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Shoreline Situation Report CITY OF VIRGINIA BEACH



Prepared and Published With Funds Provided to the Commonwealth by the Office of Coastal Zone Management,
National Oceanic and Atmospheric Administration, Grant Nos. 04-7-158-44041 and 04-8-MO1-309

Special Report In Applied Marine Science and Ocean Engineering Number 163 of the

VIRGINIA INSTITUTE OF MARINE SCIENCE
Gloucester Point, Virginia 23062

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CHAPTER 1

Introduction

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INTRODUCTION

1.1 PURPOSES AND GOALS

It is the objective of this report to supply an assessment, and at least a partial integration, of those important shoreland parameters and characteristics which will aid the planners and the managers of the shorelands in making the best decisions for the utilization of this limited and very valuable resource. The report gives particular attention to the problem of shore erosion and to recommendations concerning the alleviation of the impact of this problem. In addition, we have tried to include in our assessment a discussion of those factors which might significantly limit development of the shoreline and, in some instances, a discussion of some of the potential or alternate uses of the shoreline, particularly with respect to recreational use, since such information could aid potential users in the perception of a segment of the shoreline.

The basic advocacy of the authors in the preparation of the report is that the use of shorelands should be planned rather than haphazardly developed in response to the short term pressures and interests. Careful planning could reduce the conflicts which may be expected to arise between competing interests. Shoreland utilization in many areas of the country, and indeed in some places in Virginia, has proceeded in a manner such that the very elements which attracted people to the shore have been destroyed by the lack of planning and forethought.

The major man-induced uses of the shorelands are:

- Residential, commercial, or industrial development
- Recreation
- Transportation
- Waste disposal
- Extraction of living and non-living resources

Aside from the above uses, the shorelands serve various ecological functions.

The role of planners and managers is to optimize the utilization of the shorelands and to minimize the conflicts arising from competing demands. Furthermore, once a particular use has been decided upon for a given segment of shoreland, both the planners and the users want that selected use to operate in the most effective manner. A park planner, for example, wants the allotted space to fulfill the design most efficiently. We hope that the results of our work are useful to the planner in designing the beach by pointing out the technical feasibility of altering or enhancing the present configuration of the shore zone. Alternately, if the use were a residential development, we would hope our work would be useful in specifying the shore erosion problem and by indicating defenses likely to succeed in containing the erosion. In summary our objective is to provide a useful tool for enlightened utilization of a limited resource, the shorelands of the Commonwealth.

Shorelands planning occurs, either formally or informally, at all levels from the private owner of shoreland property to county governments, to planning districts and to the state and federal agency level. We feel our results will be useful at all these levels. Since the most basic level of comprehensive planning and zoning is at the county or city level, we have executed our report on that level although we realize some of the information may be most useful at a higher governmental level. The Commonwealth of Virginia has traditionally chosen to place as much as possible, the regulatory decision processes at the county level. The Virginia Wetlands Act of 1972 (Chapter 2.1, Title 62.1, Code of Virginia), for example, provides for the establishment of County Boards to act on applications for alterations of wetlands. Thus, our focus at the county level is intended to interface with and to support the existing or pending county regulatory mechanisms concerning activities in the shorelands zone.

1.2 ACKNOWLEDGEMENTS

This report has been prepared and published with funds provided to the Commonwealth by the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, grant number 04-7-158-44041. The Shoreline Situation Report series was originally developed in the Wetlands/Edges Program of the Chesapeake Research Consortium, Inc., as supported by the Research Applied to National Needs (RANN) program of the National Science Foundation. The completion of this report would have been impossible without the expert services of Beth Marshall, who typed several drafts of the manuscript, Bill Jenkins and Ken Thornberry, who prepared the photographs, and Sam White, who piloted the aircraft on the many photo acquisition and reconnaissance flights. We especially thank the Southeastern Virginia Planning District Commission for its assistance in the assimilation of information. Also we thank the numerous other persons who, through their direct aid, criticisms, and suggestions, have assisted our work.

CHAPTER 2
Approach Used and Elements Considered

CHAPTER 2

APPROACH USED AND ELEMENTS CONSIDERED

2.1 APPROACH TO THE PROBLEM

In the preparation of this report the authors utilized existing information wherever possible. For example, for such elements as water quality characteristics, zoning regulations, or flood hazard, we reviewed relevant reports by local, state, or federal agencies. Much of the desired information, particularly with respect to erosional characteristics, shoreland types, and use was not available, so we performed the field work and developed classification schemes. In order to analyze successfully the shoreline behavior we placed heavy reliance on low altitude, oblique, color, 35 mm photography. We photographed the entire shoreline of each county and cataloged the slides for easy access at VIMS, where they remain available for use. We then analyzed these photographic materials, along with existing conventional aerial photography and topographic and hydrographic maps, for the desired elements. We conducted field inspection over much of the shoreline, particularly at those locations where office analysis left questions unanswered. In some cases we took additional photographs along with the field visits to document the effectiveness of shoreline defenses.

