increasingly rare in the N. C. coastal plain, it was felt this criteria was important in assessing a site's overall biological significance.

The value of a site for game and non-game wildlife habitat was also used as a selection criteria. An attempt was made to adequately survey the vertebrate faunal diversity of each site and make comparisons with adjacent areas and other potential natural areas. In this way, the relative importance of an area for wildlife values could be determined. The diversity of habitats within the natural areas as well as the aerial extent of the site also entered into the evaluation. Large tracts containing a diversity of habitat types and allowing movement of large, wide-roaming mammals were given a higher priority over smaller, more restrictive and less diverse sites.

As a result of this study, it is felt that all of the major large tracts containing significant natural areas have been identified. Time and budget restraints prevented an adequate survey of all the small blocks of woodlands scattered in the county. It is possible that additional significant sites remain undiscovered in the remaining small tracts.

Six significant natural areas were identified ranging in size from 149 acres to 6450 acres. These tracts cover a variety of edaphic and biotic habitat types ranging from mesic upland hardwoods to swamp forest and upland pocosin to freshwater lakeshore marsh. Each of the natural areas has been influenced in varying degrees by past and present cultural disturbances; however, it is felt these disturbances have not been severe enough to significantly reduce their biological integrity. All but one of these sites are exclusively wetland habitats.

The six natural areas are:

1) Van Swamp: 2450 acres. Palustrine, non-alluvial swamp forest and pond pine pocosin.

2) East Dismal Swamp: 1630 acres. Palustrine, non-alluvial swamp forest.

3) Pettigrew State Park (2 natural areas) Total acreage: 250. Lakeshore baldcypress stand and freshwater marsh system.

4) Conaby Creek-Roanoke River: 3240 acres. Palustrine and riverine swamp forest associated with drainage basin.

5) Bull's Neck Swamp: 6450 areas. Palustrine swamp forest associated with drainage basin.

6) Chapel Swamp: 149 acres. Alluvial swamp forest and mesic upland hardwoods.

All of the described natural areas in Washington County, with the single exception of Pettigrew State Park, are privately owned. Lake Phelps, a 16,000-acre lake administered by the N.C. Division of Parks and Recreation, is not described in this report. A second natural area not described is the Pungo Lake National Wildlife Refuge. The 10,000 acre refuge contains the lake (2,800 acres) and adjacent altered pocosin and swamp forest lands. A research natural area containing 1,000 acres of low shrub pocosin vegetation is located on the east side of the lake. The primary natural value of the refuge is as a wildlife habitat, principally for wintering and migratory waterfowl. Portions of both Lake Phelps and Pungo Lake Refuge are registered State Natural Heritage Areas.

THREATS

As discussed in several places in the following report, the original forests of the county have been entirely removed except for a few scattered remnant tracts or woodlots. The total acreage of the six natural areas represents only 14,169 acres, or about 6.5% of the total land area in the county. Large areas have been drained and cleared for agriculture, particularly within the past thirty years. Much of the remaining area not devoted to row/crop agriculture is managed for loblolly pine production. The remaining natural lands are all threatened by eventual conversion to agricultural or silvicultural production. The only natural areas presently protected are located within the Pettigrew State Park at Lake Phelps. Both the Van Swamp and East Dismal Swamp natural areas, examples of a once extensive wetland swamp forest system, are in immediate danger of being permanently altered by timber interests. The Bull's Neck Swamp and Conaby Creek-Roanoke River natural areas are less seriously threatened at the present time. These two areas lie within extensive drainage basins, a factor which has impeded development. The Chapel Swamp natural area, which contains the only example of an upland forest type, is probably the least threatened of the privately owned natural areas. It is also the only one exclusively in family farm ownership. The others are wholly or substantially controlled by large corporations.

Peat mining is an additional threat to the remaining swamp forest wetlands of the county, particularly those in Van Swamp. Much of southeastern Washington County, which once was an extensive swamp forest and pocosin wetland, has been altered by clearing and drainage operations connected with peat mining operations underway there.

The future for the unprotected natural lands in the county looks bleak. Unless steps are taken immediately to insure their protection, the last remnants of the once great forests of the county will disappear forever. Along with the demise of the natural areas, species diversity will undoubtedly decrease. Mammals, birds, and other animals which depend on large tracts of relatively undisturbed forests will be replaced by other, more widespread species which are adapted to open farmland and other disturbed habitats.

CONCLUSION

Washington County has undergone vast land use changes in its recent past. The opening up of the vast swamp forests and pocosins to agriculture has had a profound effect on all aspects of the county's development: economical, sociological, as well as environmental. Despite these large-scale changes, there remain several tracts of land in the county which contain remnant ecosystems representative of the forested wetlands which once dominated the landscape. These remaining natural areas are described in the following report. The future for these sites is not bright. It is hoped that this report will generate some interest and enthusiasm, not only within the scientific community but also among the residents of Washington County, so that these priceless remnants of our natural heritage can be saved and future generations will have the opportunity to see the closest approximation of the original Washington County landscape.

NATURAL AREA INVENTORY FORM
(To be prepared for each site)

Basic Information Summary Sheet

1. Natural Area Name: Van Swamp

2. County: Washington

3. Location: In extreme southwestern Washington County; bounded on the south by the Beaufort County line, on the north by SR 1101, on the west by SR 1100, and on the east by NC 32.

4. Topographic quadrangle(s): Hoke (1978), Plymouth West (1979).

5. Size: Approximately 2450 acres (measured with grid calculator)

6. Elevation: 30-41 feet msl

7. Access: The Northern portion of site can be reached from Town of Hoke by going east on SR 1101 about 1.1 miles to junction with logging road to north. Turn onto logging road and go 0.25 mile to junction with second logging road to west. Continue north past this junction to dead-end. This last portion traverses through a section of the natural area.

   The Southern section can be reached from NC 32 by going south 3.35 miles from junction with SR 1101 to junction with logging road to east. Turn right (west) onto logging road and proceed about 1.2 miles to second junction with NE-SW running logging road. Best portions of natural area are SW of this intersection.

8. Names of investigators:

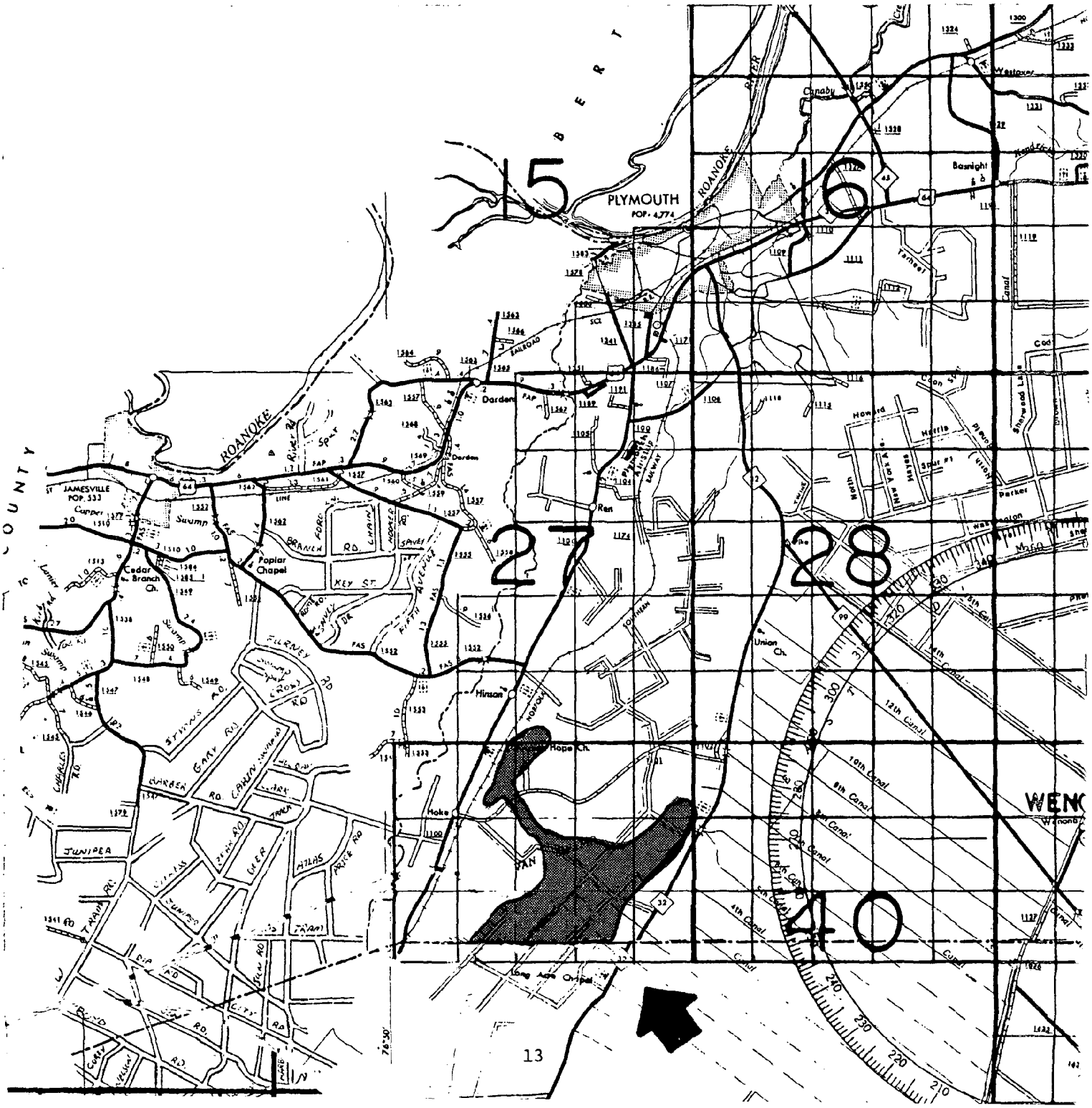
J. Merrill Lynch	S. Lance Peacock
Route 2, Box 222-B	P. O. Box 6006
Enfield, NC 27823	Raleigh, NC 27628

9. Date(s) of Investigation: April 10, 18, 1982; also April 18, 1981.

10. Priority rating: Medium-High

Fig. 2 Access information:

VAN SWAMP



11a. Prose Description of Natural Area

The Van Swamp natural area is a 2450-acre tract of swamp forest and pond pine pocosin wetlands located in southwestern Washington County. The natural area contains the last remnant stands of natural vegetation within the entire Van Swamp complex of Washington County. The original swamp system extended from near Plymouth in Washington County southwest to the community of Pinetown, Beaufort County, a distance of roughly fifteen miles. Deforestation and conversion of the original swamp forest vegetation to managed pine plantations has reduced the swamp to its present dimensions in extreme southwestern Washington and adjacent Beaufort Counties (See Fig. 1).

Originally, Van Swamp occupied an area of about 13,440 acres in southwestern Washington County from Plymouth south to the Beaufort County line, a distance of about nine miles. Roughly rectangular in size and averaging 3-4 miles wide, Van Swamp was a sizeable wetland system with no well-defined drainage outlets. It was essentially a landlocked upland bog: a non-alluvial, palustrine wetland system. Today, a network of drainage ditches have tamed the swamp and most of the original swamp and pocosin vegetation has been cleared and converted to intensively managed pine plantations. What remains of the natural ecosystem is a small chunk in the southwestern corner of the county. Geologically, Van Swamp is a relatively flat basin, bordered on its eastern and western margins by two parallel, eastward-facing scarps. The older scarp along the western margin is known as the Pinetown scarp or Pinetown shoreline. The younger, topographically lower scarp on the east is called the Union Chapel shoreline (See Fig 2). Both of these scarps probably represent old beach ridges formed during periods of high sea levels during the Pleistocene Epoch (Mixon and Pilkey 1976). The area between the scarp, i.e., Van Swamp, consists of ancient beach ridges and backdune flats. The elevation of the Van Swamp flat is generally between 30-40 feet msl. The tow of the Union Chapel Scarp is consistently 17-21 msl, whereas the toe of the Pinetown Scarp is about 38-40 feet msl (Mixon and Pilkey 1976). These two scarps are the dominant landforms in the area and are clearly visible on aerial photographs taken by the Apollo 9 spacecraft in 1969 (Mixon and Pilkey, 1976). The pronounced ridges along the crest of the scarps have effectively blocked the drainage of Van Swamp and as a result initiated the formation of the wetland system.

In order to understand the ecological systems within the natural area, it is important that an overall picture of the entire Van Swamp area be outlined.

The natural area contains the wettest, most poorly drained portion of Van Swamp. It also contains the only organic deposits deep enough to be mapped by soil scientists as histosols (peat soils) in the Washington County portion of Van Swamp. The rest of Van Swamp (outside the natural area) consists of poorly drained, wet, loamy or sandy mineral soils.

The peat deposits began forming about 6000-8000 years ago when a small stream draining the swamp through a narrow break in the Union Chapel scamp became blocked. Drainage was impeded and a shallow body of water was impounded. The peat sediments accumulated both vertically and laterally, filling in the original channel and spreading out over the adjacent flats (Otte, pers. comm. 1982). Since that time the peat has continued to accumulate and now has reached a depth of over 10 feet in places.

It is easy to envision why the area underlain by these peat deposits has remained in a relatively natural condition while adjacent areas within the Van Swamp complex have been drastically altered. The better drained mineral soils of Van Swamp required relatively little investment in equipment and money and were easily converted using modern day technology to tree farms. The difficulty of draining the peat and the cost of site preparation effectively stopped the tree farms at the margin of the peat fields. The peat, however, did not exclude selective timber operations in this section from the early 1900's to the present day. Tramroads were constructed and lumber was hauled out by rail. More recently several logging roads have been constructed and additional cutting undertaken.

The natural area of Van Swamp is not pristine. All of it has been selectively timbered at least once within the past century. However, at least up to the present day, these disturbances have not seriously affected the natural hydrological and ecological processes which have been going on since pre-settlement times.

The following paragraphs will describe the present day vegetation assemblages of the remnant Van Swamp wetland system.

The Nyssa sylvatica var. biflora/Acer rubrum/Persea borbonia community type (swamp blackgum/red maple/red bay); (CT 1) occurs in small, irregularly shaped patches throughout much of the natural area. This community is characterized by a canopy height ranging from 60-80 feet tall, an average canopy trunk diameter (above butt swell) of 14-17 inches, an estimated age of 75 + years, and a distinct three-tiered

stratification (canopy-subcanopy-tall shrub). On the best sites swamp black gum forms a closed canopy. Isolated large gums up to 32 inches dbh are scattered throughout the community along with several other species which reach the canopy but are not dominant: loblolly pine (Pinus taeda), bald cypress (Taxodium distichum), sweetbay (Magnolia virginiana), and Atlantic white cedar (Chamaecyparis thyoides). The subcanopy dominated by red maple also contains the tree species mentioned above. Redbay forms a dense tall shrub layer ranging from 10-25 feet in height. There is no dominant ground cover although species such as chain ferns (Woodwardia areolata, W. virginica, sedges (Carex spp.), and royal fern (Osmunda regalis var. spectabilis) are scattered throughout.

Vines are abundant in the community and include high-climbing species such as poison ivy (Rhus radicans), grape (Vitis sp.), laurel-leaved greenbriar (Smilax laurifolia) and yellow jessamine (Gelsemium sempervirens). During April when the yellow jessamine is in bloom, the flowers attract myriads of swallowtail butterflies including species such as palamedes, black, tiger, and spicebush.

There are minor variations in species composition of the three layers. In some areas red maple does not form a dense subcanopy. In other places red maple and sweetbay are co-dominants in the subcanopy. Truly large specimens of sweetbay are common throughout. Individuals of 10 inches dbh are common and some trees measure up to 14 inches dbh. Many are 60-75 feet tall. Sweet pepperbush (Clethra alnifolia) forms a locally dense low shrub layer, particularly along the canal banks where mineral spoil soils are exposed.

The swamp blackgum stands represent the least disturbed sections of the swamp forest. Scattered very old stumps of Atlantic white cedar and cypress indicate the area was selectively timbered, probably during the early 1900's, a period during which many extensive logging operations were underway in Washington County (Pat White, pers. comm., 1982). In those days, narrow gauge tramroads were built into the vast swamp areas and mostly high quality boles of cypress and cedar were removed. Today, large cull trees of deformed cypress and cedar remain in the swamp. Some cull cypress trees are up to 4 feet in diameter and over 100 feet tall. Probably the original swamp forest vegetation type of Van Swamp was cypress/swamp blackgum-Atlantic white cedar. Early descriptions of cypress-dominated swamp forests are common in the literature (Pinchot and Ashe, 1897; Ashe, 1894).

The second swamp forest community type (CT 2) in the natural area is Pinus taeda-Nyssa sylvatica var. biflora/ Acer rubrum/Persea borbonia (loblolly pine-swamp blackgum/ red maple/redbay). This community is characterized by a canopy height of between 65-85 feet, an average canopy tree dbh of 12-14 inches, and an age estimated to be between 50-75 years old. It is similar in many respects to CT 1, discussed in the preceding paragraphs. Common trees in the canopy (but not dominant) include Atlantic white cedar, sweet-bay, cypress, and tulip poplar (Liriodendron tulipifera). Common subcanopy and shrub layer species include the above trees in transgressive age classes plus sweet pepperbush and fetterbush (Lyonia lucida). As in CT 1, vines are abundant and include poison ivy, yellow jessamine, and laurel-leaved greenbriar.

Topographically and pedologically, this community appears to occupy the same areas as CT 1. The major difference between these communities, i.e., the dominance of loblolly pine in the canopy, is probably partly attributable to timber operations in the recent past. The smaller trunk diameters, partly open canopy cover, and greater variability of canopy and subcanopy heights indicate a wider range of age classes and a higher proportion of younger trees when compared with the vegetation structure of CT 1. This is particularly evident in certain section of the swamp where more recently cut stumps are present. However, some portions of the natural area, particularly in the corner north of SR 1101, contain many large, flattop old-growth pines and appear to be relatively undisturbed. This may be explained by a greater abundance of sandy mineral horizons close to the surface, a situation which is more favorable for loblolly pine germination and growth. Ashe (1915, p. 10) states that loblolly pine in the original forests of the coastal plain occurred among other places, in "... shallow interior swamps with loamy soils among maple, water oaks, and gums ... and in deep swamps in which it was not common and where it occurred with cypress, water gum, and water ash."

The third community type (CT 3) represented in the natural area is Pinus serotina/mixed pocosin shrubs//Smilax laurifolia (pond pine/mixed pocosin shrubs//laurel-leaved greenbriar). This community is characterized by an open canopy of scattered pond pines 60-90 feet tall over a very dense tall shrub layer composes of a number of typical pocosin shrubs and small trees such as loblolly bay (Gordonia lasianthus), sweetbay, redbay, fetterbush, sweet gallberry (Ilex coriacea), and red maple. The shrub layer is intertwined by dense tangles of laurel-leaved greenbriar. Several very large specimens of loblolly bay were seen during the course of the field work. One clump of trees was about 70 feet tall with one specimen measuring 27 inches in diameter.

This community is typical of many pond pine-evergreen shrub associations overlying deep peat areas in the eastern coastal plain of North Carolina. They are quite distinct, both structurally and floristically, from swamp forests which are usually dominated by combinations of swamp blackgum, cypress, and Atlantic white cedar. Vegetation of the evergreen shrub bogs or pocosins have been described elsewhere in the literature (Kologiski, 1977; Wells, 1942; Wells, 1967). Most botanists agree that the evergreen shrub bogs or pocosins are 1) usually over moderate to deep peat layers; 2) have seasonal high water tables at or near the surface; 3) are almost always associated with non-alluvial, upland basins and interstream divides; 4) mostly are the result of blocked drainages with the major exception of carolina bays, and 5) are dominated by a diversity of fire resistant woody shrubs and usually containing at least a few scattered pond pines.

The Van Swamp pond pine pocosin appears to be highly correlated with a particular soil series, Pungo muck (dysic, thermic Typic Medisaprists). This peat soil is characterized by upper organic horizons from 51 to more than 90 inches thick underlain by clayey mineral horizons. The seasonal water table is at or near the surface throughout much of the year. These soils differ from Belhaven muck in having much thicker organic layers (4-10 feet in depth). Recently, Otte (1981) has described a number of interrelated processes which he believes account for the distribution of pond pine pocosin in the peat dominated wetlands of the coastal plain. He concludes that an important factor concerning the maintenance of pocosins is direction of water flow.

> "Swamp forest peat (based on a number of samples) contains a higher average mineral content than does pocosin peat. This sediment is carried into the wetlands by surface runoff from the surrounding uplands. This runoff most likely also carries dissolved nutrients that would not be available to a system fed primarily by precipitation (i.e., pocosins)."

He contends that if surface runoff from adjacent highlands flows part-way into a peat-dominated wetland, but not all the way through, the outer margins of the wetland most likely would develop into swamp forest and the sediment-free, nutrient-deprived inner portions would likely develop pocosin vegetation.

In Van Swamp the distribution of the pond pine pocosin seems to support this hypothesis. The pocosin vegetation occurs in a zone of very deep peat (mapped as Pungo muck) located in the east-central portion of the swamp. Shallower peat areas on either side of the pocosin are dominated by

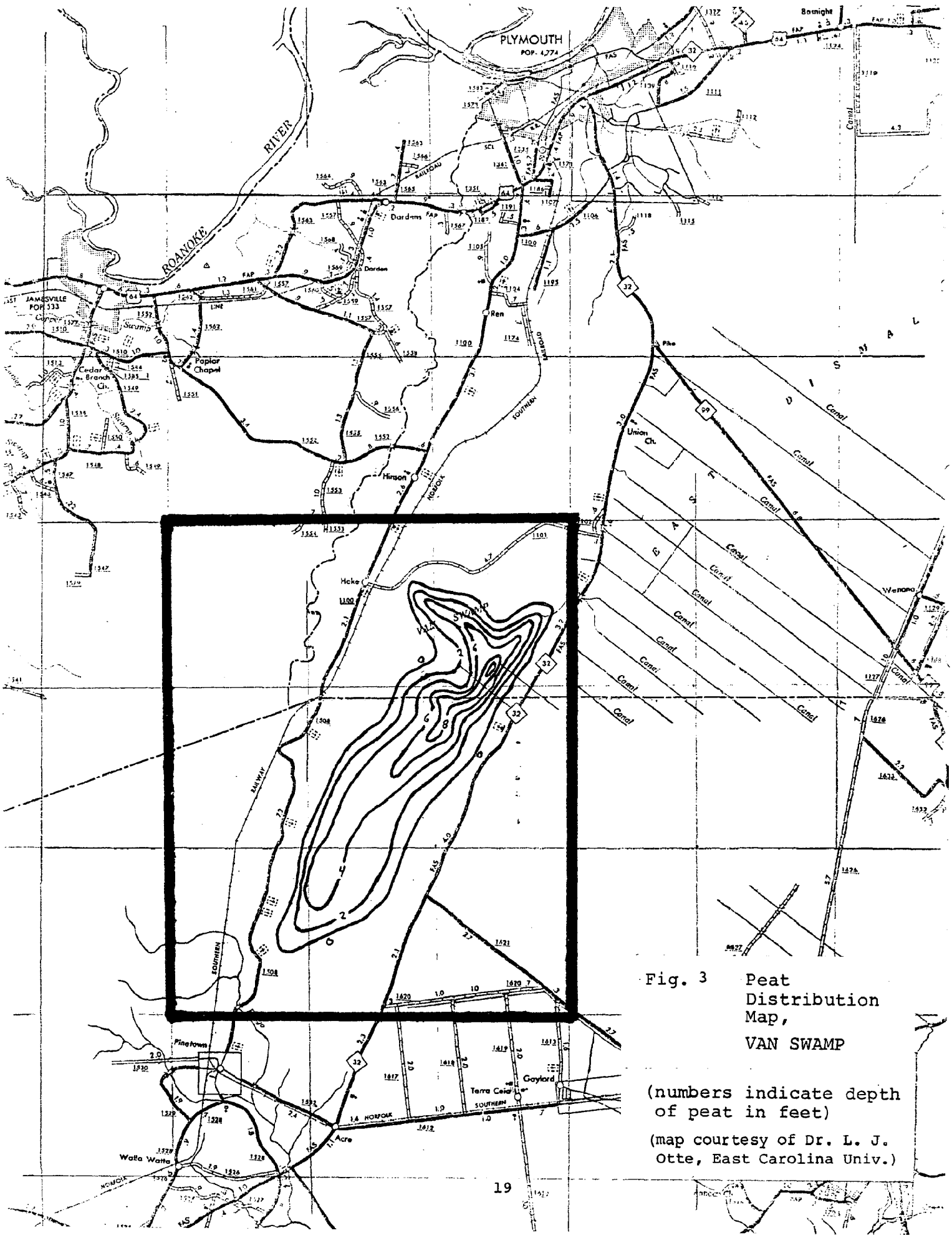


Fig. 3 Peat Distribution Map, VAN SWAMP

(numbers indicate depth of peat in feet)

(map courtesy of Dr. L. J. Otte, East Carolina Univ.)

swamp forest vegetation. These margins probably receive a degree of sediment deposition from the adjacent mineral soils along the scarps. The deep peat "dome" in the center of Van Swamp receives little, if any, nutrient imput (other than that derived from precipitation). The thickness of the peat in this area may also inhibit nutrient uptake of plants due to their inability to reach underlying mineral layers.

Man-induced disturbances such as intensive clearcutting and frequent wildfires can create pocosins from what originally was swamp forest (Otte, 1981). The timber cutting history of Van Swamp is not well-known and the question of whether the pond pine pocosin now present is a natural system or one created by past disturbances is open to debate.

However, a comparison between the pond pine pocosin vegetation and the distribution of deep peat can be made by reviewing Figs 3 and 4 . There is a high correlation of the distribution of the pond pine pocosin with the deeper peat deposits. The natural area provides an excellent opportunity to study the relationship between vegetation and the underlying soils, and the effects of sediment and nutrient recycling on vegetation systems.

Finally, the wildlife values of the Van Swamp natural area should be mentioned. According to McClanahan (North Carolina Wildlife Resources Commission District Biologist, pers. comm. 1982), the Van Swamp area supports one of the largest and healthiest whitetail deer herds in Washington County. Scat and tracks are abundant along the roads throughout the natural area. A remnant black bear population is still present (a fresh set of tracks were seen near SR 1101). However, it is questionable whether enough habitat is available to support a viable breeding population. Bobcat, uncommon in many areas of the state, are also present within the swamp. Breeding bird diversity within the swamp is excellent for a coastal plain forest system; 43 species of breeding birds were recorded within the natural area including several species which are uncommon and local in the coastal plain and which are restricted to non-alluvial swamp and pocosin wetlands. Black-throated green and worm-eating warblers were recorded including the largest population of the former recorded anywhere in the county. Both species are probably decreasing in the coastal plain as a result of habitat destruction. Other species present which require large wetland acreages and mature timber stands included the pileated woodpecker and the red-shouldered hawk, the latter considered threatened in the state (Cooper, et al, 1977).

The breeding bird diversity is all the more remarkable considering the general homogeneity of the swamp forest stands, a minimal amount of edge effect and the complete absence of open water or terrestrial habitats. Probably no other area in Washington County of comparable size and ecological uniformity contains a comparable diversity of breeding birds.

11b. Prose Description of Site Significance:

Van Swamp contains some of the finest remaining old-growth stands of swamp blackgum known in eastern North Carolina. Few examples of old-growth stands associated with a peat-dominated, palustrine wetland system are known in the state. The swamp also contains some of the largest specimens of sweetbay and loblolly bay seen by the authors anywhere in the state. Trees of "state champion" stature are present in the natural area.

Van Swamp also contains a representative example of a pond pine pocosin vegetation type associated with a deposit of deep peat. The natural area illustrates the relationship of vegetation and peat soils with contiguous examples of both swamp forest and pond pine pocosin vegetation types, both in a relatively undisturbed condition.

The 2450-acre natural area is the last remnant of natural vegetation in Van Swamp, a wetland system which once encompassed over 13,000 acres before drainage and clearing operations reduced it to its present size.

As a forested wetland ecosystem, the natural area functions as an important refuge for many wildlife species, including white-tailed deer, black bear, bobcat, and other furbearers. The site supports one of the largest deer herds in the county and also contains a small, remnant black bear population, a species which is much reduced in numbers throughout the coastal plain due to habitat destruction. Avian diversity is considered to be excellent for a coastal plain forest wetland. Forty-three species of breeding birds have thus far been recorded, including ten species of wood warblers. Two of those, the Black-throated green and worm-eating warblers, are uncommon and local breeders in the coastal plain.