The basic shoreline unit considered is called a subsegment, which may range from a few hundred feet to several thousand feet in length. The end points of the subsegments were generally chosen on physiographic consideration such as changes in the character of erosion or deposition. In those cases where a radical change in land use occurred, the point of change was taken as a boundary point of the subsegment. Segments are groups of subsegments. The boundaries for segments also were selected on physiographic units such as necks or peninsulas between major tidal creeks. Finally, the county itself is considered as a sum of shoreline segments.

The format of presentation in the report follows a sequence from general summary statements for the county (Chapter 3) to tabular segment summaries and finally detailed descriptions and maps for each subsegment (Chapter 4). The purpose in choosing this format was to allow selective use

of the report since some users' needs will adequately be met with the summary overview of the county while others will require the detailed discussion of particular subsegments.

2.2 CHARACTERISTICS OF THE SHORELANDS INCLUDED IN THE STUDY

The characteristics which are included in this report are listed below followed by a discussion of our treatment of each.

- a) Shorelands physiographic classification
- b) Shorelands use classification
- c) Shorelands ownership classification
- d) Zoning
- e) Water quality
- f) Shore erosion and shoreline defenses
- g) Limitations to shore use and potential or alternate shore uses
- h) Distribution of marshes
- i) Flood hazard levels
- j) Shellfish leases and public shellfish grounds
- k) Beach quality

a) Shorelands Physiographic Classification

The shorelands of the Chesapeake Bay System may be considered as being composed of three interacting physiographic elements: the fastlands, the shore and the nearshore. A graphic classification based on these three elements has been devised so that the types for each of the three elements portrayed side by side on a map may provide the opportunity to examine joint relationships among the elements. As an example, the application of the system permits the user to determine miles of high bluff shoreland interfacing with marsh in the shore zone.

For each subsegment there are two length measurements, the shore-nearshore interface or shoreline, and the fastland-shore interface. The two interface lengths differ most when the shore zone is embayed or extensive marsh. On the subsegment maps, a dotted line represents the fastland-shore interface when it differs from the shoreline. The fastland-shore interface length is the base for the fastland statistics.

Definitions:

Shore Zone

This is the zone of beaches and marshes. It is a buffer zone between the water body and the fastland. The seaward limit of the shore zone is the break in slope between the relatively steeper shoreface and the less steep nearshore zone. The approximate landward limit is a contour line representing one and a half times the mean tide range above mean low water (refer to Figure 1). In operation with topographic maps the inner fringe of the marsh symbols is taken as the landward limit.

The physiographic character of the marshes has also been separated into three types (see Figure 2). Fringe marsh is that which is less than 400 feet in width and which runs in a band parallel to the shore. Extensive marsh is that which has extensive acreage projecting into an estuary or river. An embayed marsh is a marsh which occupies a reentrant or drowned creek valley. The purpose in delineating these marsh types is that the effectiveness of the various functions of the marsh will, in part, be determined by type of exposure to the estuarine system. A fringe marsh may, for example, have maximum value as a buffer to wave erosion of the fastland. An extensive marsh, on the other hand, is likely a more efficient transporter of detritus and other food chain materials due to its greater drainage density than an embayed marsh. The central point is that planners, in the light of ongoing and future research, will desire to weight various functions of marshes and the physiographic delineation aids their decision making by denoting where the various types exist. The classification used is:

Beach

Marsh

Fringe marsh, < 400 ft. (122 m) in width
along shores

Extensive marsh

Embayed marsh, occupying a drowned valley
or reentrant

Artificially stabilized

Fastland Zone

The zone extending from the landward limit of the shore zone is termed the fastland. The fastland is relatively stable and is the site of most material development or construction. The

physiographic classification of the fastland is based upon the average slope of the land within 400 feet (122 m) of the fastland - shore boundary.

The general classification is:

- Low shore, 20 ft. (6 m) or less of relief; with or without cliff
- Moderately low shore, 20-40 ft. (6-12 m) of relief; with or without cliff
- Moderately high shore, 40-60 ft. (12-18 m) of relief; with or without cliff
- High shore, 60 ft. (18 m) or more of relief; with or without cliff.

Two specially classified exceptions are sand dunes and areas of artificial fill.

Nearshore Zone

The nearshore zone extends from the shore zone to the 12-foot (MLW datum) contour. In the smaller tidal rivers the 6-foot depth is taken as the reference depth. The 12-foot depth is probably the maximum depth of significant sand transport by waves in the Chesapeake Bay area. Also, the distinct drop-off into the river channels begins roughly at the 12-foot depth. The nearshore zone includes any tidal flats.