12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
High quality wetland plant community	CT 1	Nyssa sylvatica var. biflora/Acer rubrum/Persea borbonia	This community contains the best, old-growth swamp forest stands remaining in Van Swamp based on maximum values for: average canopy height, average trunk diameters, and least amount of timber cutting disturbance in the past. Van Swamp contains the most extensive stands of old-growth swamp blackgum remaining in Washington County. Represents some of the best old-growth stands associated with non-alluvial, peat-dominated wetlands known in North Carolina.
		Least disturbed, old-growth examples of above C.T.	
High quality wetland plant community	CT 2	Pinus taeda-Nyssa sylvatica var. biflora/Acer rubrum/Persea borbonia	This community type shows more recent signs of cutting disturbance than CT-1 and is not considered as significant from a disturbance viewpoint.
		Least disturbed, old-growth examples of above C.T.	
High quality wetland plant community	CT 3	Pinus serotina/mixed pocosin shrubs// Smilax laurifolia	Typical of relatively undisturbed open pond pine pocosin systems of the outer coastal plain of N.C. but significant because of its geographical location. Northwesternmost

12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
			natural, undrained pond pine pocosin in North Carolina.
Endangered or threatened species	through-out	Red-shouldered Hawk	Threatened in N.C. Breeding population of at least 2 pairs in swamp. Conversion of much of the county's swamp and pocosins to agricultural and silvicultural production has destroyed habitat.
Rare and of Special Concern Species	through-out	Black bear	Rare and of Special Concern in N.C.; particular concern for species' continued survival in coastal plain region of state. Habitat destruction has virtually eliminated habitat for this species in county. Remaining blocks of suitable habitat such as in Van Swamp, Bull's Neck Swamp, and East Dismal Swamp are probably too small and isolated to maintain viable populations in the future.

12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
Unusual size of trees or Shrubs	4	Magnolia virginiana	Trees from 12-14 inches DBH and from 60-75 feet tall were common in portions of swamp. These trees and ones present at East Dismal Swamp natural area (see pp.) are the largest we have seen anywhere in N.C. and are of state champion size.
Unusual size of trees or Shrubs	5	Gordonia lasianthus	Group of trees in pond pine pocosin are about 70 feet tall with dbh up to 27.2 inches. Largest specimens seen by authors anywhere in N.C. May represent state champion tree. Also significant because site is very close to northern limit of species range.

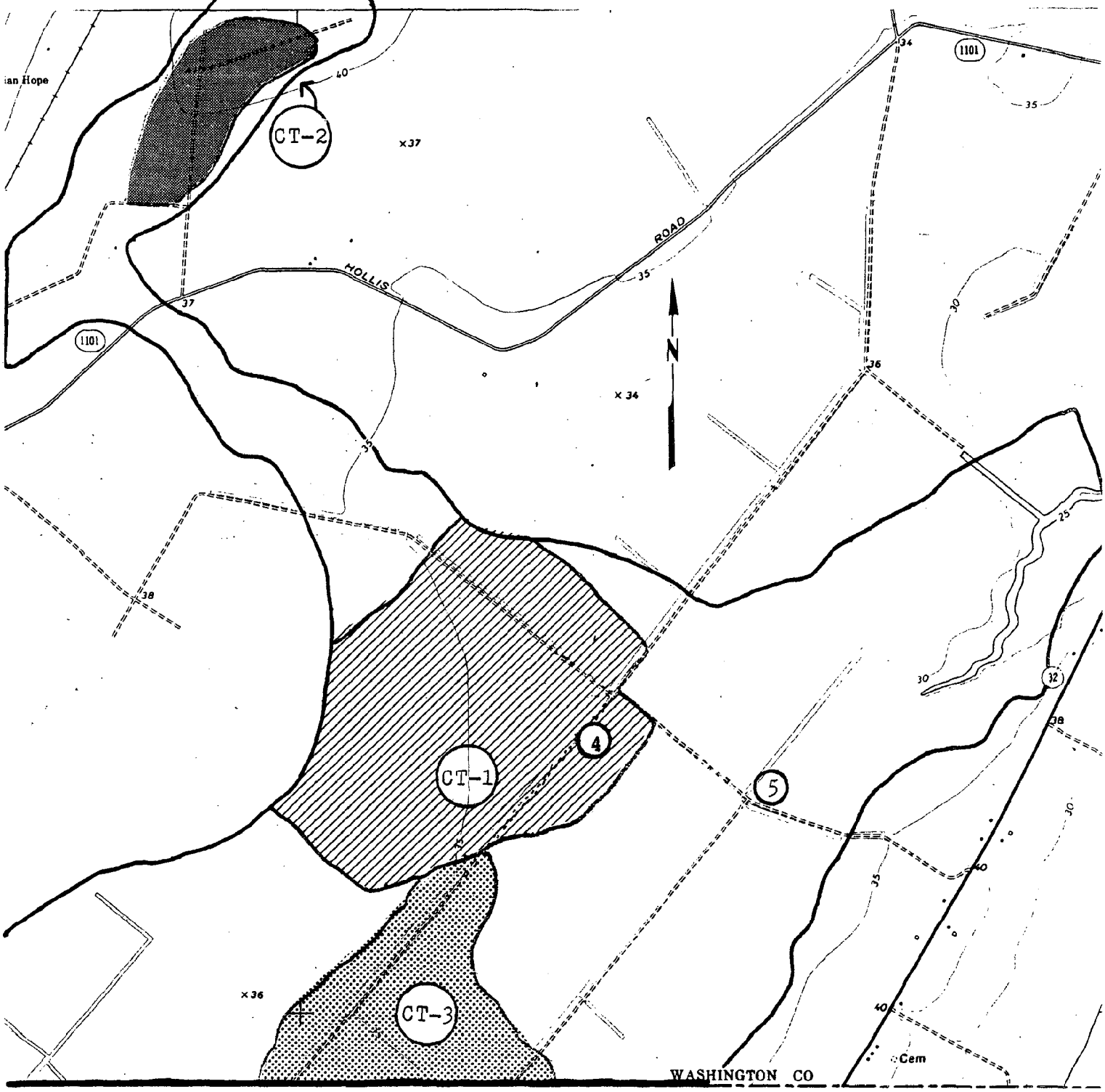
12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
Rare and of Special Concern Species	CT 1, CT 2	Black-throated Green Warbler	The coastal plain populations of this species are disjunct from the Southern Appalachian populations and occupy a distinct wetland habitat totally dissimilar in species composition and topography from the mountain habitats. Coastal plain populations are known from the Great Dismal Swamp, VA south to east-central S.C. Habitat destruction is the greatest threat to these unique coastal plain populations. Van Swamp contains the largest concentration in the county. 8 singing males were recorded on 10 April 1982.
Outstanding Avian species diversity	through-out	Breeding bird species diversity (43 species)	At least 43 species of birds were recorded in Van Swamp which were breeding or suspected of breeding. This is an excellent diversity of woodland breeding birds for the N.C. coastal plain and includes 10 species of wood warblers, 5 species of woodpeckers, and 3 vireo species. See Master Species List.

Fig. 4 Significant features:

VAN SWAMP NATURAL AREA

Community type locations are mapped generally.



Legal Status, Use, and Management

13. Ownership type by percent area:

Type	
Private	100 %
Public	%
Unknown	%

14. Number of Owners: 6

15. Name(s) of owner(s) and/or custodian(s) (with addresses, phone numbers, other pertinent information). (In order of importance.)

1) Georgia-Pacific Corporation, P. O. Box 1808 , Augusta, GA 30903 (primary owner)

2) Weyerhaeuser Corporation, P. O. Box 787, Plymouth, NC 27962

3) Hofler & Sons, Sunbury, NC 27979

4) C. T. Gaines, Box 184, Jamesville, NC 27846

5) Miller Warren, 110 Brinkley Ave., Plymouth, NC 27962

6) Vernon Howell, Pinetown, NC 27865

16. Name(s) of knowledgeable person(s) (with addresses, phone numbers, other pertinent information).

1) B. B. (Pat) White
P. O. Box 851
Plymouth, NC 27962

2) Rod McClanahan
Route 1, Box 442-B
Jamesville, NC 27846

17. Attitude of owner or custodian toward preservation (contacted?):

Not known.

18. Uses of natural area:

The portion of the natural area owned by Georgia-Pacific Corporation is open to public hunting under the N. C. Wildlife Resources Commission's Gamelands program. Deer hunting is the primary activity. The area has been timbered periodically since historical times and is presently undergoing a considerable amount of logging. Almost all of Van Swamp north of SR 1101 has been ditches, drained and converted to intensive loblolly pine silviculture. The wetter portions of the swamp south of SR 1101 (underlain by the deepest peat deposits) contain the last remnants of natural swamp vegetation although this area is presently being ditched, apparently with the intent of conversion to pine plantation.

19. Uses of surrounding land:

a. Wildland 20 %
b. Agricultural land 5 %
c. high-intensity forestry 75 %
d. developed _____ %

20. Preservation Status:

Cat	* %	*Description of preservation status
6	100	private land, not protected by owner

21. Regulatory protections in force:

None known.

22. Threats:

The natural integrity of Van Swamp is seriously threatened by the activities of the major timber corporations. The finest remaining relatively undisturbed swamp forest timber is being cut at the present time. Clearcutting is converting former hardwood swamp forest to managed loblolly pine plantations. Extensive ditching and draining operations in the wettest areas of the swamp are undoubtedly going to result in better drained conditions, alteration of the natural hydrological patterns, increased edge effect and the possibility of fire, and in general alter the natural qualities of the swamp.

23. Management and Preservation Recommendation:

Drainage and cutting must be curtailed if any portion of the natural area is to be preserved in its natural state. Construction of lateral ditches presently being dug should cease. Water control devices will have to be built on the main ditches to control gravity flow of water out of the swamp and to simulate the more natural high water table conditions. The site should be proposed for inclusion in the Society of American Foresters' Natural Areas program as an excellent mature example of Forest type No. 104 -- Sweetbay-Swamp Blackgum - Red Maple.

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 1

Community type: Nyssa sylvatica var. biflora/Acer rubrum/Persea borbonia

Community cover type: Nyssa sylvatica var. biflora

General habitat feature: non-alluvial swamp forest

Average canopy height: 60-80 feet

Estimated age of canopy trees: 75 years

Canopy cover: Closed

Estimated size of community: 740 acres

Successional stage: Near climax to climax (tree species composition and relative abundance has been somewhat altered by past timber operations)

Common canopy species in community cover or community type (but not dominant): Chamaecyparis thyoides
Taxodium distichum
Magnolia virginiana

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant): Chamaecyparis thyoides
Magnolia virginiana
Clethra alnifolia
Lyonia lucida

Common herb stratum species in community cover or community type (but not dominant):

Vines - Gelsemium sempervirens
Decumaria barbara
Vitis sp.
Smilax laurifolia
Rhus radicans

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 2

Community type: Pinus taeda-Nyssa sylvatica var. biflora/Acer rubrum/Persea borbonia

Community cover type: Pinus taeda-Nyssa sylvatica var. biflora

General habitat feature: non-alluvial swamp forest

Average canopy height: 65-85 feet

Estimated age of canopy trees: 60-75 years

Canopy cover: partially closed (50-80%)

Estimated size of community: 1100 acres

Successional stage: Late successional to near-climax

Common canopy species in community cover or community type (but not dominant): Chamaecyparis thyoides
Taxodium distichum
Magnolia virginiana
Liriodendron tulipifera

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant): Magnolia virginiana
Chamaecyparis thyoides
Clethra alnifolia

Common herb stratum species in community cover or community type (but not dominant):

Vines - Gelsemium sempervirens
Rhus radicans
Vitis sp.
Smilax laurifolia

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 3

Community type: Pinus serotina/mixed pocosin shrubs//Smilax laurifolia

Community cover type: Pinus serotina

General habitat feature: pocosin

Average canopy height: 60-90 feet

Estimated age of canopy trees: 50 - 75 + years

Canopy cover: open

Estimated size of community: 610 acres

Successional stage: late successional to near-climax

Common canopy species in community cover or community type (but not dominant):

None

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant):

Gordonia lasianthus	Lyonia lucida
Acer rubrum	Ilex coriacea
Persea borbonia	

Common herb stratum species in community cover or community type (but not dominant):

None

24b. Soil Summary (by community type) CT 1, CT 2

Soil series: Belhaven

Soil classification: Loamy, mixed, dysic, thermic Terric medisaprists

Soil association: Belhaven - Wasda - Roper

pH class: Extremely acid

Source of information: Soil Survey of Washington County, North Carolina. USDA, Soil Conservation Service, 1981.

Other notes:

24c. Hydrology Summary (by community type) CT 1, CT 2, CT 3

Hydrologic system: Palustrine

Hydrologic subsystem: interaqueous

Water chemistry: Fresh

Water regime: Saturated to intermittently exposed

Drainage class: Very poorly drained

Drainage basin: Pungo River

Hydrology characterization: A very poorly drained, saturated to intermittently exposed, freshwater palustrine system.

24b. Soil Summary (by community type) CT 3

Soil series: Pungo

Soil classification: Dysic, thermic, Typic Medisaprists

Soil association: Pungo

pH class: extremely acid

Source of information: Soil Survey of Washington County, N.C. USDA, Soil Conservation Service, 1981.

Other notes:

24c. Hydrology Summary (by community type) CT 3

Hydrologic system: Palustrine

Hydrologic subsystem: interaqueous

Water chemistry: fresh

Water regime: Saturated to intermittently exposed

Drainage class: Very poorly drained

Drainage basin: Pungo River

Hydrology characterization: A very poorly drained, saturated to intermittently exposed, freshwater palustrine system.

24d. Topography Summary: (entire natural area)

Landform: Back-dune flats

Shelter: Sheltered

Aspect: Not applicable

Slope Angle: Not applicable

Profile: Essentially flat

Surface patterns: Hummocky with scattered shallow depressions holding surface water

Position: Not applicable

25. Physiographic characterization of natural area:

An assemblage of late successional to climax communities occupying a very poorly drained upland flat which drains via a series of man-made canals into the Pungo River in the Coastal Plain Province of the Atlantic Plain.

Geological Formation:

Upper Miocene Yorktown formation overlain by Pleistocene (Chowan (Talbot) terrace) to recent sand, clays, and peat.

Geological Formation age:

Upper Miocene formation: 18-22 million years B.P.
Pleistocene formation: 1-3 million years B.P.
Recent: less than 6000 years

References Cited:

Mixon, R. B. and O. H. Pilkey. 1976. Reconnaissance Geology of the Submerged and Emerged Coastal Plain Province, Cape Lookout Area, North Carolina. Geological Survey Prof. Paper 859. U. S. Govt. Printing Office. Washington.

26. Summary - Endangered and threatened species

Name of species: Red-shouldered Hawk

Species legal status and authority: Threatened in N.C. (Cooper et al, 1977)

Number of populations on site: One

Number of individuals per population: 2-4 prs

Size or Maturity of individuals: adults with immatures

Phenology of population: not applicable

Eg: vegetative %
flowering %
fruiting %

General vigor of population: Excellent

Disturbance or threats to population: Clearcutting, drainage

Habitat characteristics

Plant community: CT 1, CT 2, CT 3

Topography:

Soil Series:

Microclimate:

Drainage basin:

Other plants and animal species present: See Master Species List

AERIAL OR DETAILED MAPS WITH POPULATIONS CLEARLY MARKED.

26. Summary - Endangered and threatened species

Name of species: Black Bear

Species legal status and authority: Of Special Concern in N.C. (Cooper et al, 1977)

Number of populations on site: one

Number of individuals per population: 2+

Size or Maturity of individuals: adult

Phenology of population: not applicable

Eg: vegetative %
flowering %
fruiting %

General vigor of population: unknown

Disturbance or threats to population: clearcutting, drainage

Habitat characteristics

Plant community: CT 1, CT 2, CT 3

Topography:

Soil Series:

Microclimate:

Drainage basin:

Other plants and animal species present: See Master Species Lists

AERIAL OR DETAILED MAPS WITH POPULATIONS CLEARLY MARKED.

27. Master species lists:

VASCULAR PLANTS
(listed alphabetically by family)

ACERACEAE
  Acer rubrum
ANACARDIACEAE
  Rhus radicans
  R. vernix
AQUIFOLIACEAE
  Ilex coriacea
  I. glabra
  I. opaca
ARALIACEAE
  Aralia spinosa
BLECHNACEAE
  Woodwardia areolata
  W. virginica
CAPRIFOLIACEAE
  Lonicera japonica
CLETHRACEAE
  Clethra alnifolia
CUPRESSACEAE
  Chamaecyparis thyoides
CYPERACEAE
  Carex spp.
CYRILLACEAE
  Cyrilla racemiflora
ERICACEAE
  Leucothoe axillaris
  Lyonia lucida
  Rhododendron viscosum
  Vaccinium corymbosum
FAGACEAE
  Quercus nigra
HAMAMELIDACEAE
  Liquidambar styraciflua
LAURACEAE
  Persea borbonia
LILIACEAE
  Smilax laurifolia
  S. rotundifolia
LOGANIACEAE
  Gelsemium sempervirens
LORANTHACEAE
  Phoradendron serotinum
MAGNOLIACEAE
  Liriodendron tulipifera
  Magnolia virginiana

MYRICACEAE
  Myrica cerifera
NYSSACEAE
  Nyssa sylvatica var. biflora
OSMUNDACEAE
  Osmunda cinnamomea
  O. regalis var. spectabilis
PINACEAE
  Pinus serotina
  P. taeda
POACEAE
  Arundinaria gigantea
POLYPODIACEAE
  Polypodium polypodioides
ROSACEAE
  Sorbus arbutifolia
SAXIFRAGACEAE
  Decumaria barbara
  Itea virginica
TAXODIACEAE
  Taxodium distichum
THEACEAE
  Gordonia lasianthus
VITACEAE
  Vitis sp.

AMPHIBIANS

Fowler's Toad
Gray Treefrog
Green Frog
Southern Leopard Frog
Carpenter Frog

REPTILES

Painted Turtle
Yellowbellied Slider
Eastern Box Turtle
Black Rat Snake
Red-bellied Water Snake

BIRDS

(Emphasis of bird lists is on breeding or summering species; lack of adequate field work during the other seasons prevented compilation of a complete list.)

KEY

PR = Permanent resident
SR = Summer resident
WR = Winter resident
T = Transient, spring or fall
PV, SV, WV = Visitor; year-round, summer, or winter
* = Breeding or suspected breeding at site

Wood Duck	PR*
Red-tailed Hawk	PR*
Red-shouldered Hawk	PR*
Sharp-shinned Hawk	T
Common Bobwhite	PR*
Great Blue Heron	PR*
Green Heron	SR*
Mourning Dove	PR*
Yellow-billed Cuckoo	SR*
Barred Owl	PR*
Ruby-Throated Hummingbird	SR*
Common Flicker	PR*
Pileated Woodpecker	PR*
Red-bellied Woodpecker	PR*
Hairy Woodpecker	PR*
Downy Woodpecker	PR*
Great Crested Flycatcher	SR*
Acadian Flycatcher	SR*
Eastern Pewee	SR*
Blue Jay	PR*
Common Crow	PR*
Fish Crow	SV
Carolina Chickadee	PR*
Tufted Titmouse	PR*
White-breasted Nuthatch	PR*
Winter Wren	WR
Carolina Wren	PR*
Gray Catbird	SR*
Wood Thrush	SR*
Hermit Thrush	WR
Blue-gray Gnatcatcher	SR*
Ruby-crowned Kinglet	WR

Cedar Waxwing	WR
White-eyed Vireo	SR*
Yellow-throated Vireo	SR*
Red-eyed Vireo	SR*
Black-and-white Warbler	T
Prothonotory Warbler	SR*
Worm-eating Warbler	SR*
Parula Warbler	SR*
Yellow-rumped Warbler	WR
Black-throated Green Warbler	SR*
Yellow-throated Warbler	SR*
Pine Warbler	PR*
Prairie Warbler	SR*
Ovenbird	SR*
Common Yellowthroat	SR*
Hooded Warbler	SR*
Common Grackle	PR
Brown-headed Cowbird	PR*
Northern Cardinal	PR*
Evening Grosbeak	WR
Purple Finch	WR
Pine Siskin	WV
American Goldfinch	PR
Rufous-sided Towhee	PR*
Dark-eyed Junco	WR

MAMMALS

Eastern Mole
Black bear (fresh set of tracks and scat; April 10)
Raccoon
Bobcat (set of tracks only)
Eastern Cottontail
Marsh Rabbit
Whitetail Deer (abundant tracks)

NATURAL AREA INVENTORY FORM
(To be prepared for each site)

Basic Information Summary Sheet

1. Natural Area Name: East Dismal Swamp

2. County: Washington

3. Location: In the west-central section of the county about 4.5 air miles SSW of Roper or about 6 air-miles SE of Plymouth.

4. Topographic quadrangle(s): Plymouth East (1974) and Roper South (1974)

5. Size: Approximately 1630 acres, measured with grid calculator

6. Elevation: 16-18 feet msl

7. Access: From Roper, proceed southeast on SR 1125 to junction with SR 1127 (unpaved). Turn right onto SR 1127 and go south about 1.4 miles to first private dirt road on right (Parker Road). Turn right (west) on Parker Road and go about 1.0 mile to junction with dirt road on left. Turn left (south) on this road and go about 0.5 mile to junction with dirt road to the right (Washington Avenue). Turn right (west) on this road. Washington Avenue traverses the central portion of the natural area.

8. Names of investigators:

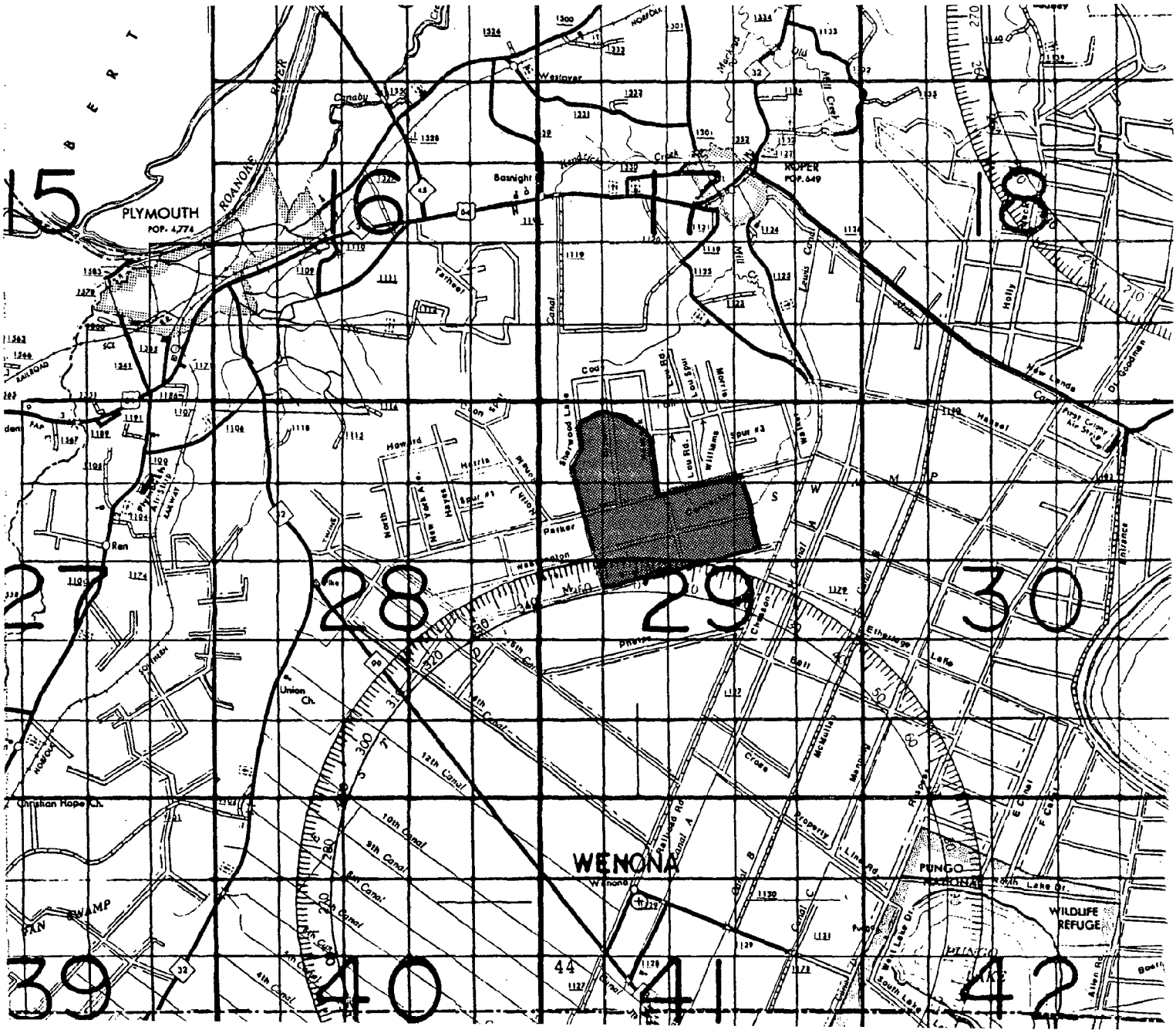
J. Merrill Lynch	S. Lance Peacock
Route 2, Box 222-B	P. O. Box 6006
Enfield, NC 27823	Raleigh, NC 27628

9. Date(s) of investigation: July 11, 1982

10. Priority rating: Medium

Fig. 5 Access information:

EAST DISMAL SWAMP



11a. Prose Description of Site:

INTRODUCTION

The East Dismal Swamp Natural Area is a 1630-acre tract containing a mixture of bottomland hardwoods and swamp forest vegetation situated on a poorly drained upland flat along the western margin of the Pamlico Terrace. The natural area contains the best remaining example in Washington County of relatively undisturbed natural vegetation within the once vast upland swamp and pocosin wetland complex known as the East Dismal Swamp.

It should be noted here that the natural area was discovered at a rather late date during the course of field work. Consequently, the authors were unable to survey the vegetation communities and other biological aspects of the site with the same amount of time and detail other natural areas received. However, an initial assessment of the site's ecological significance was determined, based on observations made during a single site visit. The conclusion is that the site is of medium to high significance due to the relatively undisturbed, old-growth condition of the plant community and its status as the only known well-preserved example of a swamp forest ecosystem remaining in the East Dismal Swamp. Further field work is urgently needed to document and substantiate the significance of the site which, based on preliminary observations, appears to have countywide or regional significance.

Pre-1950 topographic maps show the East Dismal Swamp covering almost all of Washington County from Lakes Phelps and Pungo west to the Union Chapel Scarp (N. C. Highway 32), and from U. S. Highway 64 south into Beaufort County.

During the 1950's much of this swamp was drained, cleared, and converted to agricultural production by "super-farm" corporations. The remaining small blocks of wooded land have either been drained and converted to pine plantations by the timber industry or have been almost completely cut-over, leaving a heavily disturbed woodland bearing little, if any, resemblance to the swamp forest wetland system which once covered this region.

The original extent of the East Dismal Swamp in Washington County alone is estimated to have comprised at least 70,000 acres. This figure is based on the wetland soil acreage derived from the county's general soils map (SCS 1981). Using

this figure, the natural area represents less than 3% of the original East Dismal Swamp wetland system, a miniscule remnant of the swamp forest and pocosin vegetation types which once dominated much of the Washington County landscape.

The East Dismal Swamp natural area is situated on a broad, very flat, upland surface which is poorly drained due to the lack of stream drainages in the area. Elevation ranges from 16-18 feet above sea level. Topographically, the site is located on an upland, interstream flat. To the north and east, several minor tributaries drain the margins of the flat. Areas to the south and west of the natural area are drained by a series of interconnecting ditches and canals which drain eventually into the Pungo River.

The natural area is situated on the Pamlico Terrace, the land surface containing surficial sediments deposited about 100,000 years B.P. when sea level was much higher and the Atlantic Ocean covered much of the outer coastal plain (Ingram and Otte 1982). About 18,000 years ago sea level was about 400 feet below present sea level during which time the Pamlico Terrace was dissected by stream erosion resulting in a dendritic pattern of stream valleys. Since that time sea level has been rising. About 10,000 years ago peat development began in shallow lakes and marshes along the stream courses. These blocked channels filled with peat and began flooding the adjacent low-lying areas. This flooding created a large, flat wetland on which a swamp forest became established and in which the decomposing vegetation eventually formed the organic soils covering much of East Dismal Swamp (op. cit. 1982).