The class limits for the nearshore zone classifications were chosen following a simple statistical study. The distance to the 12-foot underwater contour (isobath) was measured on the appropriate charts at one-mile intervals along the shorelines of Chesapeake Bay and the James, York, Rappahannock, and Potomac Rivers. Means and standard deviations for each of the separate regions and for the entire combined system were calculated and compared. Although the distributions were non-normal, they were generally comparable, allowing the data for the entire combined system to determine the class limits.

The calculated mean was 919 yards with a standard deviation of 1,003 yards. As our aim was to determine general, serviceable class limits, these calculated numbers were rounded to 900 and 1,000 yards respectively. The class limits were set at half the standard deviation (500 yards) each side of the mean. Using this procedure a narrow nearshore zone is one 0-400 yards in width, intermediate 400-1,400, and wide greater than 1,400.

The following definitions have no legal significance and were constructed for our classification

purposes:

- Narrow, 12-ft. (3.7 m) isobath located < 400 yards from shore
- Intermediate, 12-ft. (3.7 m) isobath 400-1,400 yards from shore
- Wide, 12-ft. (3.7 m) isobath > 1,400 yards from shore

- Subclasses: with or without bars
- with or without tidal flats
- with or without submerged vegetation

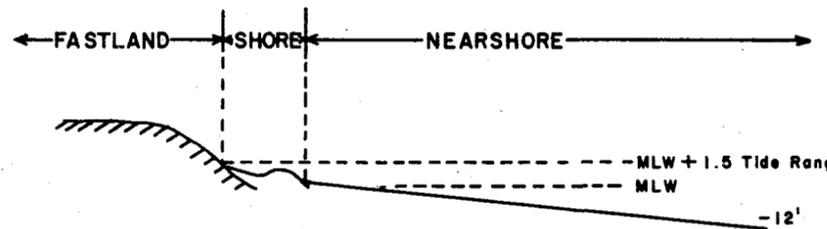


Figure 1

A profile of the three shorelands types.

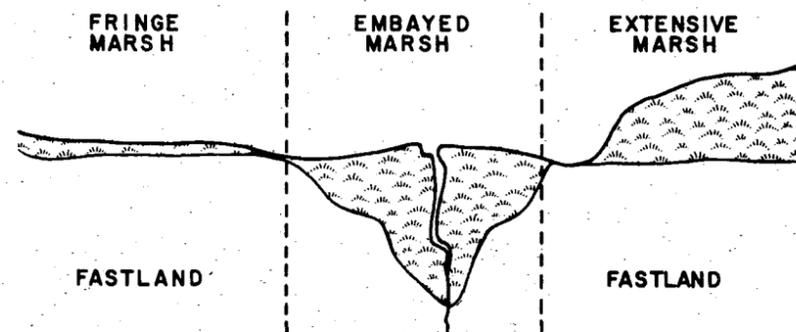


Figure 2

A plan view of the three marsh types.

b) Shorelands Use Classification

Fastland Zone

Residential

Includes all forms of residential use with the exception of farms and other isolated dwellings. In general, a residential area consists of four or more residential buildings adjacent to one another. Schools, churches, and isolated businesses may be included in a residential area.

Commercial

Includes buildings, parking areas, and other land directly related to retail and wholesale trade and business. This category includes small industry and other anomalous areas within the general commercial context. Marinas are considered commercial shore use.

Industrial

Includes all industrial and associated areas. Examples: warehouses, refineries, shipyards, power plants, railyards.

Governmental

Includes lands whose usage is specifically controlled, restricted, or regulated by governmental organizations: e.g., Camp Peary, Fort Story. Where applicable, the Governmental use category is modified to indicate the specific character of the use, e.g., residential, direct military, and so forth.

Recreational and Other Public Open Spaces

Includes designated outdoor recreation lands and miscellaneous open spaces. Examples: golf courses, tennis clubs, amusement parks, public beaches, race tracks, cemeteries, parks.

Preserved

Includes lands preserved or regulated for

environmental reasons, such as wildlife or wildfowl sanctuaries, fish and shellfish conservation grounds, or other uses that would preclude development.

Agricultural

Includes fields, pastures, croplands, and other agricultural areas.

Unmanaged

Includes all open or wooded lands not included in other classifications:

- a) Open: brush land, dune areas, wastelands; less than 40% tree cover.
- b) Wooded: more than 40% tree cover.

The shoreland use classification applies to the general usage of the fastland area to an arbitrary distance of half mile from the shore or beach zone or to some less distant, logical barrier. In multi-usage areas one must make a subjective selection as to the primary or controlling type of usage. For simplicity and convenience, managed woodlands are classified as "unmanaged, wooded" areas.