This blanket of organic deposits occupies the flat, poorly drained surface within the natural area. Almost the entire natural area has been mapped as the Belhaven muck soil series, a relatively shallow organic soil which has organic accumulations 16-51 inches thick. These shallow peats are a western extension of a much larger body of peat which lies adjacent to the southwestern and southern sides of Lake Phelps, about 6 miles SE of the natural area (op cit 1982).

VEGETATION

The natural area is dominated by an interesting assemblage of bottomland hardwoods and typical swamp forest species. One community type was determined from field observations: *Nyssa sylvatica* var. *biflora*/*Acer rubrum*-*Magnolia virginiana*/*Persea borbonia* (swamp blackgum/red maple-sweetbay/redbay; CT 1).

This community is characterized by an open to partially closed canopy 70-80 feet tall, average trunk diameters of 18-22 inches, and a distinct three-tiered stratification: canopy-subcanopy - tall shrub.

Much of the area is dominated by swamp blackgum although locally, tulip poplar (Liriodendron tulipifera) is a common canopy constituent. Extremely large specimens of the latter tree are common, ranging in size up to 90 feet tall with dbh's of 24-36 inches. Also present in the canopy are occasional large loblolly pine (Pinus taeda) and baldcypress (Taxodium distichum). The subcanopy is composed of very large sweetbay along with red maple. Occasional scattered clumps or individuals of Atlantic white cedar (Chamaecyparis thyoides) are present in this layer. Most of the cedars appear to be mature or old-growth in age.

A dense tall shrub layer dominated by redbay is ubiquitous throughout the tract. There are no distinct low shrub or ground layers. Common species present in these layers include sweet pepperbush (Clethra alnifolia), highbush blueberry (Vaccinium corymbosum), and royal fern (Osmunda regalis var. spectabilis). Vines are conspicuous and abundant in all the vegetation layers. The most common species are climbing hydrangea (Decumaria barbara), yellow jessamine (Gelsemium sempervirens), and Virginia creeper (Parthenocissus quinquefolia).

Other minor plant communities may be present within the natural area. Time restraints and the late discovery of the site prevented a more thorough examination. Some portions of the tract appear to be more recently disturbed by selective timber cutting. These areas have a greater proportion of red maple and loblolly pine in the canopy than the least disturbed, old-growth sections.

Unusually large specimens of several canopy and subcanopy components deserve mention. Scattered old-growth swamp blackgums are present with trunk diameters in excess of 30 inches. As in the Van Swamp natural area (see pp.), sweetbay reaches an impressive size with many trees present which are in the 13-15 inch dbh range (maximum dbh = 18 inches) and with heights up to 75-80 feet. Scattered old-growth baldcypress are present as emergent "flattops", reaching 62 inches dbh and 100 feet in height. These old giants are probably "cull" trees left over from past logging operations due to trunk deformities and other defects. Old-growth, flattop loblolly pines are also present. Tulip poplars, mentioned earlier in the text, reach an impressive size. They, too, appear to be old-growth "cull" trees which remain intact from earlier logging cycles. Apparently, early logging operation methods focused on the removal of the highest quality

timber, and often left smaller or deformed specimens of highly desirable species such as cypress, white cedar, and tulip-poplar remaining in the forest stands. This practice, known as high-grading, eventually reduced the dominance of baldcypress and Atlantic white cedar in the swamp forest stands, while at the same time increasing the dominance of swamp blackgum, red maple, and other less valuable timber species.

The natural area contains a fairly sizable population of tall pawpaw (Asimina triloba), a tall shrub which usually is found on rich alluvium on second-bottoms and slopes along brownwater rivers and streams. Pawpaw also occurs in mesic hardwood stands in the coastal plain but almost always on mineral soils. In the natural area the species occurs on shallow peats which have underlying mineral horizons. Pawpaw is not known to occur on peat soils anywhere else in North Carolina. Its occurrence in the natural area would not be predicted based on its known habitat associations.

The presence of tulip-poplar on peat soils is not generally well-known although it is mentioned in the literature. It is not known to be a dominant canopy tree in coastal plain wetlands. It usually occurs on moist mineral soils, particularly on sandy loams which are well-drained. Concerning its occurrence in the Pamlimarle Peninsula, Ashe (1894) writes:

> "Much of the swamp in Washington and Tyrrell Counties is thinly timbered with the savanna (pond) pine. There is a great deal of soft maple and yellow poplar scattered throughout the swamp ... Lumbering has been one of the leading industries of these counties for a great many years, the numerous canals and streams which penetrate the region affording great facilities for removing timber."

Ashe (op cit) mentions tulip-poplar in descriptions of swamp forests in other coastal plain counties and notes its occurrence along with bald-cypress and swamp blackgum.

The presence of old-growth tulip-poplar along with baldcypress, swamp blackgum, and Atlantic white cedar within the natural area probably represents an aggregation of species which, at least until modern times, was fairly typical

of upland swamp forests overlying peaty mineral or shallow organic soils.

Examples of this aggregation containing old-growth timber are not known anywhere else in the county at the present time. Other natural areas in the county, such as Van Swamp, which contain similar upland swamp forests do not contain old-growth tulip-poplar, presumably because past logging activities have removed all standing timber and regeneration has not occurred.

WILDLIFE AND AVIAN DIVERSITY

The wildlife values of the natural area are probably significant. However, the discovery of the area during the latter stage of field work prevented a thorough inventory of the fauna, and many species particularly birds, were undoubtedly missed. Abundant tracks of white-tailed deer were present throughout and several eastern gray squirrels were observed. Habitat appears to be highly suitable for breeding black-throated green warblers, an uncommon and local coastal plain species. Due to the late date none were recorded. Black bear and bobcat, although no sign of either was recorded, probably occur as either residents or as occasional visitors.

The natural area, surrounded on three sides by square miles of cleared land, probably serves as an important woodland sanctuary for many game and non-game species, particularly those species characteristic of forested wetland systems. Hopefully, further field work will shed more light on the importance of the tract as habitat for wildlife species.

11b. Prose Description of Site Significance:

The East Dismal Swamp Natural Area contains the last known remnant of mature, old-growth swamp forest vegetation remaining in a once extensive palustrine, peat-dominated wetland system which formerly covered over 70,000 acres of central and southern Washington County. The tract contains unusually large specimens of the swamp forest trees characteristic of the non-alluvial, "upland" wetlands associated with poorly drained peat or peaty mineral soils. Tulip-poplar, swamp blackgum, baldcypress, Atlantic white cedar, and loblolly pine are all present in what probably most closely resembles the original composition of the swamp vegetation before timber exploitation began.

The once vast East Dismal Swamp has been almost completely cleared of its swamp forest and converted to agricultural fields or managed tree farms. The natural area is the last known relatively undisturbed remnant of that wetland system remaining in the county.

12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
High quality wetland plant community	CT 1	Nyssa sylvatica var. biflora/Magnolia virginiana-Acer rubrum/Persea borbonia	Best remaining example in the East Dismal Swamp of a once
			extensive wetland forest
		Best example of above CT.	system. Old-growth stand, 75+ years old, with scattered very
			large cypress, tulip poplar,
			and swamp blackgum. Except
			for the protected cypress
			stands in Pettigrew State Park,
			the site contains some of the
			largest trees seen in the
			county.
Unusually large trees	CT 1	Magnolia virginiana	Very large specimens up to 18 inches DBH and 80 feet in
			height. Along with trees in
			nearby Van Swamp, largest
			specimens seen in N.C. coastal
			plain. State champion tree
			may be present.
Unusual species - soil relationship	CT 1	Asimina triloba - peat soils	Only known occurrence of paw-paw growing on histosols (peat
			soils) in North Carolina.

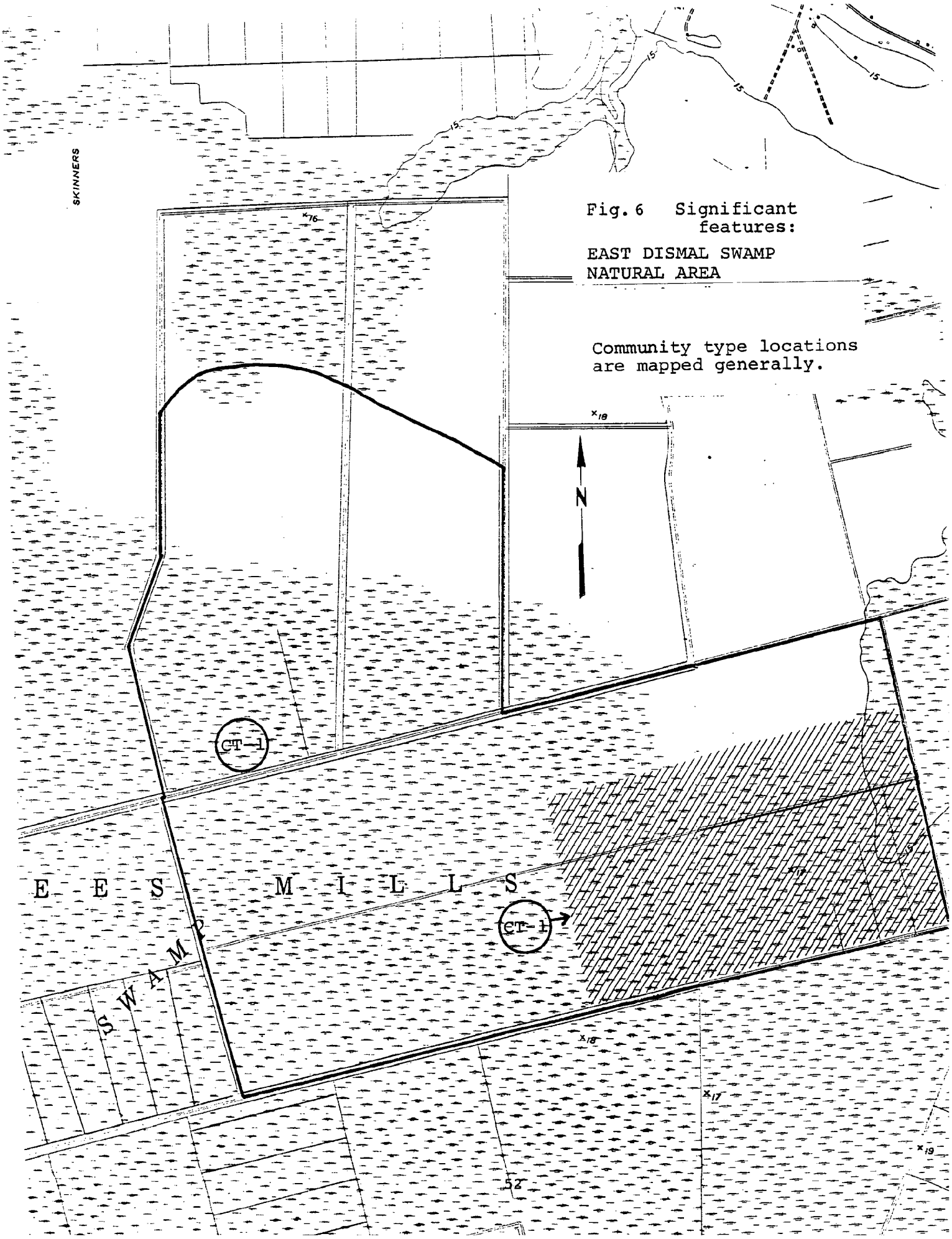


Fig. 6 Significant features:

EAST DISMAL SWAMP NATURAL AREA

Community type locations are mapped generally.

Legal Status, Use, and Management

13. Ownership type by percent area:

Type	
Private	100 %
Public	%
Unknown	%

14. Number of Owners: 1

15. Name(s) of owner(s) and/or custodian(s) (with addresses, phone numbers, other pertinent information).

Weyerhaeuser Corporation

P. O. Box 787

Plymouth, NC 27962

16. Name(s) of knowledgeable person(s) (with addresses, phone numbers, other pertinent information).

B. B. (Pat) White

P. O. Box 851

Plymouth, NC 27962

17. Attitude of owner or custodian toward preservation (contacted?):

Not known.

18. Uses of natural area:

Hunting, primarily for deer and bear, is probably a major use of the area. Easily accessible to hunters, the site is bisected by several well-maintained, graded dirt roads which are apparently never gated. It is likely that the corporation which owns the natural area and much of the adjacent lands leases the hunting rights to a local gun club, a common practice in eastern North Carolina.

Timbering activities have up to the present time been limited to low-intensity selective cutting. Old-growth stands along Washington Avenue and Sherrill Road in the southern portion of the natural area have apparently not been timbered at all within the past 50-75 years. In this area cutting was probably limited to baldcypress and Atlantic white cedar, old stumps of which are present. Other sections appear to have undergone some moderate selective thinning, although there is not evidence of cutting within the past ten years or so.

Outside the natural area boundaries, timber cutting has been both extensive and often intensive. Large tracts have been ditched, cleared, burned and reseeded in loblolly pine tree farms. Much of this activity appears to have taken place within the past ten years. Other stands have been high-graded repeatedly and now contain stands of young and medium-growth red maple, sweetgum, and loblolly pine. Ditching and drainage of these adjacent forests is a continuing practice; evidently as preparation for eventual conversion to intensively managed pine plantations.

It should also be noted that a series of parallel lateral ditches about 700 feet apart have also been constructed in parts of the natural area. These ditches were built about ten years ago but were allowed to grow up and are now barely visible. Apparently at one time the timber company planned to drain and clearcut the site. Why this has not been done is not known. Possible reasons for the delay could be the difficulty of managing peat soils or unfavorable economic conditions.

19. Uses of surrounding land:

a. Wildland 25 % c. high-intensity forestry 25 %

b. Agricultural land 50 % d. developed _____ %

20. Preservation Status:

Cat	* %	*Description of preservation status
6	100	Private land, not protected by owner

21. Regulatory protections in force:

none known

22. Threats:

The natural area is seriously threatened by drainage and clearing operations associated with the development of tree farm plantations. As mentioned in the preceding section, much of the land surrounding the site has been or is in the process of being drained and converted to loblolly pine plantations. The first stage in the conversion of swamp forest timber to managed pine plantation is the development of adequate drainage, i.e., construction of drainage ditches and canals. This stage has apparently been completed within the natural area as evidenced by a well-integrated series of lateral ditches. The next step involves clearing the vegetation and bulldozing stumps and logs into windrows to be subsequently burned. It is probably a matter of only a few years before this next stage of site preparation is implemented in the natural area.

23. Management and Preservation Recommendation:

It is highly recommended that the natural area be recognized as having superlative values as an endangered wetland system and be protected as an example of an old-growth swamp forest remnant of the once vast East Dismal Swamp complex. The timber company which owns the tract should be contacted and informed of the site's natural significance. The site is an excellent candidate for inclusion in the Society of American Forester's Natural Areas program which seeks to identify and protect examples of relatively undisturbed, mature stands of all the major forest types in the United States. The site could also be included on the N.C. Natural Heritage Program's Registry of Natural Heritage Areas as an excellent example of a swamp forest wetland containing significant aspects of the state's natural heritage. Steps should be taken immediately to address both of these options.

Management of the site should be minimal. Access restriction could be implemented with the addition of several gates. Agreements could be arranged for wildlife officers to periodically patrol the area to enforce state and local game laws.

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 1

Community type: Nyssa sylvatica var. biflora/Acer rubrum-Magnolia virginiana/Persea borbonia

Community cover type: Nyssa sylvatica var. biflora

General habitat feature: upland swamp forest

Average canopy height: 70-80 feet

Estimated age of canopy trees: 75+ years

Canopy cover: open to partially closed

Estimated size of community: 1000 acres

Successional stage: near-climax to climax

Common canopy species in community cover or community type (but not dominant): Liriodendron tulipifera, Pinus taeda, Taxodium distichum, Chamaecyparis thyoides

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant):

Clethra alnifolia
Asimina triloba

Common herb stratum species in community cover or community type (but not dominant):

Woodwardia areolata

Vines: Gelsemium sempervirens, Parthenocissus quinquefolia, Decumaria barbara, Rhus radicans

24b. Soil Summary (by community type) CT 1

Soil series: Belhaven muck

Soil classification: Loamy, mixed, dysic, thermic Terric Medisaprists

Soil association: Belhaven-Wasda-Roper

pH class: Extremely acid

Source of information: Soil Survey of Washington County, N.C., USDA, 1981

Other notes:

24c. Hydrology Summary (by community type)

Hydrologic system: Palustrine

Hydrologic subsystem: InterAqueous

Water chemistry: Fresh-acid

Water regime: Saturated to intermittently exposed

Drainage class: Very poorly drained

Drainage basin: Via canals into Kendrick Creek which drains into Albemarle Sound

Hydrology characterization: A very poorly drained, saturated to intermittently exposed, freshwater palustrine system.

24d. Topography Summary:

Landform: upland palustrine swamp

Shelter: Sheltered

Aspect: N/A

Slope Angle: N/A

Profile: Flat

Surface patterns: Hummocky, peat surface

Position: N/A

25. Physiographic characterization of natural area:

A climax community which occupies a relict backbarrier flat dominated by organic (peat) soils which now drains into Kendrick Creek, situated on the Pamlico Terrace of the Coastal Plain province of the Atlantic Plain.

Geological Formation:

Marine sediments of the Pamlico Terrace underlain by sandy clays and marls of the Yorktown Formation.

Geological Formation age:

Pleistocene Pamlico Terrace = 100,000 years B.P.

Miocene Yorktown Formation = 18-25 million years B.P.

References Cited:

Ingram, R. L. and L. J. Otte. 1982. Peat Deposits of Pamlimarle Peninsula, North Carolina. U.S. Department of Energy Contract DE-AC18-79FC14693. 36 pp.

26. Summary - Endangered and threatened species

Name of species: None known within natural area.

Species legal status and authority:

Number of populations on site:

Number of individuals per population:

Size or Maturity of individuals:

Phenology of population:

Eg: vegetative %
flowering %
fruiting %

General vigor of population:

Disturbance or threats to population:

Habitat characteristics

Plant community:

Topography:

Soil Series:

Microclimate:

Drainage basin:

Other plants and animal species present:

AERIAL OR DETAILED MAPS WITH POPULATIONS CLEARLY MARKED.

27. Master species lists:

VASCULAR PLANTS
(listed alphabetically by family)

ACERACEAE
  Acer rubrum
ANACARDIACEAE
  Rhus radicans
ANNONACEAE
  Asimina triloba
AQUIFOLIACEAE
  Ilex opaca
ARALIACEAE
  Aralia spinosa
ASPIDIACEAE
  Dryopteris celsa
BLECHNACEAE
  Woodwardia areolata
CLETHRACEAE
  Clethra alnifolia
CUPRESSACEAE
  Chamaecyparis thyoides
ERICACEAE
  Vaccinium corymbosum
LAURACEAE
  Persea borbonia
LOGANIACEAE
  Gelsemium sempervirens
LORANTHACEAE
  Phoradendron serotinum
MAGNOLIACEAE
  Liriodendron tulipifera
  Magnolia virginiana
NYSSACEAE
  Nyssa sylvatica var. biflora
OSMUNDACEAE
  Osmunda regalis var. spectabilis
PINACEAE
  Pinus taeda
SAXIFRAGACEAE
  Decumaria barbara
TAXODIACEAE
  Taxodium distichum
VITACEAE
  Parthenocissus quinquefolia

AMPHIBIANS

None recorded

REPTILES

None recorded

BIRDS

(Emphasis of bird lists is on breeding or summering species; lack of adequate field work during the other seasons prevented compilation of a complete list.)

KEY

PR = Permanent resident
SR = Summer resident
WR = Winter resident
T = Transient; spring or fall
PV, SV, WV = Visitor; permanent, summer, or winter
* = Breeding or suspected breeding at site

Turkey Vulture	PR*
Red-tailed Hawk	PR*
Ruby-throated Hummingbird	SR*
Pileated Woodpecker	PR*
Blue-gray Gnatcatcher	SR*
Gray Catbird	PR*

MAMMALS

Eastern Gray Squirrel (several seen)
White-tailed deer (abundant tracks)

NATURAL AREA INVENTORY FORM
(To be prepared for each site)

Basic Information Summary Sheet

1. Natural Area Name: Pettigrew State Park Natural Areas

2. County: Washington

3. Location: Pettigrew State Park located at Lake Phelps, a large natural lake in the southeastern part of the county about 5 miles south of the town of Creswell.

4. Topographic quadrangle(s): Creswell (1974) north shore
New Lake NW (1974) south shore

5. Size: North shore - 180 acres (measured with grid calculator)
South shore - 70 acres (measured with grid calculator)

6. Elevation: 10 (mean lake elevation) - 14 feet msl

7. Access: The north shore natural area can be reached from Creswell by taking SR 1142 southeast to junction with SR 1160. Then go south on SR 1160 for 4.5 miles to junction with SR 1166 near north shore. Go west on SR 1166 about 2.4 miles to junction with SR 1164. Best portion of natural is along nature trail south and west of this junction inside park boundary.

The south shore natural area can be reached from Roper by taking SR 1126 southeast for 6.7 miles to junction with SR 1183 at First Colony Farms office. Take SR 1183 south for 10.8 miles around lake shore to any one of several access points on lake.

8. Names of investigators:

J. Merrill Lynch	S. Lance Peacock
Route 2, Box 222-B	P. O. Box 6006
Enfield, NC 27823	Raleigh, NC 27628

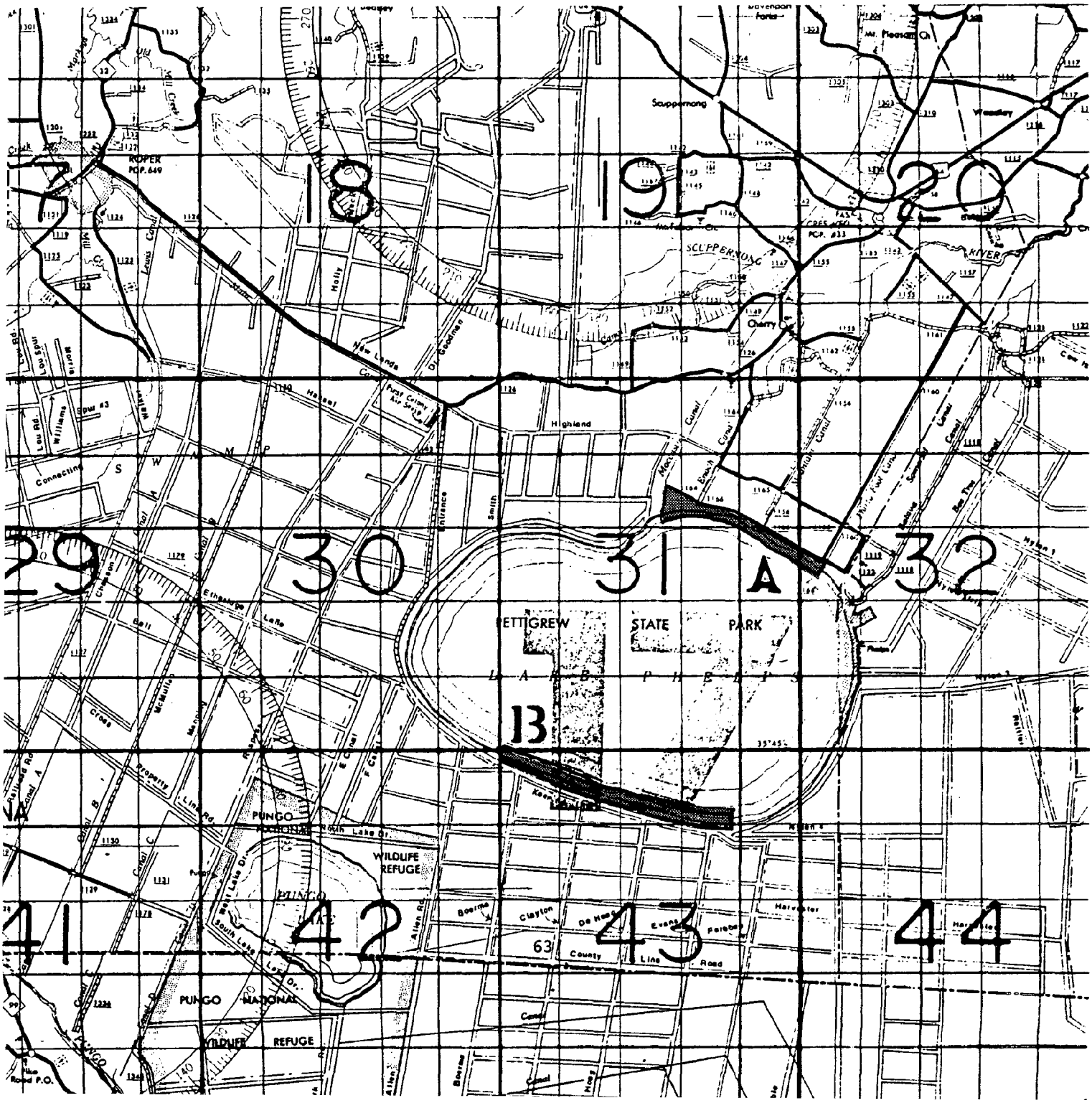
9. Date(s) of investigation: February 12, July 10, September 4, 1982

10. Priority rating: Medium-high

Fig. 7 Access information:

A. PETTIGREW STATE PARK - NORTH SHORE BALDCYPRESS STAND

B. PETTIGREW STATE PARK - SOUTH SHORE FRESHWATER MARSH



11a. Prose Description of Site

The Pettigrew State Park Natural Areas are located on the northern and southern shores of Lake Phelps, a 16,000 acre natural lake, the second largest in North Carolina. Pettigrew State Park and Lake Phelps, both administered by the N.C. Division of Parks and Recreation, encompass the entire lake acreage below the mean high water line, in addition to two upland tracts along the northern and southern margins containing 270 and 500 acres, respectively.

Lake Phelps is the dominating landform of the region. Elliptical in shape, it is located in southeastern Washington County with a small portion of its extreme eastern edge in Tyrrell County. The lake averages about 5 feet in depth and has a shallow, sandy bottom except in the northern and eastern portions where wind and water-borne silt and fine peat sediments have accumulated. The origin on Lake Phelps is unknown although several theories exist. One is that the lake is an example of a carolina bay, an elliptical depression with a NW-SE orientation and usually with a sand rim along the southeastern margin. Another theory is that Lake Phelps was formed by a peat fire which burned down to the underlying mineral layers during a severe drought below the normal water table. The depression thus formed eventually filled in with water. Later, wind and wave erosion helped to enlarge the lake, smooth out the margins, and create the elliptical shape (Otte, pers. comm. 1982).

Whatever its origin, Lake Phelps is unique compared to the similar Pungo and Alligator (New) lakes to the south. These latter two lakes do not have a sandy bottom and are totally rimmed by deep peat deposits. They are also much more depauperate both floristically and faunistically, containing very small fish populations and little if any emergent marsh vegetation.

Lake Phelps, on the other hand, supports a large population of both game and non-game fish, including the state endangered Waccamaw Killifish (N. C. Department of Natural Resources and Community Development, 1977). A number of swans, geese, and ducks use the lake for feeding and roosting during the winter months. The lake also supports a remnant old-growth stand of baldcypress along its north shore and a unique emergent and submergent marsh system along its southern shore. These two vegetation types are of statewide significance and are discussed in detail in the following pages.

North Shore Baldcypress Stand

This natural area is located along the north shore of Lake Phelps between the park headquarters on the east and the park boundary along Moccasin Canal on the west. State Road 1166 runs along part of the northern edge of the natural area. The 180-acre tract is very narrow and linear in shape, ranging from 350 to about 1300 feet wide, and is parallel to a three-mile section of the north shoreline. The boundaries of the natural area follow the park boundary on the north and the open water of the lake to the south.

The vegetation of the natural area is composed of an old-growth stand of very large trees dominated by baldcypress. The community type is Taxodium distichum/Asimina triloba/mixed herbs and ferns (baldcypress/tall pawpaw/mixed herbs and ferns; CT 1). This community also contains scattered tulip-poplar (Liriodendron tulipifera), sweetgum (Liquidambar styraciflua), and American elm (Ulmus americana) in the canopy. The closed canopy averages about 90-100 feet in height. A distinct closed shrub layer dominated by tall pawpaw, 10-30 feet tall, is located underneath. There is a 75-100% ground cover composed of various species of herbs and ferns. Most common species are Japanese honeysuckle (Lonicera japonica), jewelweed (Impatiens capensis), false nettle (Boehmeria cylindrica), and Southern lady fern (Athyrium asplenioides). High-climbing vines are abundant and include species such as poison ivy (Rhus radicans), Virginia creeper (Parthenocissus quinquefolia), cross-vine (Anisostichus capreolata), trumpet creeper (Campsis radicans), wild grape (Vitis sp.), and rattan-vine (Berchemia scandens).