Shore Zone

Bathing
Boat launching
Bird watching
Waterfowl hunting

Nearshore Zone

Pound net fishing
Shellfishing
Sport fishing
Extraction of non-living resources
Boating
Water sports

c) Shorelands Ownership Classification

The shorelands ownership classification used has two main subdivisions, private and governmental, with the governmental further divided into

federal, state, county, and town or city. Application of the classification is restricted to fastlands alone since the Virginia fastlands ownership extends to mean low water. All bottoms below mean low water are in State ownership.

d) Water Quality

The water quality sections of this report are based upon data abstracted from Virginia State Water Control Board's publication Water Quality Standards (November, 1974) and Water Quality Inventory (305 (b) Report) (April, 1976).

Additionally, where applicable, Virginia Bureau of Shellfish Sanitation data is used to assign ratings of satisfactory, intermediate, or unsatisfactory. These ratings are defined primarily in regard to number of coliform bacteria. For a rating of satisfactory the maximum limit is an MPN (Most Probable Number) of 70 per 100 ml. The upper limit for fecal coliforms is an MPN of 23. Usually any count above these limits results in an unsatisfactory rating, and, from the Bureau's standpoint, results in restricting the waters from the taking of shellfish for direct sale to the consumer.

There are instances however, when the total coliform MPN may exceed 70, although the fecal MPN does not exceed 23, and other conditions are acceptable. In these cases an intermediate rating may be assigned temporarily, and the area will be permitted to remain open pending an improvement in conditions.

Although the shellfish standards are somewhat more stringent than most of the other water quality standards, they are included because of the economic and ecological impacts of shellfish ground closures. Special care should be taken not to endanger the water quality in existing "satisfactory" areas.

e) Zoning

In cases where zoning regulations have been established the existing information pertaining to the shorelands has been included in the report.

f) Shore Erosion and Shoreline Defenses

The following ratings are used for shore erosion:

- slight or none - less than 1 foot per year
- moderate - - - - 1 to 3 feet per year
- severe - - - - - greater than 3 feet per year

The locations with moderate and severe ratings are further specified as being critical or non-critical. The erosion is considered critical if buildings, roads, or other such structures are endangered.

The degree of erosion was determined by several means. In most locations the long term trend was determined using map comparisons of shoreline positions between the 1850's and the 1940's. In addition, aerial photographs of the late 1930's and recent years were utilized for an assessment of more recent conditions. Finally, in those areas experiencing severe erosion field inspections and interviews were held with local inhabitants.

The existing shoreline defenses were evaluated as to their effectiveness. In some cases repetitive visits were made to monitor the effectiveness of recent installations. In instances where existing structures are inadequate, we have given recommendations for alternate approaches. Furthermore, recommendations are given for defenses in those areas where none currently exist. The primary emphasis is placed on expected effectiveness with secondary consideration to cost.

g) Limitations to Shore Use and Potential or Alternate Shore Uses

In this section we point out specific factors which may impose significant limits on the type or extent of shoreline development. This may result in a restatement of other factors from elsewhere in the report, e.g., flood hazard or erosion, or this may be a discussion of some other factor pertaining to the particular area.

Also we have placed particular attention on the recreational potential of the shore zone. The possible development of artificial beach, erosion protection, etc., influence the evaluation of an area's potential. Similarly, potential alternate shore uses are occasionally noted.

h) Distribution of Marshes

The acreage and physiographic type of the marshes in each subsegment is listed. These estimates of acreages were obtained from topographic maps and should be considered only as approximations. Detailed county inventories of the wetlands are being conducted by the Virginia Institute of Marine Science under the authorization of the Virginia Wetlands Act of 1972 (Code of Virginia 62.1-13.4). These surveys include detailed acreages of the grass species composition within individual marsh systems. In Shoreline Situation Reports of counties that have had marsh inventories, the marsh number is indicated, thus allowing the user of the Shoreline Situation Report to key back to the formal marsh inventory for additional data. The independent material in this report is provided to indicate the physiographic type of marsh land and to serve as a rough guide to marsh distribution, pending a formal inventory. Additional information on wetlands characteristics may be found in Coastal Wetlands of Virginia: Interim Report No. 3, by G.M. Silberhorn, G.M. Dawes, and T.A. Barnard, Jr., SRAMSOE No. 46, 1974, and in other VIMS publications.

i) Flood Hazard Levels

The assessment of tidal flooding hazard for the whole of the Virginia tidal shoreland is still incomplete. However, the United States Army Corps of Engineers has prepared reports for a number of localities which were used in this report. Two tidal flood levels are customarily used to portray the hazard. The Intermediate Regional Flood is that flood with an average recurrence time of about 100 years. An analysis of past tidal floods indicates it to have an elevation of approximately 8 feet above mean water level in the Chesapeake Bay area. The Standard Project Flood level is established for land planning purposes which is placed at the highest probable flood level.

j) Shellfish Leases and Public Grounds

The data in this report show the leased and public shellfish grounds as portrayed in the Virginia State Water Control Board publication "Shellfish growing areas in the Commonwealth of Virginia: Public, leased and condemned,"

November, 1971, and as periodically updated in other similar reports. Since the condemnation areas change with time they are not to be taken as definitive. However, some insight to the conditions at the date of the report are available by a comparison between the shellfish grounds maps and the water quality maps for which water quality standards for shellfish were used.

k) Beach Quality

Beach quality is a subjective judgment based upon considerations such as the nature of the beach material, the length and width of the beach area, and the general aesthetic appeal of the beach setting.

CHAPTER 3
Present Shorelands Situation

CHAPTER 3

PRESENT SHORELINE SITUATION OF
THE CITY OF VIRGINIA BEACH

3.1 THE SHORELANDS OF THE CITY OF VIRGINIA BEACH

The City of Virginia Beach occupies the extreme southeast corner of Virginia. It is bounded by the City of Norfolk to the west, the Chesapeake Bay to the north, the Atlantic Ocean to the east, and the state of North Carolina to the south. It is the only one of Virginia's contiguous Tidewater counties that borders on the Atlantic Ocean. The 362.9 miles of measured shoreline in Virginia Beach are highly diverse, ranging from the wide beaches of the Atlantic coast to the extensive marshes of Back Bay and the North Landing River to the artificially filled and stabilized areas of Little Creek and the Lynnhaven River. Because of its ocean beaches, Virginia Beach is one of the largest resort areas in the country. The economic prosperity of the city is largely due to the several military bases located along the shore and in the interior.

The topography of Virginia Beach is typical of the Coastal Plain areas. The area is essentially flat and low, with average elevations of 12 feet above MSL. Along the shoreline, many elevations are below 5 feet. There are four major natural shoreline divisions in Virginia Beach;

- 1) The Chesapeake Bay shoreline, 11.7 miles (Segments 2, 4, and 5). This area is from Little Creek to Cape Henry. (For the purposes of this report, the Chesapeake Bay shoreline ends at the Fort Story - North Virginia Beach limits.)
- 2) The Atlantic Ocean shoreline, 26.6 miles, (Segment 8, Subsegments 9A, 10A, and 11A) from North Virginia Beach to the Virginia - North Carolina state line.
- 3) The tributaries to Chesapeake Bay and the Atlantic Ocean, 194.7 miles (Segments 1, 3, and 8). The three tributaries are Little Creek, the Lynnhaven River, and the Rudee Inlet area.
- 4) Back Bay and the North Landing River, 129.9 miles (Subsegments 9B, 10B, 11B; Segments 12 and 13).

Basically, the Bay and ocean-fronting shorelands are dunes, especially at Cape Henry and south of Rudee Inlet. Many dunes have been leveled during shoreline development in the city. Areas of artificial fill are located in the tributaries. (Seventy-three percent of the shorelands in Little Creek are artificially filled.) The Back Bay and North Landing River shorelands are mostly low shore, the fastland in several areas being separated from the shoreline by several thousand feet of extensive marsh.

The uses of Virginia Beach's shorelands are largely dependent upon the shorelands types. The wide expanses of beach along the Bay and ocean shorelines are used extensively for public recreation. The fastland behind these areas is used for a variety of purposes. Twenty-eight percent of these shorelands are military bases owned by the federal government. The active tourist industry is generally located between 49th Street and Rudee Inlet. This ocean resort area is the largest in the state and one of the largest on the east coast. Motels, hotels, restaurants and amusement centers which cater to the tourist trade are located along this section of the city. Residential developments account for fifty-eight percent of the shorelands and are centered on the Lynnhaven River, along Rudee Inlet, in North Virginia Beach, and at Sandbridge. There are several public areas along the shoreline: Seashore State Park, False Cape State Park, Back Bay National Wildlife Refuge, MacKay Island National Wildlife Refuge, Little Island Municipal Park, Trojan State Waterfowl Refuge, and Pocohantas State Waterfowl Refuge. False Cape State Park is in the process of being developed for public recreational uses such as nature walks, hiking, and bathing.

Flooding affects all sections of shoreline in Virginia Beach. The extent and damage of a severe flood can only be estimated for much of the city, since development in many sections has only occurred during the last 10 to 15 years. Table 1 shows the relative flood heights for several areas of the city. Generally, flooding poses a serious threat to structures along the entire ocean and Bay-fronting shoreline. This is due, in part, to the natural flat and low nature of the shoreline. However, the flood hazard has increased in many areas due to the leveling or grading of the sand dunes which once offered some measure of flood protection. Many structures are located in the dune line. Even though much of the developed area in

the Virginia Beach tourist area has a concrete seawall behind the beach, past storms have shown that flood waters can damage or destroy sections of the structure and inundate areas behind. The heavily populated Lynnhaven River, while not as prone to flood inundation as other sections of the city, would nevertheless suffer heavy financial loss during a severe storm due to the large number of structures along the shoreline. It should be noted that the Fort Story area, although directly bordering on both the Atlantic Ocean and the Chesapeake Bay, does not have a history of flood inundation, primarily due to the enhanced elevations arising from the dune systems.