The sheer size of the baldcypress and other canopy trees is very impressive. Baldcypress average about 50 inches in diameter at breast height (dbh) with many trees exceeding 100 feet. The maximum dbh and height recorded is 76 inches and 120 feet, respectively. Sweetgum, tulip-poplar, and American elm also reach outstanding size. Average dbh values for the three species respectively are: 39, 27, and 21 inches. Tall pawpaw, usually a small to medium sized shrub, reaches a height of about 30 feet with dbh's better than 7 inches in the natural area. Although no tree cores were taken, the age of the baldcypress is estimated to be close to 300 years (Department of Natural Resources and Community Development, 1977).

The baldcypress stand (CT 1) is situated on Fortescue mucky loam, a very poorly drained soil limited in the county to narrow, slightly elevated rims along the northern and northwestern sides of Lake Phelps. This soil is characterized by an upper layer of mucky or silty clay loam about 21 inches

thick over a layer of muck. The upper layer of mineral soils was probably deposited by lake-borne sediments at a time when the lake level was higher than it is currently.

There are several distinct differences in the vegetation as one moves across a transect taken from the park boundary (inward side) to the open water along the lake shore. The community just described reaches its best development in terms of tree size and structural zonation on the inward (upland) side of the natural area, i.e., the side most distant from the lake. This section is the best drained portion of the natural area and is not flooded by lake waters except possibly during severe storms such as hurricanes. The percentage of sweetgum and tulip-poplar is highest in this section. Also the pawpaw and ground cover layers are best developed here. As one moves towards the lake, the baldcypress become smaller, both in trunk diameter and in height, and the relative proportions of sweetgum and tulip-poplar become lower. Swamp blackgum (Nyssa sylvatica var. biflora) becomes more common in the canopy. Pawpaw thins out and is replaced by more flood tolerant shrubs such as Virginia willow (Itea virginica), elderberry (Sambucus canadensis), and buttonbush (Cephalanthus occidentalis). The herb layer is dominated by moisture tolerant species such as tear-thumb (Polygonum sagittaefolium), jewelweed, and false nettle.

Smaller stands of baldcypress extend out into the shallow waters of the lake. Here, in a more or less permanently flooded situation, they are the sole canopy species with no underlying shrub or herb layer present.

Evidence that the water level of the lake has fluctuated in the past is reflected by the distinct age classes of the baldcypress which become successively younger towards the open water of the lake.

The cypress fringe along the lake shore is characterized from the old-growth stand (CT 1) by younger trees of smaller stature, lack of a distinct closed shrub layer (and absence of pawpaw), and the presence of a very dense herbaceous ground cover. This vegetation type is sufficiently distinct to be designated as a community: Taxodium distichum/Boehmeria cylindrica-Impatiens capensis (Baldcypress/false nettle-jewelweed). It is not considered to have a significance value which warrants its mention in the significance summary or biotic summary table, however.

Many wildlife species utilize the baldcypress stand (CT 1) for nesting, feeding and cover. At least 39 species of breeding birds are known to occur in the cypress stand itself and an additional 35 species use the lake and the surrounding farm-

lands during the winter months and in migration.

Mammals known to occur in the cypress stand include resident opossum, raccoon, eastern gray squirrel, marsh rabbit, and white-tailed deer. Black bear pass through the area on rare occasions, wandering from the large pocosin south of the lake.

The large trees provide numerous cavities for denning and the dense shrubs provide important songbird feeding and nesting habitat. The area is also important because it is the last remaining densely wooded shoreline along the lake, the remainder of which has been cleared for agriculture or residential home development, or disturbed by logging activities and frequent fires.

South Shore Marsh

The second natural area within Pettigrew State Park is located along the southern margin of Lake Phelps. This natural area contains a freshwater marsh which occupies a narrow band 60-150 wide along the shore line and the shallow (less than 18 inches deep) margin of the lake.

The plant community occurs on clean, quartz sands in shallow water. It is dominated by the community *Panicum hemitomon*-mixed aquatic herbs (*Maidencane*/mixed aquatic herbs; CT 2). Along with maidencane (an emergent marsh plant), other common aquatics include water milfoil (*Myriophyllum tenellum*), pickerelweed (*Pontederia cordata*), three-square (*Scirpus americanus*), pennywort (*Hydrocotyle umbellata*), pipewort (*Eriocaulon pellucidum*), duck potato (*Sagittaria teres* or *isoctiformis*), and needlerush (*Juncus* sp.). Species such as *Pontederia*, *Errocaulon*, *Sagittaria* and others usually occur in loose clumps and scattered individuals adjacent to the dense maidencane mats. Differences in water depth, substrate, and availability of sunlight are important factors which determine the spatial arrangements of the various species. Maidencane, because of its size (2-3 feet) and dense stem development, often forms almost pure beds at the exclusion of other, much smaller aquatics.

This 70-acre freshwater marsh community is restricted to the southern perimeter of the lake which is sheltered from the predominantly southwesterly winds. This marsh community is unique in the state because of its unusual species composition. *Myriophyllum tenellum*, for example, is a species of water milfoil which grows in dense submerged mats. It is not known to

occur elsewhere in the state and the Lake Phelps site represents the southernmost occurrence in its range which extends through the New England states into the Maritime Provinces (Aiken 1981).

Both Eriocaulon pellucidum and Sagittaria sp. (teres or isoetiformis) are listed as significantly rare plants in North Carolina and are known in the state from only a few scattered localities (N. C. Plant Protection Program, 1982, Cooper et al, 1977). The Sagittaria, because of an unclear taxonomic status, has not been determined to species as of this writing.

The marsh vegetation along the south shore is a significant breeding area for many of the game and non-game fish living in the lake. The state endangered Waccamaw Killifish is known to occur on earth only from Lakes Waccamaw and Phelps (Cooper et al, 1977). The specimens at Lake Phelps have been found to differ slightly from the Lake Waccamaw specimens in some respects. This slight differentiation in the two disjunct populations tends to lessen the possibility that the Waccamaw Killifish was accidentally introduced by man into Lake Phelps (Lindquist and Yarbrough 1981). Habitat for the Killifish is reported to be shallow, sandy shores vegetated with dense stands of Panicum hemitomon (op. cit. 1981). The natural area in all likelihood provides critical habitat for this endangered fish.

The marsh is not dense enough to provide suitable nesting and feeding cover for marsh birds, although some species such as bitterns, rails, and herons, undoubtedly use the area during migration.

11b. Prose Description of Site Significance:

The Pettigrew State Park natural areas described in this report contain unique community types unknown elsewhere in North Carolina. The Baldcypress/pawpaw/mixed herbs community (CT 1) along the north shore is highly significant for several reasons. It contains some of the largest trees known from the entire Pamlimarle Peninsula, both in terms of overall height (many trees are in excess of 100 feet) and in trunk diameter (average dbh is about 50 inches). There are no other stands known in Washington County which compare in age and stature. The presence of pawpaw as a dominant shrub species in association with cypress is not known to occur elsewhere in the state. Pawpaw is more typical of stream and river floodplains of the piedmont and upper coastal plain and is relatively rare in the outer coastal plain region of the state.

The Maidencane-mixed aquatic herbs freshwater marsh community (CT 2) along the south shore of the lake is also unique in North Carolina. No other freshwater marshes are known which contain this assortment of emergent and submergent species. The freshwater marsh community also contains a species of water milfoil, Myriophyllum tenellum, which is not known anywhere else in the state and which reaches its southernmost occurrence here. It is more typical of marshes in the Canadian Maritime Provinces and the New England states. Also present are two other plants considered to be significantly rare in the state - Eriocaulon pellucidum, and Sagittaria sp. (teres or isoetiformis). Both species are known from only a few scattered localities in North Carolina.

Also present within the lake itself and probably dependent on the marsh community for feeding/breeding habitat is a state endangered endemic fish, the Waccamaw Killifish. This species is known to occur in the world only in Lakes Waccamaw and Phelps (Cooper et al, 1977).

Lake Phelps is the second largest natural lake in North Carolina. The natural areas along its northern and southern shores contain unique plant communities and rare species which are of statewide significance and represent remnants of two lake shore ecosystems which are integral parts of the overall Lake Phelps biological systems.

North Shore Baldcypress Stand

12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
High quality wetland plant community	CT 1	Taxodium distichum/Asimina triloba/ mixed herbs and ferns	Lake shore stand contains largest and oldest trees known in Washington County and probably in the entire Pamlimarle Peninsula. Canopy height is 90-100 feet and average dbh's are about 50 inches. Only known example of this community type in NC. Best example of a relatively undisturbed, old-growth bald-cypress lakeshore stand in the state.
Endangered or threatened species	through-out	Red-shouldered Hawk	Considered threatened through-out N.C. (Cooper et al., 1977) One breeding pair is present along the north shore. Species is suffering from habitat destruction, particularly in the coastal plain.

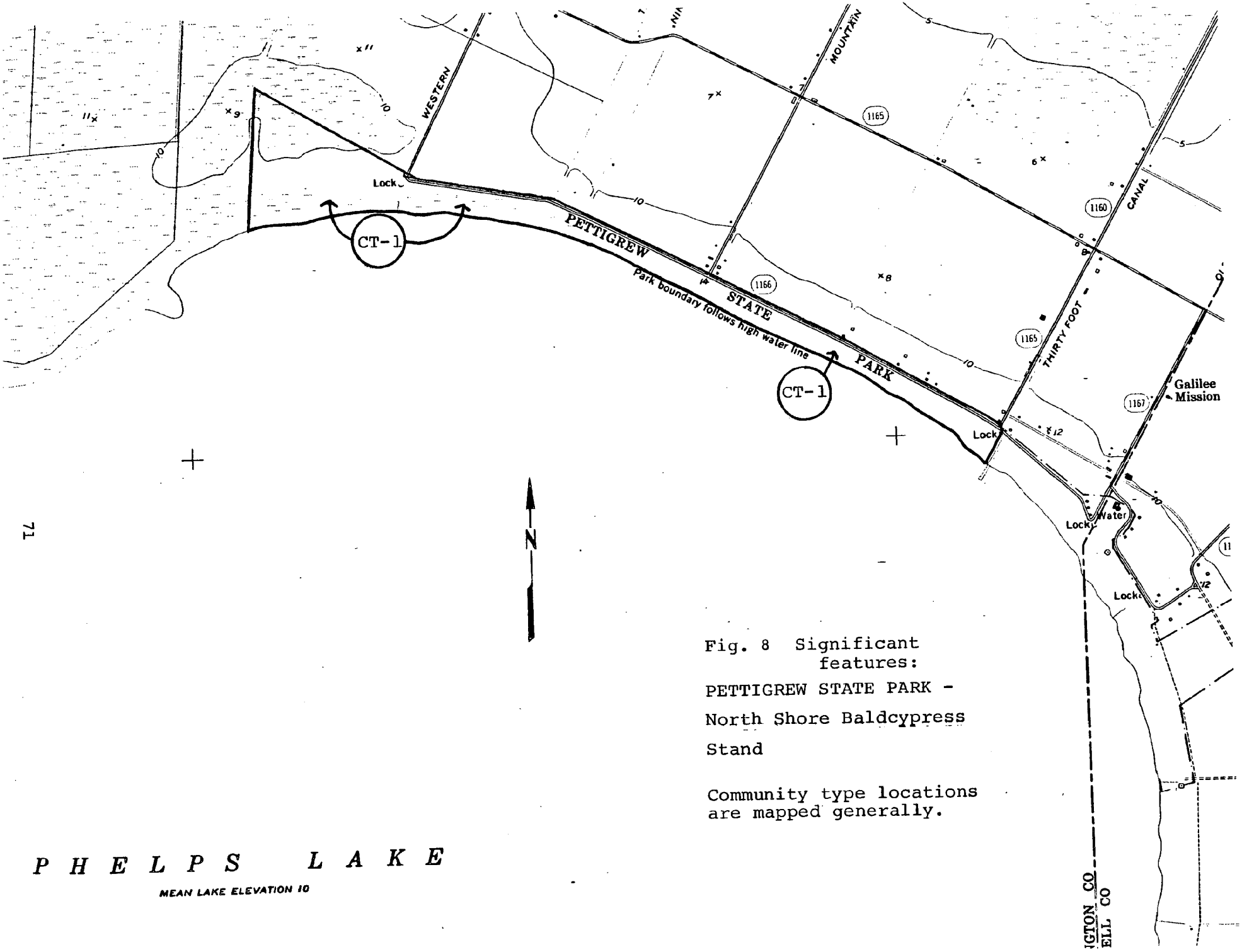


Fig. 8 Significant features:

PETTIGREW STATE PARK - North Shore Baldcypress Stand

Community type locations are mapped generally.

South Shore Freshwater Marsh

12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
High quality wetland plant community	CT 2	Panicum hemitomon-mixed aquatic herbs	Unique community type containing assemblage of species unknown elsewhere in the state. Excellent examples of a relatively undisturbed lacustrine freshwater marsh system.
Endangered or threatened species	through-out	Waccamaw Killifish (Fundulus waccamensis)	Considered to be an endangered endemic fish in N.C. World population is limited to Lake Waccamaw, Columbus Co., N.C. and Lake Phelps (Cooper, et al, 1977). Habitat is shallow lake margins with extensive beds of Panicum hemitomon (Lindquist and Yarbrough 1981)
Rare Species	CT 2	Myriophyllum tenellum	A species of water milfoil only known in N.C. from Lake Phelps. Southernmost population known along the East Coast of the US. More typical of freshwater marshes of Canadian Maritime Provinces and New England States (Aiken 1981). Species determined by J. H. Moore, NC Natural Heritage Program.

South Shore Freshwater Marsh - continued

12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
Rare Plant Species	CT 2	Eriocaulon pellucidum	Considered significantly rare throughout N.C. Only recorded from a few localities in the state (N.C. Plant Protection Program, 1982). Large population in natural area.
Rare Plant Species	CT 2	Sagittaria teres or S. isoetiformis	Considered significantly rare throughout N.C. Only recorded from a few localities in the state (N.C. Plant Protection Program, 1982). Large population in natural area.

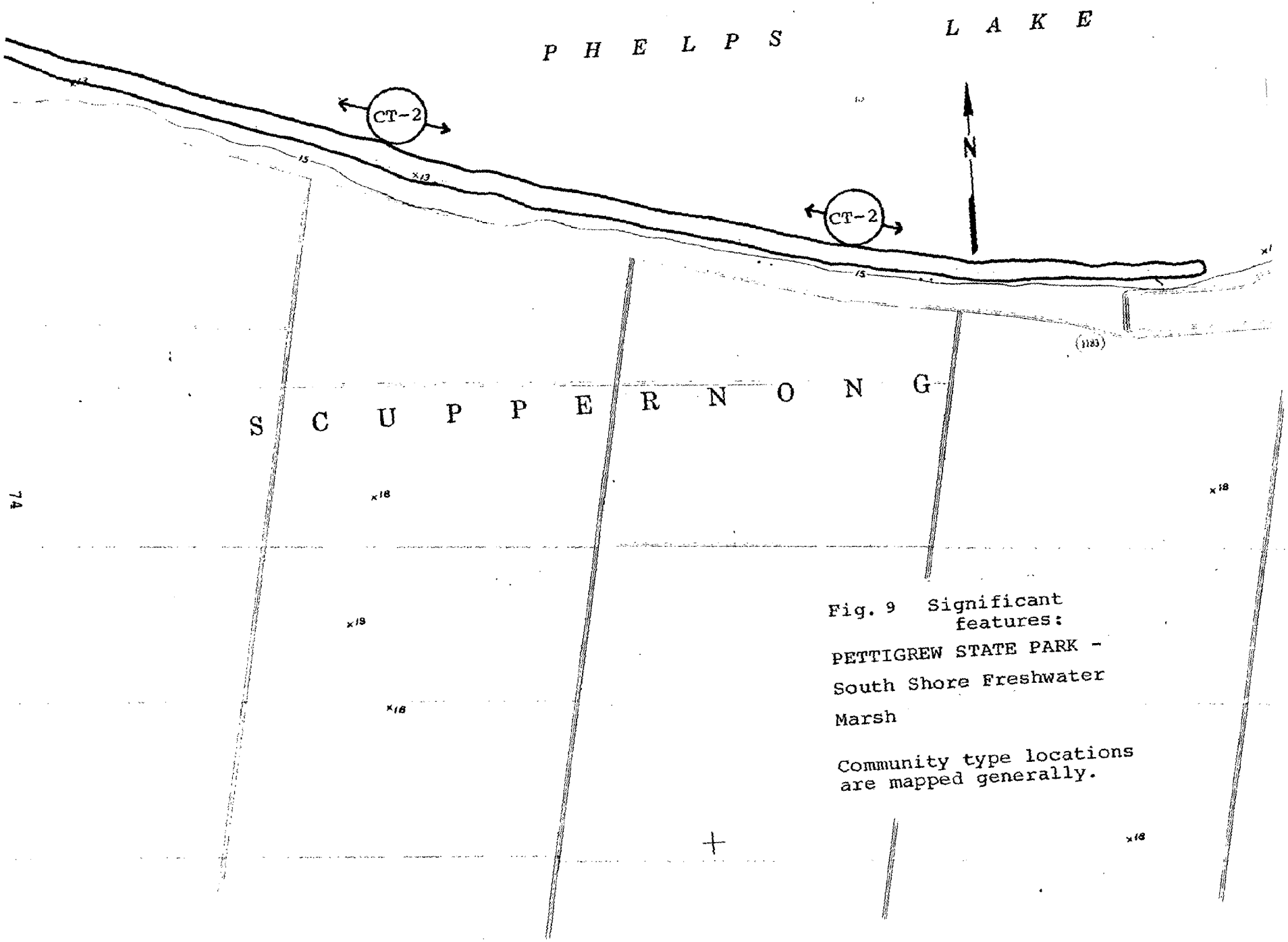


Fig. 9 Significant features:

PETTIGREW STATE PARK - South Shore Freshwater Marsh

Community type locations are mapped generally.

Legal Status, Use, and Management

13. Ownership type by percent area:

Type	
Private	%
Public 100	%
Unknown	%

14. Number of Owners: 1

15. Name(s) of owner(s) and/or custodian(s) (with addresses, phone numbers, other pertinent information).

1) State of North Carolina, Division of Parks and Recreation
P. O. Box 27687
Raleigh, NC 27611

16. Name(s) of knowledgeable person(s) (with addresses, phone numbers, other pertinent information).

1) B. B. (Pat) White
P. O. Box 851
Plymouth, NC 27962

2) Julie H. Moore
Natural Heritage Program
DNRCD
Raleigh, NC 27611

17. Attitude of owner or custodian toward preservation (contacted?):

The North Shore Baldcypress Stand is protected as a state natural area within the Pettigrew State Park. It is also recognized as a State Natural Heritage area by the N.C. Natural Heritage Program. The South Shore Freshwater Marsh is within park boundaries but is not officially recognized as a natural area.

18. Uses of natural area:

The lake itself is used for a variety of recreational activities, including boating, sailing, fishing, and skiing. The north shore cypress stand is occasionally used by park hikers. Development of the western and southwestern margins of the lake for residential homes is of the greatest concern. Leakage of septic tanks, construction of piers, and other disturbances could adversely affect water quality and consequently, the endangered plant and animal populations. Clearing of vast acreages of land around the lake for agriculture has greatly increased the amount of wind-borne sediment deposited in the lake. This has resulted in increased rate of siltation, particularly in the eastern and northeastern sections. A detailed water management plan is needed to maintain water levels to sustain healthy fish populations and prevent damage to the freshwater marsh community. A management plan for the lake and the adjoining shoreline park property has been developed by the Master Planning Unit of the Division of Parks and Recreation (Department of Natural Resources and Community Development, 1977).

19. Uses of surrounding land:

a. Wildland 5 %
b. Agricultural land 95 %
c. high-intensity forestry _____ %
d. developed _____ %

20. Preservation Status:

Cat	* %	*Description of preservation status
1	100	Public land, formally designated as a natural area - North Shore Baldcypress Stand
3	100	Public land, not recognized as a natural area - South Shore Freshwater Marsh

21. Regulatory protections in force:

The North shore natural area is protected as an official natural area by the Division of State Parks. No construction activities or other disturbances to the vegetation are allowed.
The South shore natural area is not officially designated as a natural area; regulatory protection of this area is unclear.

22. Threats:

The entire north shore bald cypress stand is protected as a state park natural area. There are no known threats to its natural integrity. The south shore marshes are protected as part of the state park but are not recognized as an outstanding natural area at the present time. Increasing development of the south shore for second-home development could adversely affect the marshes by increasing human activity in the area; i.e., swimming and wading uses and possible trampling of the vegetation.

23. Management and Preservation Recommendation:

Current recognition of the north shore cypress stand as a state natural area subject to state park regulations seems sufficient to protect the natural integrity of the site. The south shore marshes need to be recognized as a unique natural area and periodically patrolled by park personnel to insure that human activities are kept at a minimum. Designation of this area as a state registered natural area would focus additional attention on the site and help insure its protection. The area should also be included in the N.C. Natural Heritage Program's Registry of Natural Heritage Areas.

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 1

Community type: Taxodium distichum/Asimina triloba/mixed herbs and ferns

Community cover type: Taxodium distichum

General habitat feature: lake shore swamp forest or hardwood stand

Average canopy height: 90-100+ feet

Estimated age of canopy trees: 200-300 years

Canopy cover: closed

Estimated size of community: 180 acres

Successional stage: Climax

Common canopy species in community cover or community type (but not dominant):

Liquidambar styraciflua, Ulmus americana, Liriodendron tulipifera

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant):

Callicarpa americana, Sambucus canadensis, Lindera benzoin, Ilex opaca

Common herb stratum species in community cover or community type (but not dominant):

Lonicera japonica, Athyrium asplenioides, Impatiens capensis, Beehmeria cylindria, Galium sp., Arundinaria gigantea, Teucrium canadense

Vines = Rhus radicans, Anisostichus capreolata, Decumaria barbara, Vitis sp., Campis radicans, Berchemia scandens

24b. Soil Summary (by community type) CT 1

Soil series: Fortescue

Soil classification: Fine-silty, mixed, acid, thermic Cumulic Humaquepts

Soil association: Belhaven-Wasda-Roper association

pH class: strongly acid to extremely acid

Source of information: Soil Survey of Washington County, N.C.
USDA, 1981

Other notes:

24c. Hydrology Summary (by community type) CT 1

Hydrologic system: Lacustrine

Hydrologic subsystem: Limnetic

Water chemistry: Fresh-acid

Water regime: Intermittently flooded

Drainage class: Very poorly drained

Drainage basin: Lake Phelps drains into the Scuppernong River which drains into Albemarle Sound

Hydrology characterization: A very poorly drained, intermittently flooded, freshwater, limnetic lacustrine system.

24d. Topography Summary: CT 1

Landform: Lake shore

Shelter: Partly sheltered

Aspect: not applicable

Slope Angle: not applicable

Profile: Flat ,

Surface patterns: Generally smooth

Position: not applicable

25. Physiographic characterization of natural area:

Geological Formation:

Geological Formation age:

References Cited:

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 2

Community type: Panicum hemitomon-mixed aquatic herbs

Community cover type: Panicum hemitomon

General habitat feature: freshwater lacustrine marsh

Average canopy height: n/a

Estimated age of canopy trees: n/a

Canopy cover: n/a

Estimated size of community: 70 acres

Successional stage: n/a

Common canopy species in community cover or community type (but not dominant):

None

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant):

None

Common herb stratum species in community cover or community type (but not dominant):

Pontederia cordata, Scirpus americanus, Juncus sp., Myriophyllum tenellum, Eriocaulon pellucidum, Sagittaris teres, Hydrocotyle umbellata

24b. Soil Summary (by community type) CT 2

Soil series: not applicable

Soil classification: -

Soil association: -

pH class: -

Source of information: -

Other notes: Sediments that are permanently flooded are not considered soils by the SCS and therefore are not designated.

24c. Hydrology Summary (by community type) CT 2

Hydrologic system: Lacustrine

Hydrologic subsystem: Limnetic

Water chemistry: Fresh-acid

Water regime: Permanently flooded to intermittently exposed

Drainage class: not applicable

Drainage basin: Lake Phelps which drains into Scuppernong River which drains into Albemarle Sound.

Hydrology characterization: A permanently flooded to intermittently exposed, freshwater, limnetic lacustrine system.

24d. Topography Summary: CT 2

Landform: freshwater lake margin

Shelter: open

Aspect: n/a

Slope Angle: n/a

Profile: Flat

Surface patterns: smooth, quartz sands under 1-18 inches of water

Position: n/a

25. Physiographic characterization of natural area:

Mature climax plant communities in freshwater marshes and lakeshore swamp forest along the margin of Lake Phelps, on the Pamlico Terrace, in the embayed section of the coastal plain province of the Atlantic Plain.

Geological Formation:

Pamlico Terrace underlain by fossiliferous marls and clays of the Yorktown Formation.

Geological Formation age:

Pamlico Terrace = Pleistocene = 100,000 years B.P.

References Cited:

Daniels, R. B., E. E. Gamble, and W. H. Wheeler. 1978. Age of Soil Landscapes in the Coastal Plain of North Carolina. Soil Science Society of America Journal 42: 98-105.

26. Summary - Endangered and threatened species

Name of species: Myriophyllum tenellum

Species legal status and authority: Considered significantly rare in North Carolina (N.C. Plant Protection Board, Dept. of Agriculture, 1982).
Number of populations on site: one

Number of individuals per population: 5000 + stems

Size or Maturity of individuals: all age classes

Phenology of population: unknown

Eg: vegetative %
flowering %
fruiting %

General vigor of population: excellent

Disturbance or threats to population: Fluctuating water levels; siltation; disturbance from inceasing residential development.

Habitat characteristics

Plant community: Panicum hemitomon-mixed aquatic herbs (CT 2)

Topography: Flat

Soil Series: -

Microclimate: -

Drainage basin: Lake Phelps

Other plants and animal species present: See Master Species Lists.

AERIAL OR DETAILED MAPS WITH POPULATIONS CLEARLY MARKED.

26. Summary - Endangered and threatened species

Name of species: Sagittaria teres or Sagittaria isoetiformis

Species legal status and authority: Considered significantly rare in N.C. (N.C. Plant Protection Board, Dept. of Agriculture, 1982).

Number of populations on site: one

Number of individuals per population: 500+

Size or Maturity of individuals: all age classes

Phenology of population: unknown

Eg: vegetative %
flowering %
fruiting %

General vigor of population: excellent

Disturbance or threats to population: fluctuating water levels; human disturbance from increasing residential development.

Habitat characteristics

Plant community: Panicum hemitomon-mixed aquatic herbs (CT 2)

Topography: Flat

Soil Series: -

Microclimate: -

Drainage basin: Lake Phelps

Other plants and animal species present: See Master Species Lists.

AERIAL OR DETAILED MAPS WITH POPULATIONS CLEARLY MARKED.

26. Summary - Endangered and threatened species

Name of species: Eriocaulon pellucidum

Species legal status and authority: Considered significantly rare in North Carolina (N.C. Plant Protection Board, N.C. Dept. of Agriculture, 1982).

Number of populations on site: one

Number of individuals per population: 10,000+ stems

Size or Maturity of individuals: all age classes

Phenology of population: unknown

Eg: vegetative %
flowering %
fruiting %

General vigor of population: excellent

Disturbance or threats to population: Fluctuating water levels; human disturbance from increasing residential development

Habitat characteristics

Plant community: Panicum hemitomon-mixed aquatic herbs (CT 2)

Topography: Flat

Soil Series: -

Microclimate: -

Drainage basin: Lake Phelps

Other plants and animal species present: See Master Species Lists.

AERIAL OR DETAILED MAPS WITH POPULATIONS CLEARLY MARKED.

26. Summary - Endangered and threatened species

Name of species: Waccamaw Killifish (Fundulus waccamawensis)

Species legal status and authority: State Endangered Endemic (Cooper *et al.*, 1977)

Number of populations on site: one

Number of individuals per population: unknown

Size or Maturity of individuals: all age classes

Phenology of population: not applicable

Eg: vegetative %
flowering %
fruiting %

General vigor of population: unknown

Disturbance or threats to population: Siltation, fluctuating water levels

Habitat characteristics

Plant community: entire lake but particularly CT 2

Topography: -

Soil Series: -

Microclimate: -

Drainage basin: Lake Phelps

Other plants and animal species present: See Master Species Lists.