TABLE 1

RELATIVE FLOOD HEIGHTS

Flood	Location	Ft. above MSL
March, 1962	Atlantic Coast	6.7
August, 1933	Atlantic Coast	8.6
Int. Regional	Atlantic Coast	9.0
Standard Project	Atlantic Coast	13.0
- - - - -		
March, 1962	Lynnhaven Inlet	7.6
August, 1933	Lynnhaven Inlet	8.6
Int. Regional	Lynnhaven Inlet	9.0
Standard Project	Lynnhaven Inlet	13.0
- - - - -		
March, 1962	Lynnhaven Bay	7.6
August, 1933	Lynnhaven Bay	8.0
Int. Regional	Lynnhaven Bay	8.0
Standard Project	Lynnhaven Bay	12.0
- - - - -		
March, 1962	Broad & Linkhorn Bays	5.5
August, 1933	Broad & Linkhorn Bays	5.3
Int. Regional	Broad & Linkhorn Bays	7.0
Standard Project	Broad & Linkhorn Bays	11.0
- - - - -		
March, 1962	Back Bay	NA
August, 1933	Back Bay	3.8
Int. Regional	Back Bay	5.0
Standard Project	Back Bay	10.0

From "Flood Plain Information, Coastal Flooding, Virginia Beach, Virginia", U.S. Army Corps of Engineers, Norfolk, Virginia, July 1969.

Virginia Beach generally has excellent water quality. There are, however, several areas in the city which have experienced problems. Little Creek does not meet water quality standards due to heavy boating activities, urban runoff, and faulty septic tanks. This area is closed to the taking of shellfish. Parts of the Lynnhaven River and Broad Bay have recently (September 1977) been conditionally reopened to the taking of shellfish. However, the area receives heavy boating and marina use and historically has suffered from sedimentation and violations of shellfish bacteriological standards. The Western and Eastern Branches, Linkhorn Bay, and other smaller tributaries remain closed to the taking of shellfish. However, these areas do meet the State Water Control Board's 305(b)(1)(B) criteria.* Back Bay suffers from water quality problems due to poor flushing and past discharges of animal wastes into the water. Although animal waste discharges have been stopped, the area continues to experience poor water quality. However, the problem is mainly a natural (versus man-made) one and thus the area does not actually violate the 305(b)(1)(B) criteria. The North Landing River, like Back Bay, has very poor flushing. Most of its watershed is low lands and swamps, making the water dark. Problems stem from non-point agricultural runoff and high boating activities.

* 305(b)(1)(B) criteria: "Navigable water shall be of the quality to provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water."

3.2 SHORE EROSION SITUATION

The history of shoreline erosion in Virginia Beach shows alternating periods of erosion and accretion along the Chesapeake Bay and the Atlantic Ocean. According to Byrne and Anderson (1977, Shoreline Erosion in Tidewater Virginia, Special Report Number 111 in Applied Marine Science and Ocean Engineering, Virginia Institute of Marine Science, 102 pages), the historical trend along the Chesapeake Bay shoreline in Virginia Beach is one of erosion at an average rate of 1.7 feet per year. In all, the Bay shoreline has lost 207 acres over the past 100 years. Generally, the area from Fort Story to Lynnhaven Inlet and the area west of Little Creek have been accreting while the rest of the Bay shoreline has been eroding. However, recent investigations show the overall trend to be one of gradual accretion.

According to the feasibility report for Beach Erosion Control and Hurricane Protection for Virginia Beach (Norfolk District, U.S. Army Corps of Engineers, 1970), the shoreline along the Atlantic Ocean in Virginia Beach has an average historical erosion rate of 0.72 feet per year. Historically, the shorelines from Fort Story to Rudee Inlet and from False Cape to the state line have been accreting, while the shoreline from Rudee Inlet to False Cape has been eroding. The recent trend seems to be one of slight erosion for the areas of Sandbridge, North Virginia Beach and the resort area of Virginia Beach, as artificially placed beach material has continued to be eroded at rates comparable to those experienced historically.

As the City of Virginia Beach is a tourist oriented resort area, the city has been concerned with the maintenance of its beaches, especially in the resort area. Sand was artificially placed along the shoreline between Rudee Inlet and 49th Street in 1952-1953. Since then, the Virginia Beach Erosion Commission has periodically re-nourished the beaches. Although providing some protection against storm erosion and flooding, severe storms can still cause severe damage to both the beach and the structures behind. The northeaster of March 1962 destroyed or damaged many protective structures along the resort area shoreline and denuded the beaches of sand in several places. However, the presence of the artificially placed sand on the beaches probably delayed and diminished the damage incurred to some protective structures.