AERIAL OR DETAILED MAPS WITH POPULATIONS CLEARLY MARKED.

26. Summary - Endangered and threatened species

Name of species: Red-shouldered Hawk

Species legal status and authority: Threatened in N.C. (Cooper *et al.*, 1977)

Number of populations on site: one

Number of individuals per population: 1-2

Size or Maturity of individuals: adult

Phenology of population: not applicable

Eg: vegetative %
flowering %
fruiting %

General vigor of population: -

Disturbance or threats to population: land clearing, pesticides

Habitat characteristics

Plant community: CT 1

Topography:

Soil Series:

Microclimate:

Drainage basin:

Other plants and animal species present: See Master Species Lists.

AERIAL OR DETAILED MAPS WITH POPULATIONS CLEARLY MARKED.

VASCULAR PLANTS

(arranged alphabetically by family)

ACERACEAE
  Acer rubrum
ALISMATACEAE
  Sagittaria teres
ANACARDIACEAE
  Rhus radicans
ANNONACEAE
  Asimina triloba
APIACEAE
  Hydrocotyle umbellata
AQUIFOLIACEAE
  Ilex opaca
ARALIACEAE
  Aralia spinosa
ASPIDIACEAE
  Dryopteris celsa
  Athyrium asplenioides
ASTERACEAE
  Solidago rugosa
  Elephantopus carolinianus
BALSAMINACEAE
  Impatiens capensis
BETULACEAE
  Ostrya virginiana
BIGNONIACEAE
  Anisostichus capreolata
  Campsis radicans
BROMELIACEAE
  Tillandsia usneoides
CAPRIFOLIACEAE
  Lonicera japonica
  L. sempervirens
  Sambucus canadensis
CELASTRACEAE
  Euonymus americanus
CYPERACEAE
  Scirpus americanus
DROSERACEAE
  Drosera sp.
EBENACEAE
  Diospyros virginiana
ERIOCAULACEAE
  Eriocaulon pellucidum
FAGACEAE
  Quercus michauxii
HALORAGACEAE
  Myriophyllum tenellum

HAMAMALIDACEAE
  Liquidambar styraciflua
JUNCACEAE
  Juncus sp.
LAMIACEAE
  Teucrium canadense
LAURACEAE
  Lindera benzoin
  Persea borbonia
LENTIBULARIACEAE
  Utricularia cornuta
  U. purpurea
LILIACEAE
  Smilax rotundifolia
LYCOPODIACEAE
  Lycopodium appressum
LYTHRACEAE
  Decodon verticillatus
MAGNOLIACEAE
  Liriodendron tulipifera
MELASTOMACEAE
  Rhexia sp.
MORACEAE
  Morus rubra
NYSSACEAE
  Nyssa sylvatica var. biflora
OLEACEAE
  Fraxinus pennsylvanica
PHYTOLACCACEAE
  Phytolacca americana
POACEAE
  Arundinaria gigantea
  Panicum hemitomum
POLYGALACEAE
  Polygala lutea
POLYGONACEAE
  Polygonum sagittaefolium
POLYPODIACEAE
  Polypodium polypodioides
PONTEDERIACEAE
  Pontederia cordata
RHAMNACEAE
  Berchemia scandens
ROSACEAE
  Prunus serotina
  Potentilla sp.
  Geum sp.
  Rubus sp.
RUBIACEAE
  Galium sp.

SAXIFRAGACEAE
  Decumaria barbara
  Itea virginica
SYMPLOCACEAE
  Symplocos tinctoria
TAXODIACEAE
  Taxodium distichum
ULMACEAE
  Ulmus americana
URTICACEAE
  Boehmeria cylindrica
VERBENACEAE
  Callicarpa americana
  Verbena urticifolia
VITACEAE
  Vitis sp.
  Parthenocissus quinquefolia

AMPHIBIANS

Fowler's Toad
Southern Leonard Frog
Green Frog
Southern Cricket Frog

REPTILES

Five-lined Skink

BIRDS

(Emphasis of bird lists is on breeding or summering species; lack of adequate field work during the other seasons prevented compilation of a complete list.)

KEY

PR = Permanent Resident
SR = Summer Resident
WR = Winter Resident
T = Transient; spring or fall
PV, SV, WV - Visitor; permanent, summer, or winter
* = Breeding or suspected breeding at site.

Common Loon	WR
Pied-billed Grebe	WR
Great Blue Heron	PV
Green Heron	SR*
Great Egret	SV
Whistling Swan	WR
Canada Goose	WR
Mallard	WR
Black Duck	WR
Wood Duck	PR*
Hooded Merganser	WR
Turkey Vulture	PR
Red-tailed Hawk	PR*
Red-shouldered Hawk	PR*
Common Bobwhite	PR*
American Coot	WR
Killdeer	PV
Spotted Sandpiper	T
Ring-billed Gull	WR
Caspian Tern	T
Mourning Dove	PR*
Yellow-billed Cuckoo	SR*
Barred Owl	PR*
Chimney Swift	SV
Ruby-throated Hummingbird	SR*
Belted Kingfisher	PV
Common Flicker	PR*
Pileated Woodpecker	PR*
Red-bellied Woodpecker	PR*
Yellow-bellied Sapsucker	WR
Hairy Woodpecker	PR*

Downy Woodpecker	PR*
Eastern Kingbird	SR*
Great Crested Flycatcher	SR*
Acadian Flycatcher	SR*
Eastern Pewee	SR*
Tree Swallow	T
Rough-winged Swallow	T
Barn Swallow	SV
Purple Martin	SV
Blue Jay	PR*
Common Crow	PR*
Fish Crow	PV
Carolina Chickadee	PR*
Tufted Titmouse	PR*
White-breasted nuthatch	PR*
Red-breasted nuthatch	WR
Winter Wren	WR
Carolina Wren	PR*
Gray Catbird	SR*
Wood Thrush	SR*
Blue-gray Gnatcatcher	SR*
Golden-crowned Kinglet	WR
Ruby-crowned Kinglet	WR
Cedar Waxwing	WR
White-eyed Vireo	SR*
Red-eyed Vireo	SR*
Prothonotary Warbler	SR*
Northern Parula Warbler	SR*
Yellow-rumped Warbler	WR
Yellow-throated Warbler	SR*
Ovenbird	SR*
Louisiana Waterthrush	SR*
Common Yellowthroat	SR*
Hooded Warbler	SR*
Common Grackle	PV
Brown-headed Cowbird	PR*
Northern Cardinal	PR*
Indigo Bunting	SR*
Evening Grosbeak	WR
American Goldfinch	PV
White-throated Sparrow	WR
Swamp Sparrow	WR
Song Sparrow	WR

MAMMALS

Opossum
Raccoon
Eastern Gray Squirrel
Marsh Rabbit
Eastern Cottontail Rabbit
Whitetail Deer
Black Bear

NATURAL AREA INVENTORY FORM
(To be prepared for each site)

Basic Information Summary Sheet

1. Natural Area Name: Conaby Creek - Roanoke River Swamp Forest

2. County: Washington

3. Location: In the extreme northwest corner of the county near the mouth of the Roanoke River at Albemarle Sound.

4. Topographic quadrangle(s): Westover (1978)

5. Size: 3240 acres, measured with grid calculator (includes about 200 acres of open water on Conaby Creek)

6. Elevation: 0-5 feet msl

7. Access: Although relatively inaccessible, the margins of the natural area can be reached: 1) on foot north of SR 1300 between SR 1333 and 1324; 2) on foot off NC 45 near junkyard and sandpits across highway from grass airstrip; and 3) by boat from either Conaby Creek, Roanoke River, or Albemarle Sound.

8. Names of investigators:

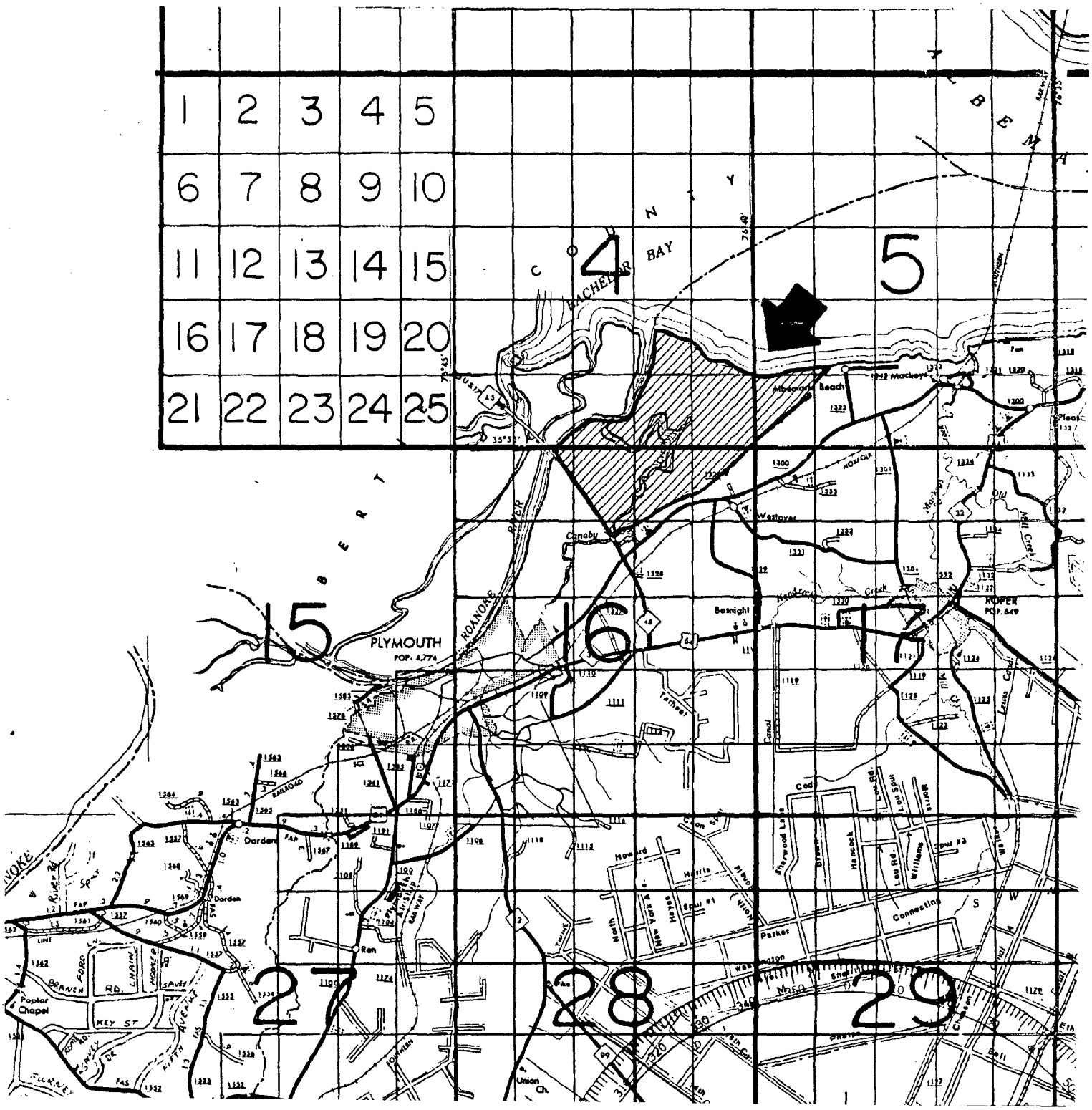
J. Merrill Lynch	S. Lance Peacock
Route 2, Box 222-B	P. O. Box 6006
Enfield, NC 27823	Raleigh, NC 27628

9. Date(s) of investigation: April 10, April 18, May 12, 1982

10. Priority rating: Medium

Fig. 10 Access information:

CONABY CREEK - ROANOKE RIVER



11a. Prose Description of Site:

The Conaby Creek-Roanoke River Natural Area is located in the northwestern corner of the county. The 3240-acre tract lies at the mouth of the Roanoke River at Albemarle Sound and includes a portion of Conaby Creek, a tributary of the Roanoke which enters the river at a point about one mile from its mouth.

The natural area is situated entirely within the Roanoke River floodplain at an elevation between sea level and four feet. The entire tract is underlain by shallow to deep deposits of organic muck which are interbedded with layers of inorganic silts, sands, and clays deposited at various times by river floodwaters. The organic muck soils and permanent high water table are the primary factors which control the vegetation; a structurally diverse but ecologically rather depauperate assemblage of swamp forest and pocosin elements.

The geological history of the area has recently been studied by Erlich (1980). A brief summary of the interesting geological development of the area follows.

The lower Roanoke River basin is an example of a drowned river valley caused by flooding associated with rising sea level. During the Early Holocene Period (7000 years before present), the Roanoke River in the natural area was characterized by typical meandering stream depositional processes. At this time sea level was approximately 46 feet lower than present day levels; therefore much of what is today covered by Albemarle Sound was at that time an exposed broad, flat plain containing the meandering channel of the Roanoke River.

From 7000 years ago to the present the sea level has been gradually rising. Albemarle Sound has been gradually expanding, filling in the former river floodplain. As a consequence of the rising sea level, organic deposits began accumulating in the natural area, covering the inorganic muds and silts deposited during earlier times. Today a vast body of peat-dominated swamp forest wetlands have developed in the lower Roanoke River basin, including the entire natural area section.

The vegetation of the natural area is a complex mosaic of various community types, of which all except one are tree-dominated swamp forest wetland types. The palustrine/riverine wetlands have been influenced in the past by natural and man-induced events. The influence of Roanoke River floodwaters carrying suspended sediments such as silt and mud, storm and wind tides from adjacent Albemarle Sound, and past logging operations are some

of the factors which have combined to mold the vegetation makeup of the natural area. A description of the major community types and several of the minor ones follows in the following paragraphs. Note that only two communities have been given community type designations.

The most widespread plant community is Pinus taeda/ Acer rubrum-Chamaecyparis thyoides/mixed wetland shrubs// Smilax laurifolia (loblolly pine/red maple-Atlantic white cedar/mixed wetland shrubs//laurel-leaved greenbriar; CT 1). This community occurs throughout much of the interior of the natural area away from the Conaby Creek-Roanoke River channels and Albemarle Sound. Though dominated by loblolly pine, the canopy contains scattered individuals of baldcypress (Taxodium distichum), pond pine (Pinus serotina), red maple, and locally dense patches of swamp blackgum (Nyssa sylvatica var. biflora). The loblolly pine canopy is typically open and varies from 60-80 feet in height with average dbh values of 10-15 inches. Scattered much larger pines are present throughout. The subcanopy is usually closed and is dominated by varying proportions of red maple and Atlantic white cedar. Below the subcanopy is a very dense medium-tall shrub zone containing a mixture of species including sweetbay (Magnolia virginiana), redbay (Persea borbonia), sweet gallberry (Ilex coriacea), and fetterbush (Lyonia lucida). There is no distinct ground cover although chain ferns (Woodwardia virginica and W. areolata) are common along with various sedges (Carex spp.). The lower layers are intertwined by an almost impenetrable tangle of the vine laurel-leaved greenbriar (Smilax laurifolia). Other vines present include poison ivy (Rhus radicans) and climbing hydrangea (Decumaria barbara). Dense sphagnum mats are almost universally present.

Along portions of Conaby Creek and the Roanoke River, swamp blackgum-dominated stands are common. This community is identified as Nyssa sylvatica var. biflora/Persea borbonia-Fraxinus caroliniana (swamp blackgum/redbay-Carolina water ash; CT 2). The canopy is usually closed and averages about 50-60 feet in height with an average dbh of 8-12 inches. The shrub layer is composed of redbay and Carolina water ash, two species which are not often found as associates in a swamp forest wetland. The presence of the ash, a species typical of brownwater river swamps dominated by mineral sediments, is probably due to the silting influence of the channels, discussed in more detail below. The shrub layer is typically not as dense as in the loblolly pine dominated community (CT 1). The characteristic vine of that latter community, laurel-leaved greenbriar, is generally uncommon in the swamp blackgum stands. In some areas beds of lizard's tail (Saururus cernuus) form a distinct ground

cover. Other common ground cover species include various sedges (Carex spp.) and netted chain fern. The gum stands are also apparently influenced to some degree by minor and infrequent depositions of suspended silt, deposited during periods of overbank flooding along the channels. Occasional water tupelo (Nyssa aquatica) trees occur along the silty banks of the channels but these are not extensive enough to warrant community type designation.

Along the Albemarle Sound shoreline a distinctive band of small to medium sized baldcypress, 30-50 feet high and with dbh's of less than 14 inches is present. This bald cypress fringe extends out into the shallow waters of the sound and are a graphic indication of the rising sea level. This is a minor community within the natural area and is not included in the biotic summary.

Another minor community which deserves mention is the Atlantic white cedar-dominated stands which occur primarily along the margin of the valley wall or floodplain escarpment (southeastern edge of the natural area). These monospecific stands are composed of dense, closed stands of cedar 20-50 feet tall which are usually even-aged. A mixture of shrubs such as fetterbush and redbay is present underneath. These cedar stands occur over peat containing a mixture of sandy mineral soil washed in from the adjacent uplands.

The communities described up to now represent forested palustrine or riverine wetland systems associated with deep peat or interbedded inorganic muds and peat. Another plant community, dissimilar from the others occurs along the margins of Conaby Creek and the Roanoke River. A submerged, aquatic community dominated by aquatic plants is present. Floating mats of cow-lily (Nuphar luteum var. luteum) and fragrant water-lily (Nymphaea odorata) are associated with other aquatic species such as bladderwarts (Utricularia spp.) and water-milfoils (Myriophyllum spp.). This community is in shallow, sheltered coves and backwaters along the channel margins.

The entire natural area is essentially flat. Elevation ranges from sea level along the waterways to 5 feet along the floodplain margin. There are no subaerial topographic landforms such as sand ridges present in the natural area. A mantle of organic sediments essentially covers the natural area from the channel margins inward to the valley wall. These organic soils are mapped as the Dorovan series: dysic, thermic Typic Medisaprists (SCS, 1981). These soils are characterized by an organic surface layer 51 to greater than 91 inches thick over unconsolidated fluvial inorganic sediments. The peat has a mineral content of 5 to 20%.

The water table is at or very close to the surface year-round. The position of the natural area within a floodplain at or slightly above sea level is the primary reason for the high water table.

The natural area is the only one of six natural areas in Washington County which is completely roadless. Several minor ditches have been constructed into the margins of the swamp but these have had little, if any, effect on the hydrology. Apparently, all logging operations up to the present have removed timber either by barge or by temporary skid-roads.

Because of the inaccessibility of the swamp forest, little is known concerning the wildlife values of the natural area. White-tailed deer, river otter, and black bear are known to occur; the latter species probably only as an occasional visitor.

The large size of the tract, combined with continuous riverbottom wetlands further upstream, comprises an extensive woodland corridor which undoubtedly serves as important habitat and refuge for many game and non-game mammals and birds. The lack of roads and the dense vegetation render the tract virtually inaccessible to man. This factor is significant because it provides many species, particularly large wide-roaming mammals such as black bear, a safe refuge from hunting pressures.

11b. Prose Description of Site Significance:

The Conaby Creek-Roanoke River natural area is the largest tract of roadless wilderness existing in Washington County. Both black bear and river otter, considered rare throughout the coastal plain, occur respectively, within the extensive swamp forest and along the waterways.

The swamp forest contains extensive stands of second-growth loblolly pine, Atlantic white cedar, baldcypress, and swamp blackgum. Although not pristine, these forest stands are significant in their acreage and their inaccessibility. The swamp forest serves as an important wildlife refugium. When combined with adjacent riverbottom wetlands of Bertie County upstream, the natural area encompasses the largest continuous, relatively undisturbed alluvial wetland ecosystem in northeastern North Carolina.

12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
High quality wetland plant community	CT 1	Pinus taeda/Acer rubrum-Chamaecyparis thyoides/mixed wetland shrubs//Smilax laurifolia (includes other wetland communities of minor extent mentioned in the text)	2nd largest alluvial swamp forest wetland in the county (1st is Bull's Neck Swamp). Some scattered old-growth timber remains in interior portions of swamp. When combined with contiguous alluvial swamp forest wetlands in Bertie County, the natural area is part of the largest alluvial wetland system in northeastern North Carolina.
High quality wetland plant community	CT 2	Nyssa sylvatica var. biflora/Persea borbonia-Fraxinus caroliniana	Occurs as band along Conaby Creek and Roanoke River. This community type is not known elsewhere in the county.
Rare and of Special Concern Species	through-out	Black Bear	Listed as of Special Concern by Cooper, et al. 1977. Undetermined population exists in swamp. Area acts as an important refugium for displaced bears from large-scale clearing operations in the south and east.

12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
Rare Species	along waterways	River otter	Considered to be rare or uncommon throughout most of its range in N.C. Undetermined population exists in natural area.
Wilderness aspect	throughout	Large wilderness area	The natural area is the largest completely roadless wilderness area remaining in the county. 3240 acres.

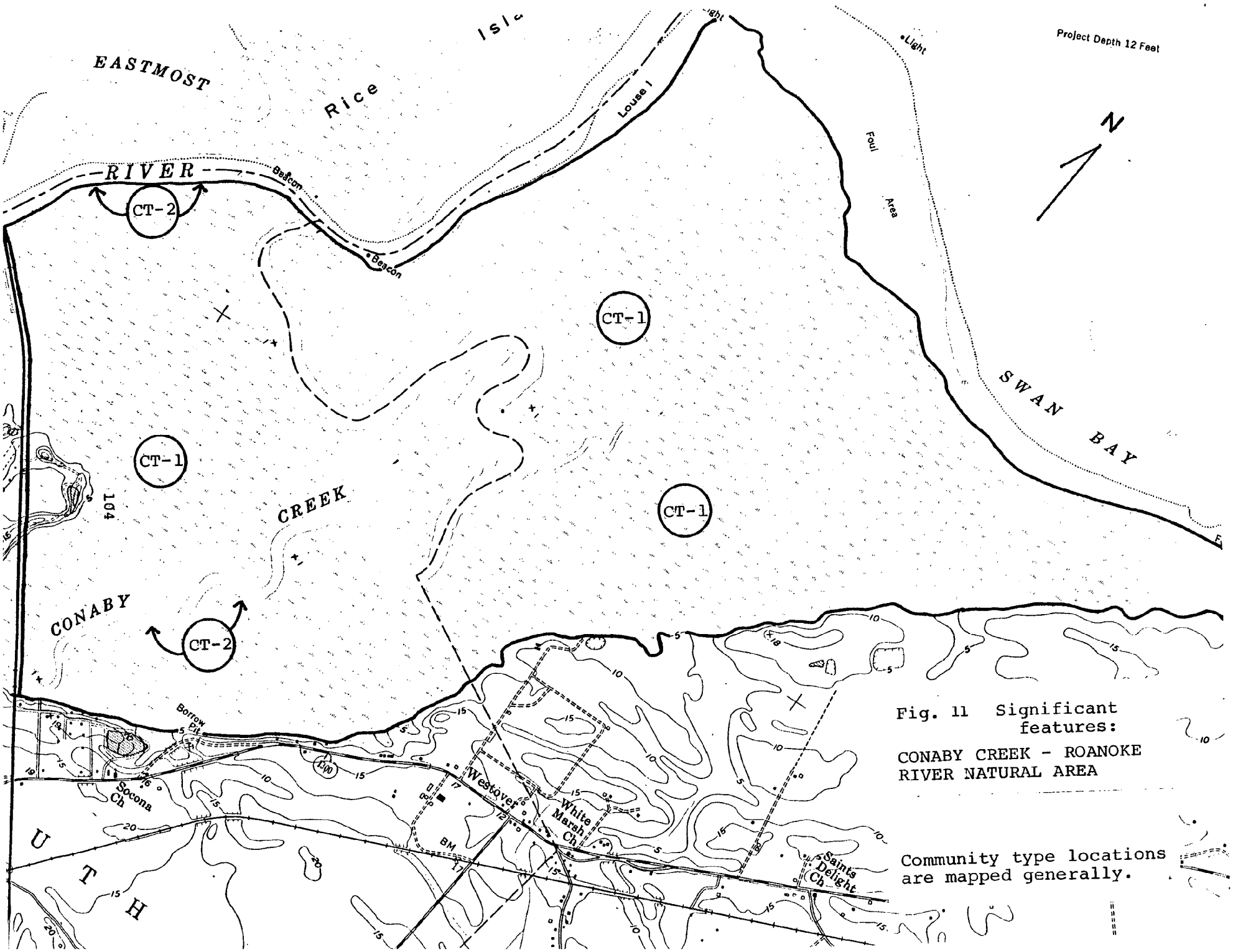


Fig. 11 Significant features:

CONABY CREEK - ROANOKE RIVER NATURAL AREA

Community type locations are mapped generally.

Legal Status, Use, and Management

13. Ownership type by percent area:

Type	
Private	100 %
Public	%
Unknown	%

14. Number of Owners: 5

15. Name(s) of owner(s) and/or custodian(s) (with addresses, phone numbers, other pertinent information). (in order of importance)

1) Ronald Harrison, Box 712, Plymouth, NC 27962

2) Georgia-Pacific Corp., P. O. Box 909, Augusta, GA 30903

3) O. G. and Joe Rand, attorneys at law, Wilson, NC 27893

4) L. L. Mizelle, Rt. 1, Box 602, Plymouth, NC 27962

5) Thomas Gaines, 2818 Ward St., Wilmington, NC 28401

16. Name(s) of knowledgeable person(s) (with addresses, phone numbers, other pertinent information).

1) B. B. (Pat) White
P. O. Box 851
Plymouth, NC 27962

2) Julie H. Moore
Natural Heritage Program
NRCD
Raleigh, NC 27611

17. Attitude of owner or custodian toward preservation (contacted?):

None known.

18. Uses of natural area:

The portion of the natural area owned by Georgia-Pacific Corporation is open to public hunting under the N. C. Wildlife Resources Commission Gamelands program. Because of the lack of roads, dense vegetation, and general inaccessibility it is unlikely that any section of the natural area receives much hunting pressure. The entire area has been timbered, primarily by tram and scid roads during the early 1900's. There is some evidence of fire in the 1930's (Pat White, pers. comm., 1982). There has apparently been no large scale logging operations within the past 70-80 years. This is the only truly roadless area remaining in Washington County.

19. Uses of surrounding land:

a. Wildland 90 %
b. Agricultural land 10 %
c. high-intensity forestry ____ %
d. developed ____ %

20. Preservation Status:

Cat	* %	*Description of preservation status
6	100	Private land, not protected by owner

21. Regulatory protections in force:

Dredge and fill permits under Section 404 of the Clean Water Act apply to the natural area and are regulated by the Army Corps of Engineers.

22. Threats:

One landowner has recently asked for a federal dredge and fill permit to mine sand and gravel near the western margin of the natural area. This landowner also has property contained within the natural area. It is conceivable that future mining in the area is a possibility. Timber operations also pose a potential threat. Much merchantible timber remains in the area although access roads and ditches will need to be built in order to log the area using modern methods.

Because of the high ash content of the peat deposits and their location within the floodplain, the possibility of future peat mining is considered to be very low (Lee Otte, pers. comm. 1982).

23. Management and Preservation Recommendation:

The natural area should be preserved in its present roadless condition. Construction of access roads or drainage ditches should not be allowed so that the natural hydrological systems can remain intact. Some selective timbering by barge could be allowed without damage to the natural integrity of the site. The area should be considered an important wetlands resource and protected for its scenic, wildlife, and fisheries values. Any dredge and fill permit applications should be reviewed carefully.

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 1

Community type: Pinus taeda/Acer rubrum-Chamaecyparis thyoides/ mixed wetland shrubs//Smilax laurifolia

Community cover type: Pinus taeda

General habitat feature: river floodplain swamp

Average canopy height: variable; from 60-80 feet

Estimated age of canopy trees: unknown

Canopy cover: open

Estimated size of community: 1800 acres

Successional stage: late successional to climax

Common canopy species in community cover or community type (but not dominant):

Taxodium distichum, Nyssa sylvatica var. biflora, Acer rubrum, Pinus serotina

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant):

Magnolia virginiana, Persea borbonia, Ilex coriacea, Lyonia lucida

Common herb stratum species in community cover or community type (but not dominant):

Woodwardia virginica, Woodwardia areolata, Carex spp.