TABLE 2

ARTIFICIALLY STABILIZED AREAS IN VIRGINIA BEACH

Area	Riprap (Feet)	Bulkhead (Feet)	Unprotected Shoreline (Feet)
Chesapeake Bay	2,600	3,700	55,100
Atlantic Ocean		19,200	119,100
Little Creek	6,800	19,100	12,700
Lynnhaven River	8,500	229,600	712,900
Rudee Inlet	300	12,200	27,700
Back Bay	2,000	17,300	496,400
North Landing River		1,500	168,900
Total Feet	20,200	302,600	1,592,800
% of Total	1%	16%	83%

As can be seen from Table 2, the vast majority of artificial stabilization in Virginia Beach has taken place along the tributaries rather than along the Bay or ocean. There are two main areas along the Bay and ocean which have been stabilized. Part of Fort Story's shoreline at Cape Henry is protected by several thousand feet of rubble riprap. To the south, the resort section of Virginia Beach is protected by approximately 16,400 feet of concrete seawall. Other sections of the shoreline have only individual protective structures.

3.3 SHORE USE LIMITATIONS

There are several factors which control or limit development along the shorelands of Virginia Beach. Existing use or ownership of many areas preclude other uses. Besides the extensive military holdings and several federal and state parks and wildlife refuges, many areas in the private sector are already extensively used for various residential and commercial purposes. The only major unused or lightly used shorelands in the city are south of Sandbridge, parts of Back Bay and parts of the North Landing River. It is expected that the Sandbridge area will continue to be developed for residential purposes. However, since this section of shoreline is extremely vulnerable to flooding, structural and non-structural means should be implemented to cope with the problem. This would include careful attention to the engineering aspects of building in a flood prone area and legislative aspects such as insuring an adequate setback zone from the shoreline.

Though Back Bay and the North Landing River are also susceptible to flooding, these areas are mostly protected from severe water inundation. However, by the same measure, these areas do not have ready access to the ocean or other deep water, thus limiting the water-related residential development value of the land. Also, most of these shorelands are fronted by extensive marshes, some of which extend for over a mile in width. These areas are thus not considered prime development targets.

Development in the city will, nonetheless, continue. The resort section of Virginia Beach is constantly being redeveloped, as older structures are razed and modern facilities built. Likewise, the existing residential developments along the Lynnhaven River and other places are being more intensely developed, as shorelands property is being consumed. Since the demand for residential, commercial, and industrial property in "The Resort City" is at a premium, the continued development and redevelopment of available lands is assured. However, care should be taken to preserve the environment of the city's shorelands, the dunes along the Bay and ocean, the marshes of Back Bay and North Landing River, the miles of beach and marsh at False Cape. These areas, while being important in the preservation of the wildlife that make them their habitats, are also important as open recreational spaces for the citizens of the surrounding communities, this state, and neighboring states.



FIGURE 3

FIGURE 3: Chesapeake Bay Bridge Tunnel, Segment 2. These houses have been built very near the tidal zone. Abnormally high water would damage or destroy these structures.

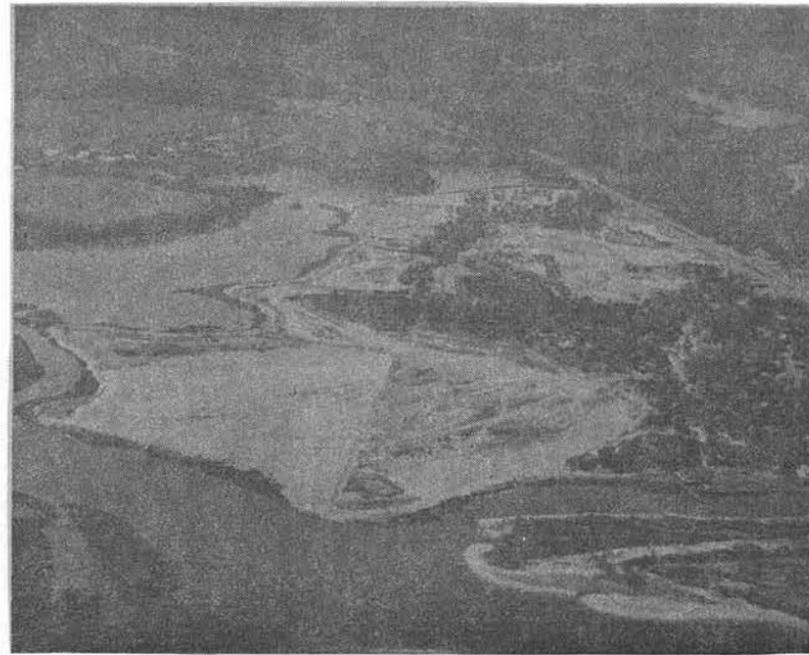


FIGURE 4

FIGURE 4: Pleasure House Point, Subsegment 3A. This area, once marsh, has recently been filled and is to be used for residential purposes.

FIGURE 5: Witch Duck Point, Subsegment 3B. This is a typical residential development in the Lynnhaven River.