Vines: Smilax laurifolia
Decumaria barbara
Rhus radicans

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 2

Community type: Nyssa sylvatica var. biflora/Persea borbonia-Fraxinus caroliniana

Community cover type: Nyssa sylvatica var. biflora

General habitat feature: river floodplain swamp

Average canopy height: 50-60 feet

Estimated age of canopy trees: unknown

Canopy cover: mostly closed

Estimated size of community: 900

Successional stage: late successional to near-climax

Common canopy species in community cover or community type (but not dominant):

Acer rubrum, Taxodium distichum

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant):

None

Common herb stratum species in community cover or community type (but not dominant):

Saururus cernuus
Carex spp.
Woodwardia areolata

Vines: Rhus radicans
Decumaria barbara

24b. Soil Summary (by community type) CT 1, CT 2

Soil series: Corovan muck

Soil classification: Dysic, thermic Typic Medisaprists

Soil association: Dorovan

pH class: extremely acid

Source of information: Soil Survey of Washington County, N.C. USDA, 1981

Other notes:

24c. Hydrology Summary (by community type) CT 1, CT 2

Hydrologic system: Palustrine (CT 1) and Riverine (CT 2)

Hydrologic subsystem: InterAqueous (CT 1) and lower perennial (CT 2)

Water chemistry: Fresh-acid

Water regime: Saturated (CT 1) to seasonably flooded (CT 2)

Drainage class: Very poorly drained

Drainage basin: Roanoke River flows into Albemarle Sound

Hydrology characterization: Very poorly drained, saturated to seasonally flooded, fresh, inter-aqueous and lower perennial, palustrine and riverine systems.

24d. Topography Summary: CT 1, CT 2

Landform: alluvial floodplain (drowned river valley)

Shelter: partly sheltered to open

Aspect: n/a

Slope Angle: n/a

Profile: Flat

Surface patterns: hummocky, peat surface except along stream channels where thin layer of silt and mud sediments occur
Position: n/a

25. Physiographic characterization of natural area:

Late successional to climax communities on organic and inorganic sediments of the Roanoke River drowned river valley, and situated on the Pamlico Terrace of the Coastal Plain province of the Atlantic Plain.

Geological Formation:

Marine and fluvial sediments of the Pamlico Terrace

Geological Formation age:

Pleistocene (100,000 years B.P.) to
Recent (Holocene) less than 6,000 years B.P.

References Cited:

Erlich, R. N. 1980. Early Holocene to Recent Development and Sedimentation of the Roanoke River area, North Carolina. Unpublished dissertation, Department of Geology, UNC - Chapel Hill.

26. Summary - Endangered and threatened species

Name of species: Black Bear

Species legal status and authority: Listed as of Special Concern by Cooper et al., 1977

Number of populations on site: one

Number of individuals per population: unknown, several sets of scat seen near NC 45

Size or Maturity of individuals: unknown

Phenology of population: n/a

Eg: vegetative %
flowering %
fruiting %

General vigor of population: unknown

Disturbance or threats to population: clearcutting, drainage, illegal hunting

Habitat characteristics

Plant community: CT 1

Topography: n/a

Soil Series: n/a

Microclimate: n/a

Drainage basin: n/a

Other plants and animal species present: See Master Species list.

AERIAL OR DETAILED MAPS WITH POPULATIONS CLEARLY MARKED.

VASCULAR PLANTS

(arranged alphabetically by family)

ACERACEAE
  Acer rubrum
ANACARDIACEAE
  Rhus radicans
AQUIFOLIACEAE
  Ilex coriacea
  I. glabra
  I. opaca
BETULACEAE
  Alnus serrulata
BLECHNACEAE
  Woodwardia areolata
  W. virginica
BROMELIACEAE
  Tillandsia usneoides
CAPRIFOLIACEAE
  Viburnum nudum
CLETHRACEAE
  Clethra alnifolia
CUPRESSACEAE
  Chamaecyparis thyoides
CYPERACEAE
  Carex spp.
CYRILLACEAE
  Cyrilla racemiflora
ERICACEAE
  Lyonia lucida
  Vaccinium corymbosum
  Leucothoe axillaris
  Kalmia angustifolia
LAURACEAE
  Persea borbonia
LILIACEAE
  Smilax laurifolia
  S. rotundifolia
LORANTHACEAE
  Phoradendron serotinum
MAGNOLIACEAE
  Magnolia virginiana
NYSSACEAE
  Nyssa sylvatica var. biflora
  N. aquatica
OLEACEAE
  Fraxinus caroliniana
  F. pennsylvanica
OSMUNDACEAE
  Osmunda regalis var. spectabilis

PINACEAE
  Pinus taeda
  P. serotina
ROSACEAE
  Sorbus arbutifolia
  Rosa palustris
SAURURACEAE
  Saururus cernuus
SAXIFRAGACEAE
  Itea virginica
  Decumaria barbara
TAXODIACEAE
  Taxodium distichum
TYPHACEAE
  Typha latifolia
VITACEAE
  Vitis sp.

AMPHIBIANS

Southern Leopard Frog
Green Frog
Bullfrog
Green Treefrog
Southern Cricket Frog
Carpenter Frog

REPTILES

Black Rat Snake
Red-bellied Water Snake
Painted Turtle
Yellow-bellied Slider
Florida Cooter
Fine-lined Skink

BIRDS

(Emphasis of bird lists is on breeding or summering species; lack of adequate field work during the other seasons prevented compilation of a complete list.)

KEY

PR = Permanent resident
SR = Summer resident
WR = Winter resident
T = Transient; spring or fall
PV, SV, WV - Visitor; permanent, summer, or winter
* = Breeding or suspected breeding at site

Wood Duck	PR*
Turkey Vulture	PV
Mourning Dove	PR*
Barred Owl	PR*
Yellow-billed Cuckoo	SR*
Pileated Woodpecker	PR*
Red-bellied Woodpecker	PR*
Hairy Woodpecker	PR*
Downy Woodpecker	PR*
Great-crested Flycatcher	SR*
Barn Swallow	SV
Blue Jay	PR*
Fish Crow	SV
Carolina Chickadee	PR*
Tufted Titmouse	PR*
Winter Wren	WR
Carolina Wren	PR*
Gray Catbird	PR*
Hermit Thrush	WR
Ruby-crowned Kinglet	WR
Cedar Waxwing	WV
White-eyed Vireo	SR*
Prothonatory Warbler	SR*
Northern Parula Warbler	SR*
Pine Warbler	PR*
Common Yellowthroat	SR*
Common Grackle	PV
Northern Cardinal	PR*

MAMMALS

Raccoon (tracks)
River Otter (tracks)
White-tailed Deer (tracks)
Black Bear (scat)

NATURAL AREA INVENTORY FORM
(To be prepared for each site)

Basic Information Summary Sheet

1. Natural Area Name: Bull's Neck Swamp (Big Swamp)

2. County: Washington

3. Location: Along the south shore of Albemarle Sound in the northeastern corner of the county about 5 air-miles NNW of the town of Creswell.

4. Topographic quadrangle(s): Leonard's Point (1974)

5. Size: Approximately 6450 acres, measured with grid calculator

6. Elevation: 0-4 feet msl

7. Access: 1) From junction of SR 1308 and SR 1306 go west on SR 1308 about 0.3 mile to unpaved road on right. Turn right (north) and go about 0.5 mile to deadend at Deep Creek. A jeep trail continues north into interior of the swamp.

   2) From junction of NC 32 and SR 1302 go east on SR 1302 3.4 miles to SR 1312 (unpaved) on left. Take this road for about 0.5 mile to well-defined fork. Take right fork and continue along edge of field to margin of swamp where there is a locked gate. A logging road continues ENE then N into the interior of the swamp.

8. Names of investigators:

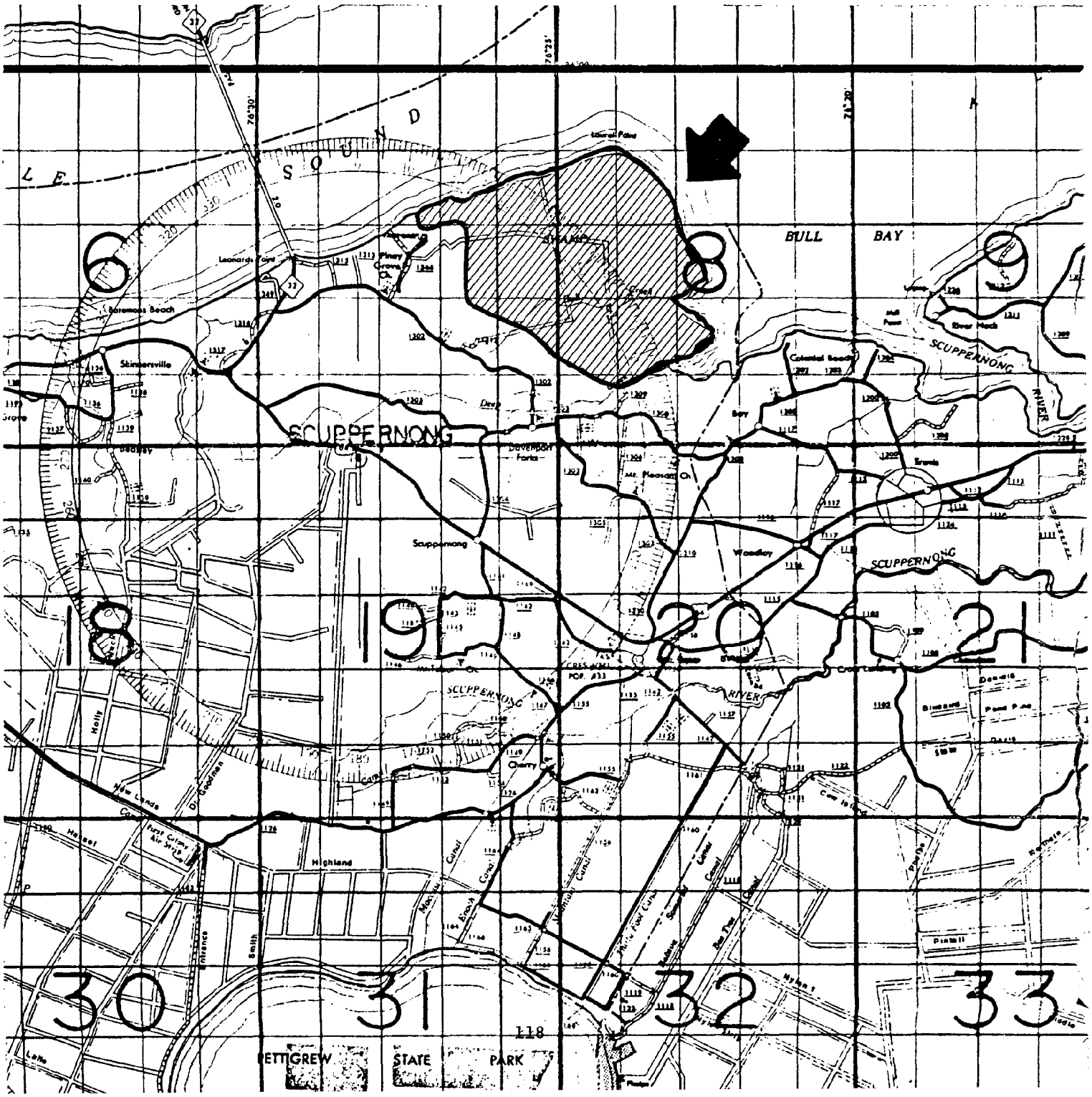
J. Merrill Lynch	S. Lance Peacock
Route 2, Box 222-B	P. O. Box 6006
Enfield, NC 27823	Raleigh, NC 27628

9. Date(s) of investigation: April 18, May 12-13, July 11, 1982

10. Priority rating: Medium

Fig. 12 Access information:

BULL'S NECK SWAMP



11a. Prose Description of Site:

INTRODUCTION

The Bull's Neck Swamp Natural Area occupies a large peninsula along the southern margin of Albemarle Sound in northeastern Washington County. The natural area encompasses about 6450 acres containing a mosaic of wetland habitats over both organic and mineral soils. It is by far the largest significant natural area remaining in the county.

Before describing the habitat diversity of the site, an introduction to the area's geology and developmental history will be outlined. According to Erlich (1980) Albemarle Sound is an example of a drowned river valley. About 8,000 to 10,000 years ago sea level was at least 46 feet lower than the present-day level. At this time the Albemarle Sound basin was a vast alluvial floodplain containing a meandering river channel and extensive swamp forests. Since that time rising sea levels have caused large scale flooding and enlargement of the Albemarle Sound to its present dimensions.

Parts of the original river floodplain have filled in with organic deposits caused by an accumulation of decomposing swamp forest and marsh vegetation. The present day lower portions of the Roanoke River basin (see Conaby Creek Natural Area site report, pp.) and the Bull's Neck peninsula are examples of this organic sedimentation. Close examination of aerial photographs of Bull's Neck reveals a series of long, arcuate sand ridges representing a relic fluvial ridge and swale system which was probably formed during a low sea level stand. Some of these ridges rise 5-8 feet above modern sea level and have been cleared for cultivation. Other ridges (within the natural area boundary) are much lower, 1-4 feet msl; and are periodically flooded by storm tides. The mantle of organic deposits has apparently covered all but the highest portions of these low-elevation ridges. This topographic diversity has created areas of very deep peat (former sloughs between the ridges), areas of very shallow peat (overlying low, now-buried portions of the sand ridges), and areas of higher ridges dominated by loamy sands (not yet covered by the slowly advancing peat mantle).

This diverse geomorphology accounts partly for the habitat diversity of Bull's Neck. A complex history of past logging disturbances and wildfires combine to create a mosaic of vegetation types, all of which reflect patterns relating to soils, topography, degree of flooding, and human disturbance.

VEGETATION

The largest acreage, high-quality plant communities at Bull's Neck are the *Nyssa sylvatica* var. *biflora*/mixed wetland shrubs or *Nyssa sylvatica* var. *biflora*/*Acer rubrum*-*Persea borbonia*/mixed wetland shrubs (swamp blackgum/mixed wetland shrubs or swamp blackgum/red maple-red bay/mixed wetland shrubs; CT 1). These very similar stands are dominated by swamp blackgum in the canopy (maximum height 70 feet) with some denser, closed stands lacking a well-defined subcanopy and other more open ones containing a layer of red maple and redbay. Both have low shrub layers containing various proportions of species such as swamp azalea (*Rhododendron viscosum*), sweet gallberry (*Ilex coriacea*), fetterbush (*Lyonia lucida*), sweet pepperbush (*Clethra alnifolia*, and blueberry (*Vaccinium* sp.). There is essentially no herb layer although dense mats of sphagnum moss are common and widespread. The gum-dominated stands also contain a good proportion of Atlantic white cedar (*Chamaecyparis thyoides*) in both the canopy and subcanopy layers. Also scattered in the canopy are baldcypress (*Taxodium distichum*) and loblolly pine (*Pinus taeda*). The average diameter of the gum canopy trees ranges from 12 to 18 inches, depending on cutting history. Scattered large trees up to 28" dbh are present. Charred stumps occur in scattered places in the gum stands indicating that fire has played some role in the ecology of the area. However, there is no evidence of fire in recent times; i.e. within the past fifty years.

In areas where more intensive cutting has taken place, such as in portions of the southern and western margins of the natural area, loblolly pine and red maple are much more predominant in the canopy. Some areas which were intensively logged are dominated by these two early successional species.

The gum stands occur in areas which are mapped as the Dorovan muck soil series. These organic soils average from 51 to greater than 99 inches in the depth of their muck surface horizons. They are very poorly drained and

are saturated for most of the year due to a high water table (SCS 1981). The gum stands are most extensive in the central portion of the site (see map) where organic soils of moderate depths are prevalent.

Scattered throughout much of the natural area are dense stands of even-aged Atlantic white cedar (CT 2). These stands vary in height and average dbh depending on their age and cutting history. Stands sampled during this survey ranged from 20-30 feet in height and 3 inches average dbh up to 40-50 feet tall and 10 inches dbh. The white cedar stands are characterized by a very high stem density, exclusion of most other swamp forest trees and shrubs, and a uniform height and size. Fire, or more likely, previous clearcutting account for the even-aged and dense character of these stands.

Other species present in the white cedar stands but usually of scattered occurrence include red maple and redbay. Mats of sphagnum moss are often common ground cover.

The physiognomy of Atlantic white cedar is highly variable in the natural area. The species occurs as scattered individuals in the previously described gum-dominated communities (CT 1) and also in the pond pine stands (CT 3). The dense stands of Atlantic white cedar (CT 2) vary from less than one acre to about 220 acres in size. The dense stands (CT 2) occupy about 350 total acres, or about 5.4% of the natural area.

The 220-acre stand is significant enough to describe in more detail. This stand is located near the northern point of the peninsula (Laurel Point) and has a distinctive linear, east-west alignment, about 1.5 miles long by 0.25 mile wide. Site surveys and inspection of aerial photographs suggest that this stand occurs on shallow peat overlying a partially buried sand ridge. Its alignment is similar to exposed sand ridges to the south. Buell and Cain (1943) describe the general habitat of this species as "peat bog underlain by sand." They mention that hardwood or cypress swamps are more likely to develop where the underlying mineral layers are composed mainly of silts and clays. White cedar is also known to require open, sunny conditions for germination (op. cit.). The clearing agent was originally fire, although present timber clear cutting practices often create ideal conditions for the germination and establishment of cedar stands. As mentioned earlier in this discussion, logging activities have been prevalent in Bull's Neck at intervals

since the late 19th century. Tram roads were used to haul timber out during the early 1900's before the advent of modern road and canal construction. It is likely that most if not all of the dense white cedar stands in Bull's Neck Swamp are the result of past timber cutting.

The third high-quality community type located in Bull's Neck is Pinus serotina/Chamaecyparis thyoides-Acer rubrum/Myrica heterophylla-Baccharis halimifolia/ mixed marsh herbs (pond pine/Atlantic white cedar-red maple/bayberry-groundsel tree/mixed marsh herbs; CT 3).

This community is dominated by an open stand of pond pine over an open subcanopy of Atlantic white cedar and red maple. A low shrub layer of bayberry and groundsel tree occurs throughout much of the community over a mixture of marsh herbs. Common herbs include pickerelweed (Pontederia cordata), sedges (Carex spp.), tear-thumb (Polygonum sagittatum), and marsh pennywort (Hydrocotyle sp.). Canopy height ranges from 40-50 feet with trunk diameters of 8-12 inches.

This community is restricted to the northernmost point of Bull's Neck in an area just north of the large white cedar stand previously described. It occupies an area of about 664 acres, or about 10% of the natural area. The area is underlain by Dorovan muck, already described.

The community is an unusual one, containing an assemblage of species not typically found growing together. It appears to be in a state of transition from pond pine-white cedar forest to a shrub-marsh system. Almost all of the white cedars in the community appear to be under stress and many have recently died. Dead cedar trunks are scattered throughout. Reasons for this are unclear. The pond pines appear to be healthy, although somewhat stunted and the red maples also seem to be relatively healthy. Could rising sea level coupled with increasing salinity be the reason for the cedar's demise? This seems to be a good possibility since other possible factors such as disease or insect predation should affect trees throughout the natural area. White cedar stands in other, more inland portions of the natural area seem to be thriving and healthy.

The three previous communities are all swamp forest systems over shallow to deep organic deposits. The fourth community type differs in having a mineral soil type and somewhat better drainage. This type, Pinus taeda/Acer rubrum (loblolly pine/red maple); CT 4, is located on loamy sand ridges scattered within the natural area and lying 2-4 feet in elevation above the surrounding peat-dominated wetlands. These ridges, the remnants of the ridge-and-swale system noted above, exist as isolated, elongated islands oriented generally in a east-west direction, and ranging from several acres to about 185 acres in extent. Most have been timbered extensively and are presently vegetated with young-growth stands of loblolly pine, red maple, and sweetgum. A few of the more remote islands, located in the southern portion of the natural area contain stands of pine 70-80 feet high. A diversity of shrubs and herbs occur including flowering dogwood (Cornus florida), bayberry, American holly, sourwood (Oxydendrum arboreum), American beech (Fagus grandifolia), various oak species (Quercus spp.), tulip-poplar (Liriodendron tulipifera), Japanese honeysuckle (Lonicera japonica), partridgeberry (Mitchella repens), and poison ivy (Rhus radicans).

Early tramroads apparently followed these islands, using them as convenient bridges to reach the less accessible swamp forests. Later, road systems and canals were constructed across the larger ridges. Consequently, little timber remains today and the ecological significance of the pine ridges has been substantially reduced.

The soils of the ridges are mapped as the Dragston loamy fine sand series, a somewhat poorly drained wet soil that is flooded occasionally.

WILDLIFE AND AVIAN DIVERSITY

Because of its large size, habitat diversity of pine ridges, cedar stands and hardwood swamps, Bull's Neck would be expected to represent highly significant wildlife habitat. In some respects the area does seem to have high wildlife values, in others it appears to be rather depauperate.

Four days of field work in the area failed to reveal the presence of any white-tailed deer, a very unusual situation considering the habitat, and the fact that Washington County has one of the largest deer herds in the North Carolina coastal plain (Rod McClanahan, WRC Biologist, pers. comm. 1982). The apparent absence of deer in the area begs explanation.

However, black bear are known to occur (R. McClanahan, pers. comm., 1982) and a set of tracks and scat were observed. The size of this population is unknown. Information on the presence of other furbearers is not available. Breeding bird diversity is high, with at least 47 species known or suspected of nesting in the area. In this regard, Bull's Neck compares favorably with the Van Swamp natural area (See pp.). Breeding birds include ten species of wood warblers and 5 species of woodpeckers, both considered excellent totals for the coastal plain.

11b. Prose Description of Site Significance

Bull's Neck Swamp does not contain any highly significant or unique old-growth timber stands nor does it contain any outstanding wildlife populations or endangered species. Its chief value is the areal extent of the wetland forests; the largest continuous tract of swamp forest vegetation in a relatively natural state in the county. Only two major canal/roads traverse the peninsula and much of the swamp forests are virtually inaccessible. The area functions as a wildlife refugium, and its importance in this regard will surely increase as areas to the south continue to be drained and cleared for agriculture and silviculture.

The swamp also has the largest acreage of pure Atlantic white cedar stands in the county (about 350 acres).

It contains habitat supporting populations of at least two species considered rare or threatened in North Carolina, black bear and red-shouldered hawk, respectively.

12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
High-quality wetland plant community	CT 1	Nyssa sylvatica var. biflora/mixed wetland shrubs or N. sylvatica var.	Largest acreage (3000 a.) of swamp blackgum-dominated
		biflora/Acer rubrum-Persea borbonia/ mixed wetland shrubs	swamp forest remaining in Washington County. Includes
			some old, second-growth timber.
High-quality wetland plant community	CT 2	Chamaecyparis thyoides	Largest acreage (350 a.) of dense, even-aged Atlantic
			white cedar remaining in county.
High-quality wetland plant community	CT 3	Pinus serotina/Chamaecyparis thyoides-Acer rubrum/Myrica heterophylla-	Unusual community type unknown elsewhere in county.
		Baccharis halimifolia/mixed marsh herbs	
Endangered or threatened species	through-out	Red-shouldered Hawk	Listed as threatened in N.C. by Cooper, et al, 1977.
			Population at site thought to consist of 2-3 breeding
			pairs.

12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
Rare species	through-out	Black bear	Listed as of Special Concern by Cooper et al., 1977. Decreasing in coastal plain due mainly to habitat destruction. Population size present within natural area unknown. Questionable whether site contains enough acreage to maintain viable population.
Rare species	CT 1, CT 2	Black-throated Green Warbler Worm-eating Warbler Swainson's Warbler	All three species are considered uncommon to rare and local in the N.C. coastal plain. They are restricted primarily to pocosin and swamp forest wetlands with dense understory layers. The Black-throated Green Warbler is often associated with Atlantic white cedar stands. Regional populations are likely declining due to land clearing and habitat destruction. All three are breeding residents in the natural area.

12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
Breeding Bird species diversity	CT 1, CT 2	47 species of breeding birds	47 species of birds are known or suspected of nesting within the natural area, including ten species of wood warblers and five species of woodpeckers This is an exceptionally high total for the N.C. coastal plain in an area dominated exclusively by forested wetlands.

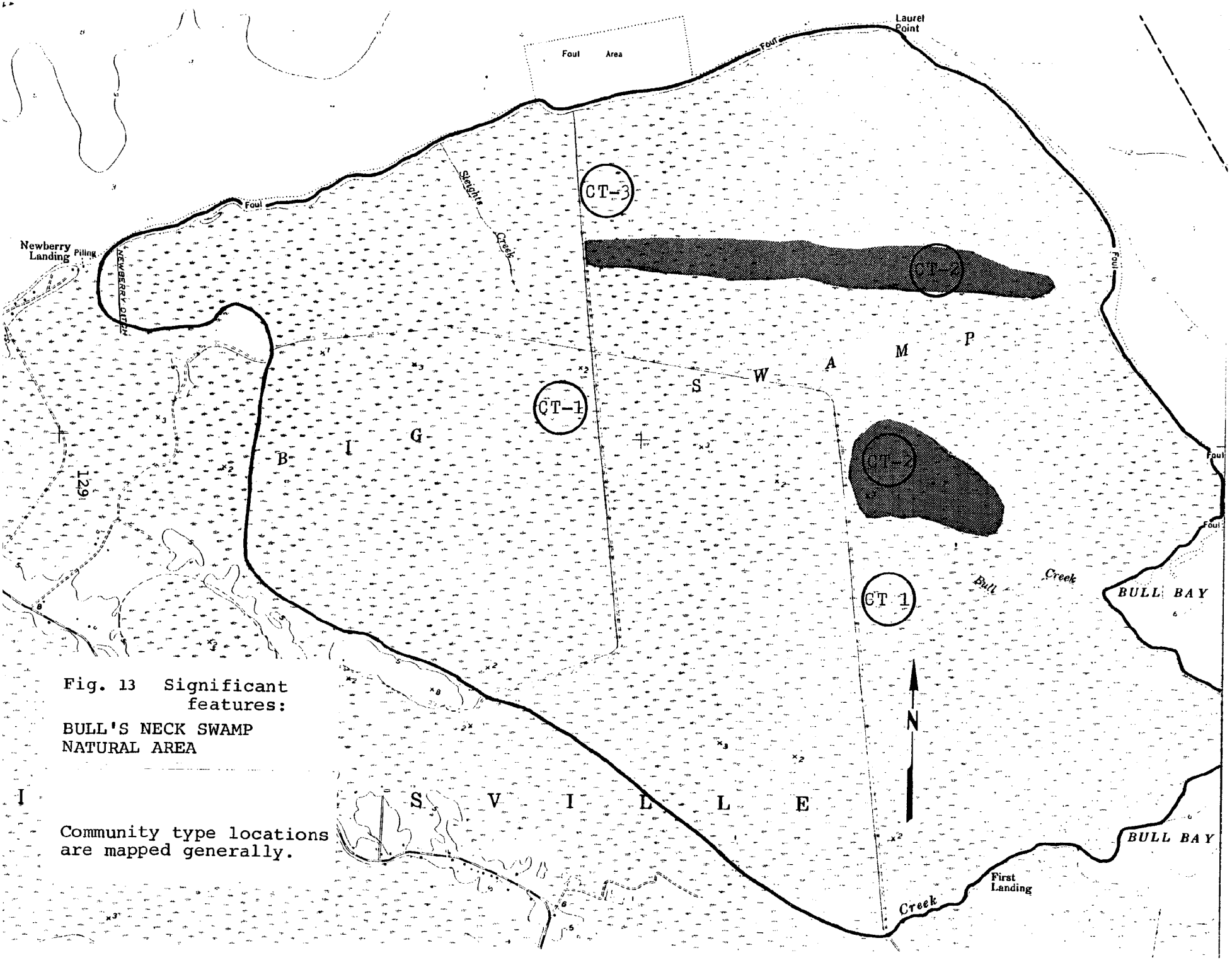


Fig. 13 Significant features:

BULL'S NECK SWAMP NATURAL AREA

Community type locations are mapped generally.

Legal Status, Use, and Management

13. Ownership type by percent area:

Type	
Private	100 %
Public	%
Unknown	%

14. Number of Owners: 4 (one primary)

15. Name(s) of owner(s) and/or custodian(s) (with addresses, phone numbers, other pertinent information). (In order of importance)

1) Lyme Forest Products, Inc., Lyme, CN (6146 a.) Primary landowner

2) Coastal Lumber Co., Box 231, Weldon, NC 27890 (295 a.)

3) L. C. Tarkington, 104 Benefit Road, Chesapeake, VA 23322 (1316 a.)

4) Union Camp Corporation, Franklin, VA 23851

16. Name(s) of knowledgeable person(s) (with addresses, phone numbers, other pertinent information).

1) B. B. (Pat) White
P. O. Box 851
Plymouth, NC 27962

2) Julie H. Moore
Natural Heritage Program
DNRCD, Raleigh, NC 27611

3) Ron McClanahan
Wildlife Biologist
Route 1, Box 442-B
Jamesville, NC 27846

17. Attitude of owner or custodian toward preservation (contacted?):

Not known.

18. Uses of natural area:

The Bull's Neck Swamp Natural Area has been registered in the past as a state gamelands (1980-81) although with a recent change in ownership the present gamelands status is uncertain. Because of the scarcity of white-tailed deer, the swamp is presently under very little hunting pressure. Locked gates or ditches prevent vehicular access by any land route. Since the area is bounded on three sides by Albemarle Sound and Bull's Bay, the swamp shoreline is accessible by boat. Because of the swamp's dense forbidding vegetation there is little likelihood that anyone attempts to enter the swamp interior by this method. In the past the entire swamp has been logged, most recently in the 1950's and 1960's.

19. Uses of surrounding land:

a. Wildland 80 %
b. Agricultural land 20 %
c. high-intensity forestry _____ %
d. developed _____ %

20. Preservation Status:

Cat	* %	*Description of preservation status
6	100	not protected by owner

21. Regulatory protections in force:

The Army Corps of Engineers has jurisdiction over the area concerning Section 404 permit applications for dredging and filling operations.

22. Threats:

The natural area is probably protected from most high-intensive operations because it is 1) very low in elevation (0-4 feet msl), 2) adjacent to navigable waterways and subject to federal permit regulations, 3) subject to storm-tide flooding, and 4) it contains low-value peat reserves (high ash content). However, intensive timber operations could significantly decrease the swamp's natural significance. Large-scale ditching could lower the water table and combined with heavy cutting of the swamp gum, baldcypress, and white cedar, could result in the establishment of a swamp hardwoods community dominated by "weedy" species such as sweetgum and red maple.

23. Management and Preservation Recommendation:

The area should be preserved in its natural state with no further road or canal construction. Timber operations should be limited to small (less than 50 acres) clearcuts or light selective cutting to maintain dominance by swamp blackgum and other dominant swamp trees and prevent invasion of early successional "weedy" species such as sweetgum and red maple.

Its importance as a floodplain wetland ecosystem should be recognized by county planners and efforts should be made to preserve its natural integrity.

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 1

Community type: Nyssa sylvatica var. biflora/mixed wetland shrubs or Nyssa sylvatica var. biflora/Acer rubrum-Persea borbonia/mixed wetland shrubs
Community cover type: Nyssa sylvatica var. biflora

General habitat feature: swamp forest

Average canopy height: 70 feet

Estimated age of canopy trees: unknown

Canopy cover: closed

Estimated size of community: 3000 acres

Successional stage: near-climax (except in areas recently disturbed by logging)

Common canopy species in community cover or community type (but not dominant):

Pinus taeda, Chamaecyparis thyoides

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant):

Persea borbonia, Rhododendron viscosum, Lyonia lucida, Vaccinium sp., Acer rubrum, Ilex coriacea

Common herb stratum species in community cover or community type (but not dominant):

Woodwardia areolata, Osmunda regalis var. spectabilis

Vines: Smilax laurifolia, Gelsemium sempervirens, Rhus radicans

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 2

Community type: Chamaecyparis thyoides

Community cover type: Chamaecyparis thyoides

General habitat feature: swamp forest

Average canopy height: 40-50 feet

Estimated age of canopy trees: unknown

Canopy cover: closed

Estimated size of community: 350 acres

Successional stage: early-mid successional

Common canopy species in community cover or community type (but not dominant):

Acer rubrum

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant):

Persea borbonia

Common herb stratum species in community cover or community type (but not dominant):

None

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 3

Community type: Pinus serotina/Chamaecyparis thyoides-Acer rubrum/ Myrica heterophylla-Baccharis halimifolia/mixed marsh herbs

Community cover type: Pinus serotina

General habitat feature: swamp forest

Average canopy height: 40-50 feet

Estimated age of canopy trees: unknown

Canopy cover: Open

Estimated size of community: 664 acres

Successional stage: successional (appears to be transitional from pond pine community to shrub-marsh community)

Common canopy species in community cover or community type (but not dominant):

None

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant):

Acer rubrum, Cephalanthus occidentalis

Common herb stratum species in community cover or community type (but not dominant):

Pontederia cordata, Carex spp., Polygonum sagittatum, Hydrocotyle sp., Cuscuta sp.

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 4

Community type: Pinus taeda/Acer rubrum

Community cover type: Pinus taeda

General habitat feature: mesic sand ridge

Average canopy height: 60-90 feet

Estimated age of canopy trees: unknown

Canopy cover: Open

Estimated size of community: 320 acres

Successional stage: late successional

Common canopy species in community cover or community type (but not dominant):

Acer rubrum, Quercus michauxii

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant):

None

Common herb stratum species in community cover or community type (but not dominant):

Mitchella repens

24b. Soil Summary (by community type) CT 1, CT 2, CT 3

Soil series: Dorovan muck

Soil classification: Dysic, thermic Typic Medisaprists

Soil association: Dorovan

pH class: Extremely acid

Source of information: Soil Survey of Washington County, N.C., U.S.D.A., 1981

Other notes:

24c. Hydrology Summary (by community type) CT 1, CT 2, CT 3

Hydrologic system: Palustrine

Hydrologic subsystem: Interaqueous

Water chemistry: Fresh

Water regime: semipermanently flooded to saturated

Drainage class: very poorly drained

Drainage basin: Albemarle Sound

Hydrology characterization: A very poorly drained, semipermanently flooded to saturated, fresh, interaqueous, palustrine system.

24b. Soil Summary (by community type) CT 4

Soil series: Dragston loamy fine sand

Soil classification: Coarse-loamy, mixed, thermic Aeric Ochraquults

Soil association: Dorovan

pH class: very strongly or strongly acid

Source of information: Soil Survey of Washington County, N.C., U.S.D.A., 1981

Other notes:

24c. Hydrology Summary (by community type) CT 4

Hydrologic system: Palustrine

Hydrologic subsystem: Interaqueous

Water chemistry: Fresh-acid

Water regime: Intermittently flooded

Drainage class: somewhat poorly drained

Drainage basin: Albemarle Sound

Hydrology characterization: A somewhat poorly drained, intermittently flooded, fresh-acid, interaqueous palustrine system.

24d. Topography Summary:	CT 1, CT 2, CT 3	CT 4
Landform:	embayed river swamp	mesic sand ridge within embayed river swamp
Shelter:	sheltered to partly sheltered	sheltered
Aspect:	not applicable	not applicable
Slope Angle:	not applicable	not applicable
Profile:	Flat	Flat
Surface patterns:	Hummocky peat surface	Smooth
Position:	not applicable	not applicable

25. Physiographic characterization of natural area:

A range of early successional to near-climax communities on organic swamp deposits and mineral sand ridges lying within the Albemarle Sound drowned river valley, and situated on the Pamlico Terrace of the Coastal Plain province of the Atlantic Plain.

Geological Formation:

Fluvial and marine sediments of the Pamlico Terrace formation.

Geological Formation age:

Pleistocene (100,000 years B.P.) overlain by Holocene (less than 6,000 years B.P.)

References Cited:

Erlich, R. N. 1980. Early Holocene to Recent Development and Sedimentation of the Roanoke River Area, N.C. Unpublished dissertation, Department of Geology, UNC-Chapel Hill.

26. Summary - Endangered and threatened species

Name of species: Red-shouldered Hawk

Species legal status and authority: Listed as Threatened in N.C. by Cooper, et al., 1977

Number of populations on site: one

Number of individuals per population: Probably 2-3 nesting pairs occur at the site

Size or Maturity of individuals: adults and immatures

Phenology of population: Not applicable

Eg: vegetative %
flowering %
fruiting %

General vigor of population: Unknown

Disturbance or threats to population: Clearcutting, drainage of swamp forest

Habitat characteristics

Plant community: CT 1, CT 2, CT 3, CT 4

Topography:

Soil Series:

Microclimate:

Drainage basin:

Other plants and animal species present: See Master Species List.

AERIAL OR DETAILED MAPS WITH POPULATIONS CLEARLY MARKED.

26. Summary - Endangered and threatened species

Name of species: Black Bear

Species legal status and authority: The coastal plain population was listed as of Special Concern by Cooper, et al., 1977.

Number of populations on site: one (1 set of tracks and scat were observed 13 May 1982).

Number of individuals per population: Unknown

Size or Maturity of individuals: Unknown

Phenology of population: n/a

Eg: vegetative %
flowering %
fruiting %

General vigor of population: Unknown

Disturbance or threats to population: Logging, illegal hunting or trapping

Habitat characteristics

Plant community: CT 1, CT 2, CT 3, CT 4

Topography:

Soil Series:

Microclimate:

Drainage basin:

Other plants and animal species present: See Master Species List.

AERIAL OR DETAILED MAPS WITH POPULATIONS CLEARLY MARKED.

BULL'S NECK SPECIES LIST

VASCULAR PLANTS
(listed alphabetically by family)

ACERACEAE
  Acer rubrum
ALISMATACEAE
  Sagittaria sp.
ANACARDIACEAE
  Rhus radicans
  Rhus sp.
APIACEAE
  Cicuta maculata
  Hydrocotyle sp.
AQUIFOLIACEAE
  Ilex opaca
  Ilex glabra
  Ilex coriacea
ARALIACEAE
  Aralia spinosa
ARISTOLOCHIACEAE
  Hexastylis arifolia
ASPIDIACEAE
  Thelypteris noveboracensis
ASTERACEAE
  Baccharis halimifolia
BETULACEAE
  Alnus serrulata
BLECHNACEAE
  Woodwardia areolata
  W. virginica
CAPRIFOLIACEAE
  Viburnum nudum
  Lonicera japonica
  Lonicera sempervirens
CLETHRACEAE
  Clethra alnifolia
CONVOLVULACEAE
  Cuscuta sp.
CUPRESSACEAE
  Chamaecyparis thyoides
CYRILLACEAE
  Cyrilla racemiflora
ERICACEAE
  Rhododendron viscosum
  Lyonia lucida
  Oxydendron arboreum
  Gaultheria procumbens
  Leucothoe axillaris
  Vaccinium spp.

FAGACEAE
  Quercus alba
  Q. nigra
  Q. laurifolia
  Q. michauxii
  Fagus grandifolia
HAMAMELIDACEAE
  Liquidambar styraciflua
LAURACEAE
  Persea borbonia
LILIACEAE
  Smilax laurifolia
  S. rotundifolia
LOGANIACEAE
  Gelsemium sempervirens
LORANTHACEAE
  Phoradendron serotinum
MAGNOLIACEAE
  Liriodendron tulipifera
  Magnolia virginiana
MYRICACEAE
  Myrica cerifera
  Myrica heterophylla
NYSSACEAE
  Nyssa sylvatica var. biflora
ORCHIDACEAE
  Cypripedium acaule
OSMUNDACEAE
  Osmunda regalis var. spectabilis
PINACEAE
  Pinus taeda
  Pinus serotina
POLYGONACEAE
  Polygonum sagittatum
PONTEDERIACEAE
  Pontederia cordata
PTERIDACEAE
  Pteridium aquilinum
ROSACEAE
  Sorbus arbutifolia
  Rosa palustris
RUBIACEAE
  Cephalanthus occidentalis
  Mitchella repens
SAXIFRAGACEAE
  Itea virginica
  Decumaria barbara
SYMPLOCACEAE
  Symplocos tinctoria
TAXODIACEAE
  Taxodium distichum
VITACEAE
  Parthenocissus quinquefolia
  Vitis sp.

AMPHIBIANS

Southern Leopard Frog
Southern Cricket Frog
Green Frog
Bullfrog
Fowler's Toad
Pinewoods Treefrog

REPTILES

Eastern Box Turtle
Eastern Cottonmouth
Red-bellied Water Snake

BIRDS

(Emphasis of bird lists is on breeding or summering species; lack of adequate field work during the other seasons prevented compilation of a complete list.)

KEY

PR = Permanent resident
SR = Summer resident
WR = Winter resident
T = Transient; spring or fall
PV, SV, WV - Visitor; permanent, summer, or winter
* = Breeding or suspected breeding at site

Wood Duck	PR*
Great Egret	SV
Green Heron	SR*
Turkey Vulture	PR*
Red-shouldered Hawk	PR*
Common Bobwhite	PR*
Mourning Dove	PR*
Yellow-billed Cuckoo	SR*
Screech Owl	PR*
Great Horned Owl	PR*
Barred Owl	PR*
Whip-poor-Will	SR*
Chimney Swift	SV
Ruby-throated Hummingbird	SR*

Belted Kingfisher	PR
Common Flicker	PR*
Pileated Woodpecker	PR*
Red-bellied Woodpecker	PR*
Hairy Woodpecker	PR*
Downy Woodpecker	PR*
Great Crested Flycatcher	SR*
Acadian Flycatcher	SR*
Eastern Pewee	SR*
Barn Swallow	SV
Purple Martin	SV
Blue Jay	PR*
Common Crow	PR*
Fish Crow	SV
Carolina Chickadee	PR*
Tufted Titmouse	PR*
Carolina Wren	PR*
Gray Catbird	PR*
Wood Thrush	SR*
Blue-gray Gnatcatcher	SR*
White-eyed Vireo	SR*
Red-eyed Vireo	SR*
Black-and-White Warbler	T
Prothonotary Warbler	SR*
Swainson's Warbler	SR*
Worm-eating Warbler	SR*
Northern Parula Warbler	SR*
Black-throated Blue Warbler	T
Black-throated Green Warbler	SR*
Blackpoll Warbler	T
Pine Warbler	PR*
Prairie Warbler	SR*
Ovenbird	SR*
Northern Waterthrush	T
Common Yellowthroat	SR*
Hooded Warbler	SR*
American Redstart	T
Bobolink	T
Common Grackle	PR*
Brown-headed Cowbird	PR*
Summer Tanager	SR*
Northern Cardinal	PR*
Indigo Bunting	SR*
American Goldfinch	PR*
Rufous-sided Towhee	PR*
Swamp Sparrow	WR

MAMMALS

Opossum (tracks)
Eastern Mole (tunnels)
Black Bear (tracks and scat)
Eastern Gray Squirrel (seen)
Raccoon (tracks)

NATURAL AREA INVENTORY FORM
(To be prepared for each site

Basic Information Summary Sheet

1. Natural Area Name: Chapel Swamp

2. County: Washington

3. Location: Along US 64 in the north-central section of the county

4. Topographic quadrangle(s): Roper North (1978)

5. Size: 149 acres, measured with grid calculator

6. Elevation: 4-10 feet msl

7. Access: Along south side of US 64 at Chapel Swamp, about 1.4 miles west of junction with SR 1136. Best portion of natural area is the east side of the swamp.

8. Names of investigators:

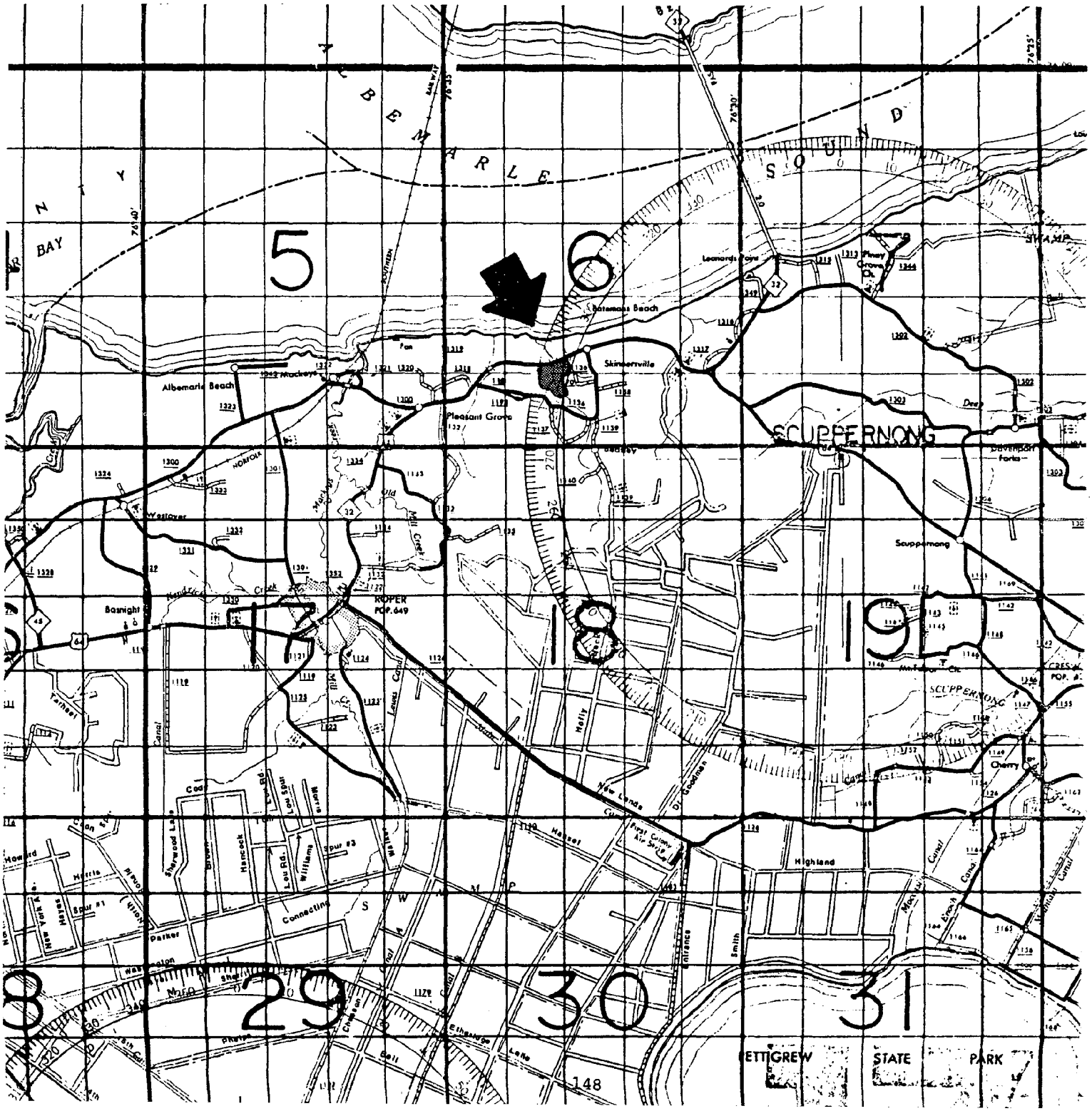
J. Merrill Lynch	S. Lance Peacock
Route 2, Box 222-B	P. O. Box 6006
Enfield, NC 27823	Raleigh, NC 27628

9. Date(s) of investigation: December 5, 1981; May 13, July 11, 1982.

10. Priority rating: Medium

Fig. 14 Access information:

CHAPEL SWAMP



11a. Prose Description of Site:

The Chapel Swamp Natural Area is a 149-acre tract which contains the narrow alluvial floodplain and adjacent upland slopes of a small stream draining the southern margin of Albemarle Sound. The natural area contains the best preserved examples of upland slope and alluvial floodplain communities remaining in Washington County.

Chapel Swamp is a small, low-gradient stream which drains a portion of the upland mineral soils which occur as a relatively narrow band 2-3 miles wide along the south side of Albemarle Sound. The stream is one of several located along the northern border of the county between Mackeys and the Tyrrell County line. The narrow alluvial floodplain along the meandering channel is dominated by swamp forest typical of alluvial brownwater rivers and streams of the coastal plain.

The plant community of the floodplain is Nyssa aquatica/Saururus cernuus (water tupelo/lizard's tail; CT 1). It is dominated by water tupelo (Nyssa aquatica) in the canopy over a sparse, poorly-developed shrub layer of carolina water ash (Fraxinus caroliniana) and virginia willow (Itea virginica) over a ground layer locally dominated by dense patches of lizard's tail (Saururus cernuus). The water tupelo average about 60-70 feet in height and have an average diameter at breast height (dbh) of about 28 inches. Scattered very large, old-growth trees up to 45 inches dbh are present. Mixed with the gum are scattered baldcypress (Taxodium distichum) up to 90 feet tall and 43 inches dbh, cull trees which were not harvested during earlier periods of timber removal. Scattered very large cypress stumps indicate that the swamp forest community was probably dominated by cypress prior to logging activities.

The water tupelo swamp forest stand is characterized by the distinct, swollen bases of the trees, an indication that deep flooding of the swamp is a periodic occurrence. Water lines on the trees indicate flooding depths of up to two feet.

The swamp soils are mapped as Dorovan mucky silt loam overwash, an organic soil that has developed a shallow mineral surface horizon (SCS 1981). These silty loam soils apparently account for the presence of water tupelo, a species more commonly associated with silty and clayey swamps of larger brownwater river bottoms. The water tupelo swamp is the only well-developed, mature stand known in Washington County. This species is at or very near the eastern margin of its range in the Pamli-

marle Peninsula at this site.

Adjacent to the swamp are a series of slopes which rise 5-6 feet above the floodplain. Along the gentle (2-6°) slopes and the relatively flat ridgecrests the plant community (CT 2) occurs: Mixed upland hardwoods/Fagus grandifolia transgressives or Ostrya virginiana (Mixed hardwoods/American beech transgressives or hop hornbeam). This upland, terrestrial community contains several species of hardwoods, the two most common being white oak (Quercus alba) and American beech. Species also present in the canopy in smaller proportions include southern red oak (Quercus falcata var. falcata), tulip poplar (Liriodendron tulipifera), loblolly pine (Pinus taeda), black gum (Nyssa sylvatica var. sylvatica), and pignut hickory (Carya glabra). These upland hardwood stands average 60-70 feet in height and 20-22 inches dbh. A fairly well-developed subcanopy layer dominated by younger American beech and, locally, by hophornbeam is present. Also present in the shrub layer are scattered clumps of silky camellia (Stewartia malacodendron), a tall shrub which is uncommon and local throughout most of the coastal plain. The natural area is the only known location for the species on the Pamlimarle Peninsula, excluding Beaufort County. The ground layer is typically sparse but contains small patches of lady fern (Athyrium asplenioides), New York fern (Thelypteris noveboracensis), mayapple (Podophyllum peltatum), and other herbaceous species.

The upland hardwood stands represent a plant community which is of very limited extent in the county and which is at the eastern limit of its range in the Pamlimarle Peninsula. Although topographically the region is no higher than the extensive wetlands of the East Dismal Swamp to the south, these slopes and low ridges are much better drained. The better drainage is the result of the series of dendritic stream basins, such as Chapel Swamp, which drain into adjacent Albemarle Sound, located about ¼ to ½ mile away from the natural area.

The soils of the uplands are mapped as the Altavista, Dogue, and Wahee series, all of which are fine sandy loams and differ only in minor degrees of drainage and mineral particle size content. Because of their better drainage, most of these soils have been cleared for agriculture for some time. Most of the earlier farming settlements of Washington County were in this zone of mineral soils along the south edge of Albemarle Sound.

Geologically, the natural area lies on the Pamlico Terrace, a flat surface comprised of marine sediments deposited some 100,000 years ago when sea level was much higher and the shoreline was along the Suffolk Scarp, at

about the present-day 25-foot contour level (Ingram and Otte, 1982). At about 18,000 years ago the sea had receded to about 400 feet below the present level. At this time, downcutting by streams produced the series of slopes and dendritic drainages such as Chapel Swamp (op. cit.,1982). From 18,000 years BP to the present day sea level has been gradually rising and downcutting by the streams has essentially stopped. The upland hardwood stands which were probably much more extensive in the region during the low sea level period have been steadily encroached upon by rising waters of the sound and peat-dominated wetlands to the south. They can be considered a relict community which has persisted to the present day within the natural area because of adequate drainage associated with the more dynamic topography.

In terms of average size of trees, minimal degree of past timbering disturbances, and lack of non-native species invasion, the upland hardwood stands of the natural area are the best examples of this community type known in the Pamlimarle Peninsula. The water tupelo swamp forest is the best example of an old-growth, relatively undisturbed alluvial floodplain stand in the Pamlimarle Peninsula. Together these two forest types comprise a near-pristine example of an ecosystem which has almost completely disappeared from the Washington County landscape.

Because of the small size of the tract, the natural area is not believed to be of great significance as wildlife habitat, particularly for wide-ranging mammals. Despite its small size, the tract contains at least 30 species of breeding birds, including one species that deserves special mention because of its rarity in the Pamlimarle Peninsula. Several pairs of white-breasted nuthatches nest in the swamp and upland forests along Chapel Swamp. This species is known elsewhere in the county only from Van Swamp and Lake Phelps; populations are very local and scattered in adjacent Tyrrell, Beaufort, and Hyde Counties. In the Coastal Plain it usually occurs in brownwater river swamps and extensive mesic hardwood flats, primarily in areas with old-growth or mature, second-growth timber.

11b. Prose Description of Site Significance:

The Chapel Swamp Natural Area contains the best examples of alluvial floodplain swamp forest and upland hardwood communities known in the county. The swamp forest dominated by water tupelo is the only example of that community type known in the county and is also significant because of the old-growth age of the stand and the relative lack of disturbance. The upland hardwoods community is equally significant in that it represents an old-growth, relatively undisturbed example of a climax forest type which is very limited in the outer coastal plain and which has in most regions been almost completely cleared for agriculture. Although the site contains no plant or animal species listed as endangered in the state, it does contain a significant population of silky camellia (*Stewartia malacodendron*) a tall shrub which is uncommon and local in the North Carolina coastal plain, and a breeding population of red-shouldered hawks, a species considered to be threatened throughout the state (Cooper, et al, 1977). The locally rare white-breasted nuthatch, a species of small bird, also occurs on the tract and is one of only three breeding populations known in the county.

12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
High quality wetland plant community	CT 1	Nyssa aquatica/Saururus cernuus or Nyssa aquatica	Only known example in county of a swamp forest stand dominated exclusively by water tupelo. Also significant is size class of trees (average dbh 28 inches), and lack of cutting disturbance.
High quality terrestrial plant community	CT 2	Mixed upland hardwoods/Fagus grandifolia transgressives or Ostrya virginiana	Old-growth stand which contains trees of unusually large size (average dbh 20-22 inches) and which has been exposed to relatively minor logging disturbances in the past (selectively timbered at least 50 years ago). Only known example of community type in Pamlimarle Peninsula (Washington, Dare, and Hyde Counties).
Endangered or threatened species	through-out	Red-shouldered Hawk	Listed as threatened in N.C. One breeding pair in swamp. Habitat destruction is a continuing threat throughout its range.

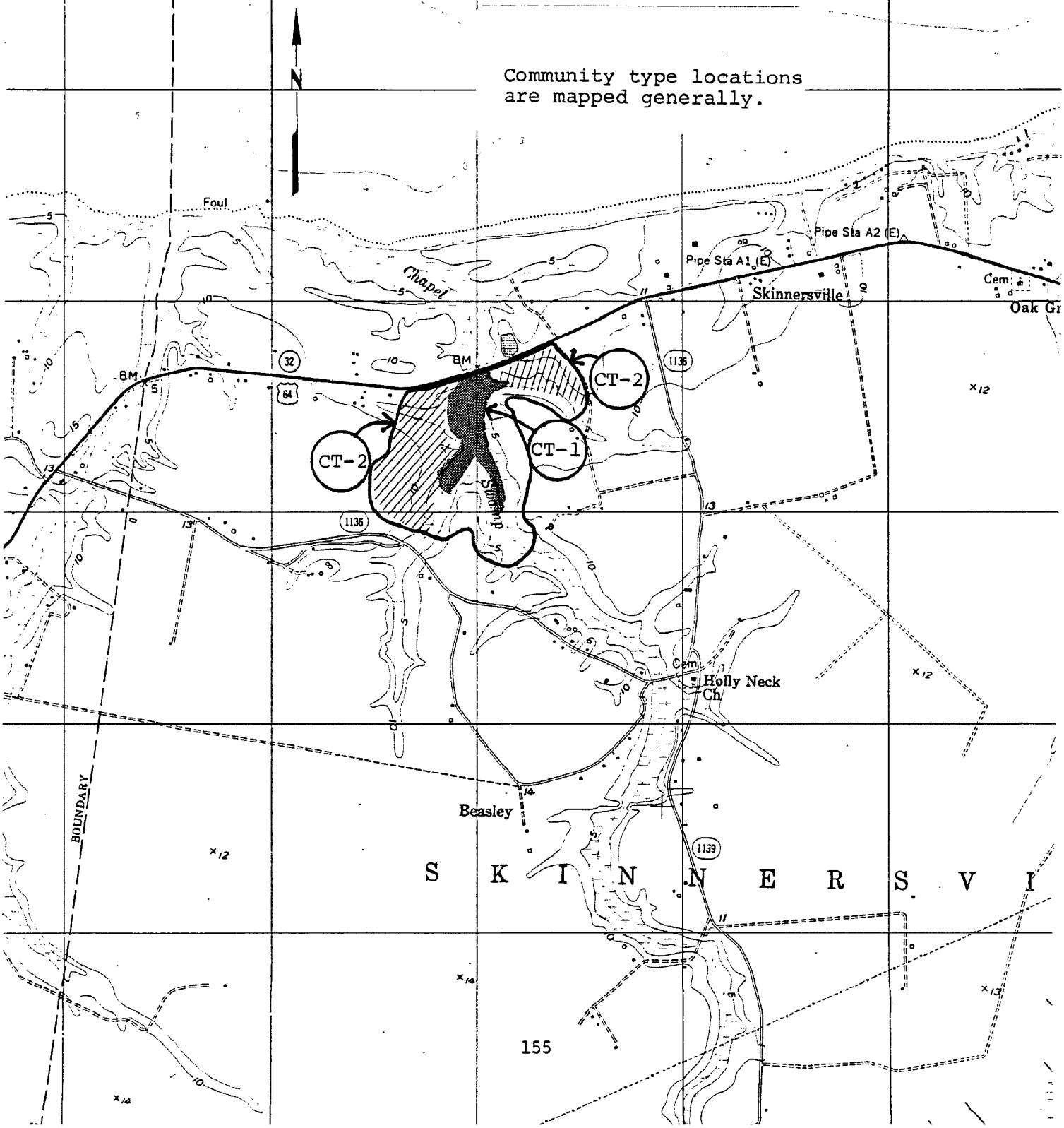
12. Significance Summary Table (categories represented and descriptions) - by site

a. Feature	Map Legend	b. Description of significant feature	c. Comparative assessment
Rare Species	CT 1	Stewartia malacodendron	Only population known in county Known in only 22 counties in N.C. (Radford, et al 1968).
Rare Species	CT 1, CT 2	White-breasted Nuthatch	One of only 3 known breeding populations in county. Rare and local throughout much of the outer coastal plain of N.C.

Fig. 15 Significant features:

CHAPEL SWAMP NATURAL AREA

Community type locations are mapped generally.



Legal Status, Use, and Management

13. Ownership type by percent area:

Type	
Private	100 %
Public	%
Unknown	%

14. Number of Owners: 5

15. Name(s) of owner(s) and/or custodian(s) (with addresses, phone numbers, other pertinent information).

1) D. W. Chesson (Mrs.), Route 1, Box 300, Roper, NC 27970

2) Carlton Phelps, Route 1, Box 306, Roper, NC 27970

3) Sybil Davenport, 1542 Jupiter Cove, Jupiter, Florida 33458

4) C. D. Swain, Route 1, Box 816, Roper, NC 27970

5) B. F. Phelps, Route 2, Box 606, Roper, NC 27970

16. Name(s) of knowledgeable person(s) (with addresses, phone numbers, other pertinent information).

B. B. (Pat) White

P. O. Box 851

Plymouth, NC 27962

17. Attitude of owner or custodian toward preservation (contacted?):

Not known.

18. Uses of natural area:

Chapel Swamp is apparently used sparingly by squirrel and deer hunters in season. The highest-quality portion (see map) of the natural area has not been timbered within the past 50 years. Old stumps indicate that some selective cutting occurred sometime ago. The natural area is an essentially undisturbed but unfortunately small remnant of the upland hardwood and alluvial swamp forest communities which formerly occurred on the better drained soils along the south margin of Albemarle Sound.

19. Uses of surrounding land:

a. Wildland 10 %
b. Agricultural land 90 %
c. high-intensity forestry _____ %
d. developed _____ %

20. Preservation Status:

Cat	* %	*Description of preservation status
6	100	not protected by owner

21. Regulatory protections in force:

None known.

22. Threats:

The threat of logging is always present as it is with most natural areas. Possible widening to four-lanes of the US 64 highway would remove a significant portion of the high-quality natural area. Additional clearing for agriculture is possible on the upland portions of the tract.

23. Management and Preservation Recommendation:

The area could be protected if included in the North Carolina Natural Heritage Program's Registry of Natural Heritage Areas. The primary landowners should be contacted about a possible registry agreement.

It is recommended that the tract be set aside in its present undisturbed condition and managed as a state or county natural area. The site would make an ideal location for a county or regional park as long as construction of parking lots and other facilities was limited to already cleared upland areas adjacent to the natural area. A series of interpretive trails could be built which illustrate the natural history of the area.

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 1

Community type: Nyssa aquatica/Saururus cernuus or Nyssa aquatica

Community cover type: Nyssa aquatica

General habitat feature: alluvial swamp

Average canopy height: 60-70 feet

Estimated age of canopy trees: unknown

Canopy cover: closed

Estimated size of community: 72 acres

Successional stage: Climax

Common canopy species in community cover or community type (but not dominant): Taxodium distichum

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant):

Itea virginica
Fraxinus caroliniana

Common herb stratum species in community cover or community type (but not dominant):

Carex spp.

Vines: Rhus radicans

Natural Characteristics Summary

24a. Vegetation - Biotic Community Summary CT 2

Community type: mixed upland hardwoods/Fagus grandifolia transgressives or Ostrya virginiana

Community cover type: Mixed upland hardwoods

General habitat feature: upland slopes

Average canopy height: 60-70 feet

Estimated age of canopy trees: unknown

Canopy cover: closed

Estimated size of community: 77 acres

Successional stage: climax

Common canopy species in community cover or community type (but not dominant): Fagus grandifolia, Quercus alba, (two preceding species most common), Liriodendron tulipifera, Carya glabra, Carya tomentosa, Pinus taeda, Quercus falcata var. falcata

Common sub-canopy or shrub stratum species in community cover or community type (but not dominant): Nyssa sylvatica, Cornus florida, Carpinus caroliniana, Symplocos tinctoria, Ilex opaca, Oxydendron arboreum, Stewartia malacodendron

Common herb stratum species in community cover or community type (but not dominant): Hexastylis arifolia, Mitchella repens, Thelypteris noveboracensis, Athyrium asplenioides

24b. Soil Summary (by community type) CT 1

Soil series: Dorovan mucky silt loam, overwash

Soil classification: Dysic, thermic Typic Medisaprists

Soil association: Dorovan

pH class: Very strongly to extremely acid

Source of information: Soil Survey of Washington County, N.C. USDA, 1981

Other notes:

24c. Hydrology Summary (by community type) CT 1

Hydrologic system: Riverine

Hydrologic subsystem: Lower perennial

Water chemistry: Fresh

Water regime: Seasonally flooded

Drainage class: Very poorly drained

Drainage basin: Chapel Swamp -- Albemarle Sound

Hydrology characterization: A very poorly drained, seasonally flooded, freshwater, lower perennial riverine system.

24b. Soil Summary (by community type) CT 2

Soil series: Altavista fine sandy loam
Dogue fine sandy loam
Wahee fine sandy loam

Soil classification: Altavista = fine-loamy, mixed, thermic Aquic Hapludults
Dogue = Clayey, mixed, thermic Aquic Hapludults
Wahee = Clayey, mixed, thermic Aeric Ochraquults

Soil association: Augusta - Altavista - Wahee

pH class: Extremely acid to medium acid

Source of information: Soil Survey of Washington County, N.C. USDA, 1981

Other notes:

24c. Hydrology Summary (by community type) CT 2

Hydrologic system: Terrestrial

Hydrologic subsystem: Mesic to Dry - mesic

Water chemistry: Fresh

Water regime: Not applicable

Drainage class: Somewhat poorly drained (Wahee) to moderately well-drained (Altavista and Dogue)

Drainage basin: Chapel Swamp drains directly into Albemarle Sound

Hydrology characterization: A somewhat poorly drained to moderately well-drained, mesic to dry-mesic terrestrial system.

24d. Topography Summary:

	CT 1	CT 2
Landform:	alluvial floodplain	stream drainage slopes
Shelter:	Sheltered	Sheltered
Aspect:	Not applicable	All aspects but mainly south
Slope Angle:	Not applicable	Gently sloping (2-6°)
Profile:	Flat	Constant and convex
Surface patterns:	Smooth	Smooth
Position:	Entire floodplain	Entire slope

25. Physiographic characterization of natural area:

Climax communities along the slopes and floodplain of the Chapel Swamp drainage, and situated on the Pamlico Terrace of the Coastal Plain province of the Atlantic Plain.

Geological Formation:

Marine sediments of the Pamlico Terrace.

Geological Formation age:

Pleistocene = 100,000 yrs. B.P.
to Recent = less than 6000 yrs. B.P.

References Cited:

Ingram, R. L. and L. J. Otte. 1982. Peat Deposits of Pamlimarle Peninsula, North Carolina. U.S. Department of Energy Contract DE-AC18-79FC14693.36 pp.

26. Summary - Endangered and threatened species

Name of species: Red-shouldered Hawk

Species legal status and authority: Listed as Threatened in N.C. by Cooper, et al (1977).

Number of populations on site: one

Number of individuals per population: 1-2

Size or Maturity of individuals: adults

Phenology of population: N/A

Eg: vegetative %
flowering %
fruiting %

General vigor of population: Excellent

Disturbance or threats to population: Clearcutting

Habitat characteristics

Plant community: CT 1, CT 2

Topography: n/a

Soil Series: n/a

Microclimate: n/a

Drainage basin: n/a

Other plants and animal species present: See Master Species List.

AERIAL OR DETAILED MAPS WITH POPULATIONS CLEARLY MARKED.

27. Master species lists:

VASCULAR PLANTS
(listed alphabetically by family)

ACERACEAE
  Acer rubrum
ALISMATACEAE
  Echinodorus cordifolius
ANACARDIACEAE
  Rhus radicans
ANNONACEAE
  Asimina parviflora
AQUIFOLIACEAE
  Ilex opaca
  Ilex decidua
ARACEAE
  Arisaema triphyllum
  Peltandra virginica
ARISTOLOCHIACEAE
  Hexastylis arifolia
  H. virginica
ASPIDIACEAE
  Athyrium asplenioides
  Dryopteris celsa
  Polystichum acrostichoides
  Thelypteris noveboracensis
ASPLENIACEAE
  Asplenium platyneuron
ASTERACEAE
  Prenanthes sp.
BERBERIDACEAE
  Podophyllum peltatum
BETULOCEAE
  Corylus americana
  Carpinus caroliniana
  Ostrya virginiana
BIGNONIACEAE
  Anisostichus capreolata
  Campsis radicans
BLECHNACEAE
  Woodwardia areolata
BROMELIACEAE
  Tillandsia usneoides
CAMPANULACEAE
  Lobelia cardinalis
CAPRIFOLIACEAE
  Lonicera japonica
  Viburnum nudum

CELASTRACEAE
  Euonymus americanus
CORNACEAE
  Cornus florida
CUPRESSACEAE
  Juniperus virginiana
CYPERACEAE
  Carex spp.
DIOSCOREACEAE
  Dioscorea villosa
ERICACEAE
  Chimaphila maculata
  Leucothoe axillaris
  Oxydendron arboreum
  Rhododendron atlanticum
  Rhododendron nudiflorum
  Vaccinium sp.
FAGACEAE
  Fagus grandifolia
  Quercus alba
  Q. falcata var. falcata
  Q. laurifolia
  Q. michauxii
  Q. nigra
  Q. velutina
HAMAMELIDACEAE
  Hamamelis virginiana
  Liquidambar styraciflua
JUGLANDACEAE
  Carya glabra
  C. tomentosa
LAURACEAE
  Sassafras albidum
LILIACEAE
  Smilacena racemosa
  Smilax bona-nox
  Uvularia sp.
LOGANIACEAE
  Gelsemium sempervirens
LORANTHACEAE
  Phoradendron serotinum
MAGNOLIACEAE
  Liriodendron tulipifera
  Magnolia virginiana
MORACEAE
  Morus rubra
NYSSACEAE
  Nyssa aquatica
  Nyssa sylvatica var. sylvatica
OLEACEAE
  Fraxinus caroliniana
  F. pennsylvanica

OPHIOGLOSSACEAE
  Botrychium sp.
ORCHIDACEAE
  Spiranthes cernuus
  Tipularia discolor
OROBANCHACEAE
  Epifagus virginiana
OSMUNDACEAE
  Osmunda cinnamomea
  O. regalis var. spectabilis
PINACEAE
  Pinus echinata
  P. taeda
POACEAE
  Arundinaria gigantea
POLYPODIACEAE
  Polypodium polypodioides
PTERIDACEAE
  Pteridium aquilinum
ROSACEAE
  Prunus serotina
RUBIACEAE
  Mitchella repens
SALICACEAE
  Populus heterophylla
SAURURACEAE
  Saururus cernuus
SAXIFRAGACEAE
  Decumaria barbara
  Itea virginica
STYRACACEAE
  Styrax sp.
SYMPLOCACEAE
  Symplocos tinctoria
TAXODIACEAE
  Taxodium distichum
THEACEAE
  Stewartia malacodendron
VIOLACEAE
  Viola primulifolia
VITACEAE
  Parthenocissus quinquefolia
  Vitis sp.

AMPHIBIANS

Southern Leopard Frog
Fowler's Toad

REPTILES

Eastern Box Turtle
Eastern Mud Turtle
Snapping Turtle
Red-bellied Watersnake

BIRDS

(Emphasis of bird lists is on breeding or summering species; lack of adequate field work during the other seasons prevented compilation of a complete list.)

KEY

PR = Permanent resident
SR = Summer resident
WR = Winter resident
T = Transient; spring or fall
PV, SV, WV - Visitor; permanent, summer, or winter
* = Breeding or suspected breeding at site

Red-shouldered Hawk	PR*
Common Bobwhite	PR*
Mourning Dove	PR*
Yellow-billed Cuckoo	SR*
Barred Owl	PR*
Chimney Swift	SV
Ruby-throated Hummingbird	SR*
Common Flicker	PR*
Pileated Woodpecker	PR*
Red-bellied Woodpecker	PR*
Hairy Woodpecker	PR*
Downy Woodpecker	PR*
Great Crested Flycatcher	SR*
Acadian Flycatcher	SR*
Eastern Pewee	SR*
Blue Jay	PR*
Common Crow	PR*
Fish Crow	PV
Carolina Chickadee	PR*

Tufted Titmouse	PR*
White-breasted Nuthatch	PR*
Red-breasted Nuthatch	WR
Carolina Wren	PR*
Wood Thrush	SR*
Veery	T
Blue-gray Gnatcatcher	SR*
Golden-crowned Kinglet	WR
Ruby-crowned Kinglet	WR
Red-eyed Vireo	SR*
Prothonotary Warbler	SR*
Northern Parula Warbler	SR*
Black-throated Blue Warbler	T
Yellow-throated Warbler	SR*
Blackpoll Warbler	T
Ovenbird	SR*
American Redstart	T
Common Grackle	PV
Brown-headed Cowbird	PR*
Summer Tanager	SR*
Northern Cardinal	PR*
Evening Grosbeak	WV

MAMMALS

Eastern Gray Squirrel (seen)
Marsh Rabbit (seen)

BIBLIOGRAPHY

Aiken, S. G. 1981. A Conspectus of Myriophyllum (Haloragaceae) in North America. Brittonia 33: 57-69.

Ashe, W. W. 1894. Forests, Forest Lands and Forest Products of Eastern North Carolina. N.C. Geological Survey Bulletin No. 5. Raleigh, N.C.

_____. 1915. Loblolly or North Carolina Pine - Its Growth and Management. N.C. Geological and Economic Survey Bulletin No. 24. Raleigh, N.C.

Buell, M. F. and R. L. Cain. 1943. The Successional Role of Southern White Cedar, Chamaecyparis thyoides, in Southeastern North Carolina. Ecology 24: 85-93.

Cooper, J. E., S. S. Robinson, and J. B. Funderburg (Eds.). 1977. Endangered and Threatened Plants and Animals of North Carolina. N.C. State Museum of Natural History, Raleigh, N.C. 444 pp + i-xvi.

Erlich, R. N. 1980. Early Holocene to Recent Development and Sedimentation of the Roanoke River Area, North Carolina. Unpublished dissertation, Dept. of Geology, UNC-Chapel Hill.

Ingram, R. L., and L. J. Otte. 1982. Peat Deposits of Pamlimarle Peninsula-Dare, Hyde, Tyrrell, and Washington Counties, North Carolina. Prepared for the U.S. Dept. of Energy and the N.C. Energy Institute. 36 pp. + 1 map.

Kologiski, R. L. 1977. The Phytosociology of the Green Swamp, North Carolina. N.C. Agricult. Exp. Sta. Bull. No. 250. 101 pp.

Lindquist, D. G. and C. G. Yarbrough. 1981. Status of the Rare and Endangered Fauna of Lake Waccamaw, North Carolina. Quarterly Progress Report to the N.C. Wildlife Resources Commission. Raleigh, N.C.

Lynch, J. M. 1981. Roanoke River Preserve Design Report. N.C. Natural Heritage Program, N.C. Dept. of Natural Resources and Community Development, Raleigh, N.C. 198 pp.

Martof, Bernard S., W. M. Palmer, J. R. Bailey, and J. R. Harrison. 1980. Amphibians and Reptiles of the Carolinas and Virginia. UNC Press, Chapel Hill. 264 pp.

Mixon, R. B. and O. H. Pilkey. 1976. Reconnaissance Geology of the Submerged and Emerged Coastal Plain Province, Cape Lookout Area, North Carolina. Geological Survey Paper 859. U.S. Gov't. Printing Office, Washington, D.C. 45 pp.

N.C. Department of Agriculture; Plant Protection Program. In preparation. Endangered, threatened and rare plants of North Carolina: A revised list.

N.C. Department of Natural Resources and Community Development. 1977. Pettigrew State Park Master Plan. Div. of Parks and Recreation, Master Plan Unit. Raleigh, N.C.

Otte, L. J. 1981. Origin, Development, and Maintenance of the Pocosin Wetlands of North Carolina. N.C. Natural Heritage Program, N.C. Department of Natural Resources and Community Development, Raleigh, N.C. 51 pp.

Otte, L. J. and R. L. Ingram. 1980. Peat Resources of North Carolina. 1980 Annual Report to N.C. Energy Institute, U.S. Dept. of Energy. DE-ACol-79ET-14693. 60 pp.

Peterson, R. T. 1980. A Field Guide to the Birds. Houghton-Mifflin Co., Boston.

Pinchot, G. and W. W. Ashe. 1897. Timber Trees and Forests of North Carolina. N.C. Geological Survey Bulletin No. 6. Raleigh, N.C.

Radford, A. E., H. E. Ahles, and C. R. Bell. 1968. Manual of the Vascular Flora of the Carolinas. UNC Press, Chapel Hill. 1183 pp.

Richardson, C. J. 1981. Pocosin Wetlands. Hutchinson Ross Publishing Company. Stroudsburg, Pa. 364 pp.

Soil Conservation Service. 1981. Soil Survey of Washington County. SCS, U.S. Department of Agriculture, Washington, D.C. 98 pp.

Wells, B. W. 1942. Ecological Problems of the Southeastern United States Coastal Plain. Botanical Review 8: 533-561.

_____. 1967. The Natural Gardens of North Carolina. UNC Press, Chapel Hill. 458 pp.

GLOSSARY

(from Bellis *et al.*, 1975)

Area of Environmental Concern-(AEC) Especially fragile or ecologically unique areas of the North Carolina Coast where development should occur only if it is in harmony with natural processes. Areas of the coast where the public welfare might be endangered by unwise manipulation of the environment.

BP - Before present.

canopy - A layer of leaves and branches formed by the interlocking mosaic of tree tops in a forest.

Coastal Area Management Act of 1974 - An act passed by the North Carolina legislature in 1974 intended to promote wise development of North Carolina'a coastal resources. Among other provisions this act calls for the designation of certain especially sensitive areas as 'Areas of Environmental Concern.'

cypress fringe - A straight or curved line of cypress running parallel to the shoreline. Older cypress fringe has its trees standing in water while young cypress fringe occupies sandy beaches in front of eroding sand or clay banks.

dbh - Diameter at breast height (diameter of tree in inches measured at a point 4.5 feet above the ground).

ecological succession - Process by which one community of living organisms is gradually replaced by another. Usually each successive community is more stable than the last, thus leading toward a final community especially well suited to the particular environmental conditions existing at that location.

flood plain - Lowlands adjacent to a river or stream which become inundated during periods of high flow. Flood plains are a natural component of the river system and function as overflow storage areas.

msl - Mean sea level.

Pamlico Terrace - A low, flat, featureless, topographic surface extending over the Coastal Plain of the Southeastern U.S. at elevations less than 20 feet above sea level. It is considered the relict sea floor of the Sangamon Interglacial.

Pamlimarle Peninsula - The peninsula bounded on the north by Albemarle Sound and on the south by the Pamlico River. Includes all of Washington, Beaufort, and mainland portions of Dare and Hyde Counties.

peat - Accumulations of slowly decomposing plant remains. Peat is formed in swamps and marshes. Erosion of peat soils releases suspended organic matter into coastal waters as well as certain 'humic acids' which give water a tea colored stain.

Pleistocene Epoch - That period of earth history which saw the advance and retreat of the four great Ice Ages. It is generally considered to have begun between 1 and 2 million years ago and to have continued up until about 18,000 years ago.

relict beach ridge - Throughout the Southeastern U.S. ancient shorelines are detected at various elevations inland from the coast. These shorelines are often manifested as continuous ridges and are considered a product of higher stands of the sea during the Pleistocene Ice Ages.

Sangamon Interglacial - A period of deglaciation (no continental ice sheets) during the Pleistocene Epoch between the Illinoian and Wisconsin Ice Ages. This period is generally considered to have taken place about 80-100,000 years ago.

sp and spp - Species (singular and plural).

Suffolk Scarp - A topographic ridge rising from 20 to 40 feet above sea level which runs parallel to the coast throughout North Carolina. It is considered an ancient shoreline formed during the Pleistocene Epoch.

swamp forest - Type of forest characterized by seasonal flooding and water saturated organic soils. Water tupelo, swamp black gum and bald cypress are dominant tree species.

Talbot (Chowan) Terrace - A rather flat but stream-dissected surface lying at an average elevation of 40-45 feet throughout Southeastern United States. It is considered to have been a sea floor during the Pleistocene Epoch. In North Carolina it lies west of the topographic ridge known as the Suffolk Scarp.

Yorktown Formation - An ancient deposit of clay and clayey sand which typically contains abundant marine fossils including clams, snails, whale vertebrae, and shark teeth. It occurs extensively over eastern North Carolina and is generally considered a depositional product of the Miocene Epoch which took place 15-20 million years ago.

CEIP Publications

1. Hauser, E. W., P. D. Cribbins, P. D. Tschetter, and R. D. Latta. Coastal Energy Transportation Needs to Support Major Energy Projects in North Carolina's Coastal Zone. CEIP Report #1. September 1981. $10.

2. P. D. Cribbins. A Study of OCS Onshore Support Bases and Coal Export Terminals. CEIP Report #2. September 1981. $10.

3. Tschetter, P. D., M. Fisch, and R. D. Latta. An Assessment of Potential Impacts of Energy-Related Transportation Developments on North Carolina's Coastal Zone. CEIP Report #3. July 1981. $10.

4. Cribbins, P. S. An Analysis of State and Federal Policies Affecting Major Energy Projects in North Carolina's Coastal Zone. CEIP Report #4. September 1981. $10.

5. Brower, David, W. D. McElyea, D. R. Godschalk, and N. D. Lofaro. Outer Continental Shelf Development and the North Carolina Coast: A Guide for Local Planners. CEIP Report #5. August 1981. $10.

6. Rogers, Golden and Halpern, Inc., and Engineers for Energy and the Environment, Inc. Mitigating the Impacts of Energy Facilities: A Local Air Quality Program for the Wilmington, N. C. Area. CEIP Report #6. September 1981. $10.

7. Richardson, C. J. (editor). Pocosin Wetlands: an Integrated Analysis of Coastal Plain Freshwater Bogs in North Carolina. Stroudsburg (Pa): Hutchinson Ross. 364 pp. $25. Available from School of Forestry, Duke University, Durham, N. C. 27709. (This proceedings volume is for a conference partially funded by N. C. CEIP. It replaces the N. C. Peat Sourcebook in this publication list.)

8. McDonald, C. B. and A. M. Ash. Natural Areas Inventory of Tyrrell County, N. C. CEIP Report #8. October 1981. $10.

9. Fussell, J., and E. J. Wilson. Natural Areas Inventory of Carteret County, N. C. CEIP Report #9. October 1981. $10.

10. Nyfong, T. D. Natural Areas Inventory of Brunswick County, N. C. CEIP Report #10. October 1981. $10.

11. Leonard, S. W., and R. J. Davis. Natural Areas Inventory for Pender County, N. C. CEIP Report #11. October 1981. $10.

12. Cribbins, Paul D., and Latta, R. Daniel. Coastal Energy Transportation Study: Alternative Technologies for Transporting and Handling Export Coal. CEIP Report #12. January 1982. $10.

13. Creveling, Kenneth. Beach Communities and Oil Spills: Environmental and Economic Consequences for Brunswick County, N. C. CEIP Report #13. May 1982. $10.

CEIP Publications

14. Rogers, Golden and Halpern, Inc., and Engineers for Energy and the Environment. The Design of a Planning Program to Help Mitigate Energy Facility-Related Air Quality Impacts in the Washington County, North Carolina Area. CEIP Report #14. September 1982. $10.

15. Fussell, J., C. B. McDonald, and A. M. Ash. Natural Areas Inventory of Craven County, North Carolina. CEIP Report #15. October 1982. $10.

16. Frost, Cecil C. Natural Areas Inventory of Gates County, North Carolina. CEIP Report #16. April 1982. $10.

17. Stone, John R., Michael T. Stanley, and Paul T. Tschetter. Coastal Energy Transportation Study, Phase III, Volume 3: Impacts of Increased Rail Traffic on Communities in Eastern North Carolina. CEIP Report #17. August 1982. $10.

19. Pate, Preston P., and Jones, Robert. Effects of Upland Drainage on Estuarine Nursery Areas of Pamlico Sound, North Carolina. CEIP Report #19. December 1981. $1.00.

25. Wang Engineering Co., Inc. Analysis of the Impact of Coal Trains Moving Through Morehead City, North Carolina. CEIP Report #25. October 1982. $10.

26. Anderson & Associates, Inc. Coal Train Movements Through the City of Wilmington, North Carolina. CEIP Report #26. October 1982. $10.

27. Peacock, S. Lance and J. Merrill Lynch. Natural Areas Inventory of Mainland Dare County, North Carolina. CEIP Report #27. November 1982. $10.

28. Lynch, J. Merrill and S. Lance Peacock. Natural Areas Inventory of Hyde County, North Carolina. CEIP Report #28. October 1982. $10.

29. Peacock, S. Lance and J. Merrill Lynch. Natural Areas Inventory of Pamlico County, North Carolina. CEIP Report #29. November 1982. $10.

30. Lynch, J. Merrill and S, Lance Peacock. Natural Areas Inventory of Washington County, North Carolina. CEIP Report #30. October 1982. $10.

31. Muga, Bruce J. Review and Evaluation of Oil Spill Models for Application to North Carolina Waters. CEIP Report #31. August 1982. $10.

33. Sorrell, F. Yates and Richard R. Johnson. Oil and Gas Pipelines in Coastal North Carolina: Impacts and Routing Considerations. CEIP Report #33. December 1982. $10.

34. Roberts and Eichler Associates, Inc. Area Development Plan for Radio Island. CEIP Report #34. June 1983. $10.

35. Cribbins, Paul D. Coastal Energy Transportation Study, Phase III, Volume 4: The Potential for Wide-Beam, Shallow-Draft Ships to Serve Coal and Other Bulk Commodity Terminals along the Cape Fear River. CEIP Report #35. August 1982. $10.

DATE DUE

GAYLORD	No. 2333		PRINTED IN U.S.A.

NOAA COASTAL SERVICES CENTER LIBRARY

3 6668 14106 2143