FIGURE 5

FIGURE 6: Filled area, Seashore State Park, Subsegment 3H. Sand from a nearby spit has been used to fill this area to make a public recreational spot.

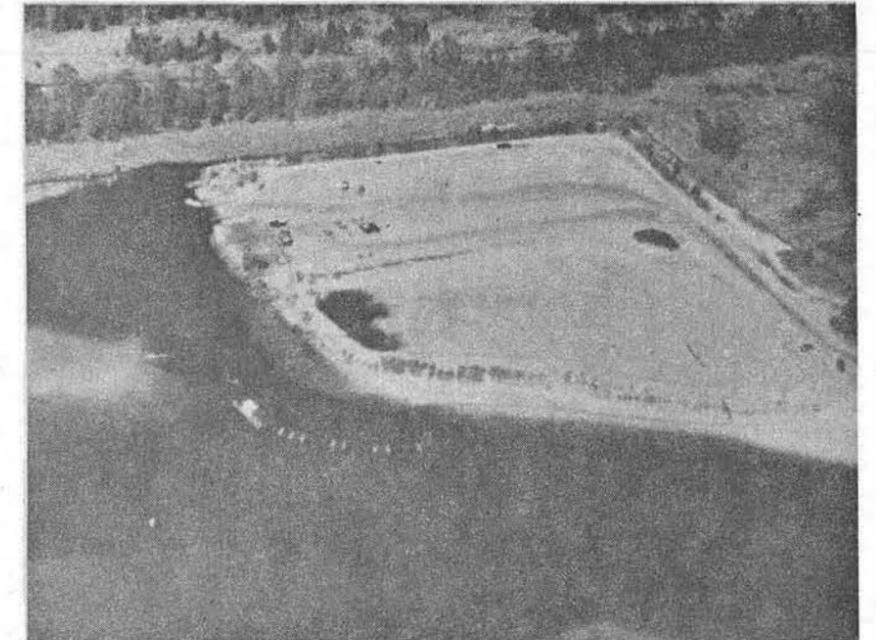


FIGURE 6

FIGURE 7: Cape Story by the Sea, Subsegment 3H. Canals have been dredged here to create waterfront property in this new residential area. This practice has been fairly common in Virginia Beach.



FIGURE 7

FIGURE 8: Mouth of Lynnhaven River, Subsegment 3H. A view from inside the mouth. Notice the large amount of boating activity at the marinas.



FIGURE 8



FIGURE 9



FIGURE 10

FIGURE 9: Fort Story, Segment 5. Note the dunes along the shore. Only minor flooding occurs in this area due to the protection given by the dunes.

FIGURE 10: North Virginia Beach, Segment 6. The wide beach is backed by an area of low vegetated dunes, which serves to protect the residential area.



FIGURE 11

FIGURE 11: Virginia Beach resort area, Segment 7. The concrete seawall which protects this section has been defeated in past storms. Though repaired, a severe storm could endanger these structures.

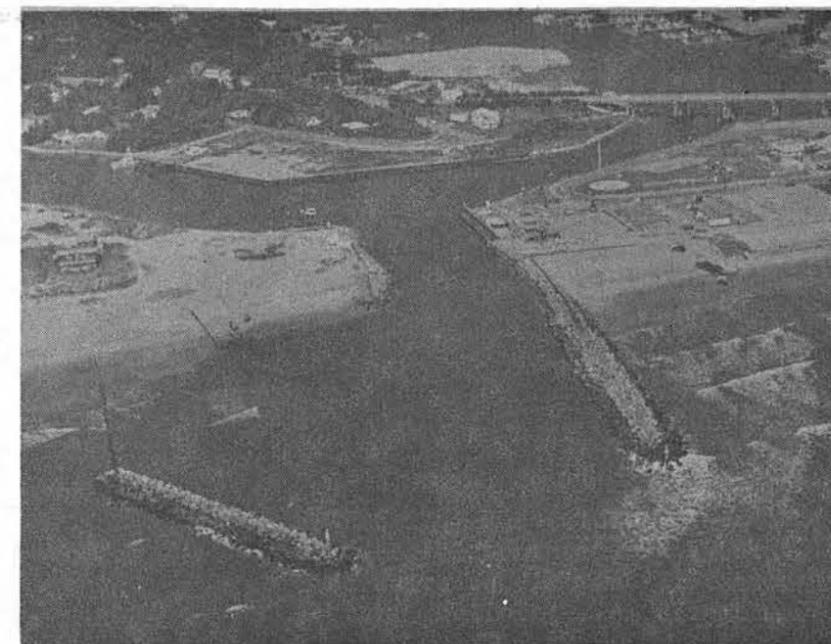


FIGURE 12

FIGURE 12: Rudee Inlet, Segment 8. There are several marinas in the interior of the inlet. The riprap jetties serve to diminish siltation of the inlet and to protect the inlet from direct wave attack.

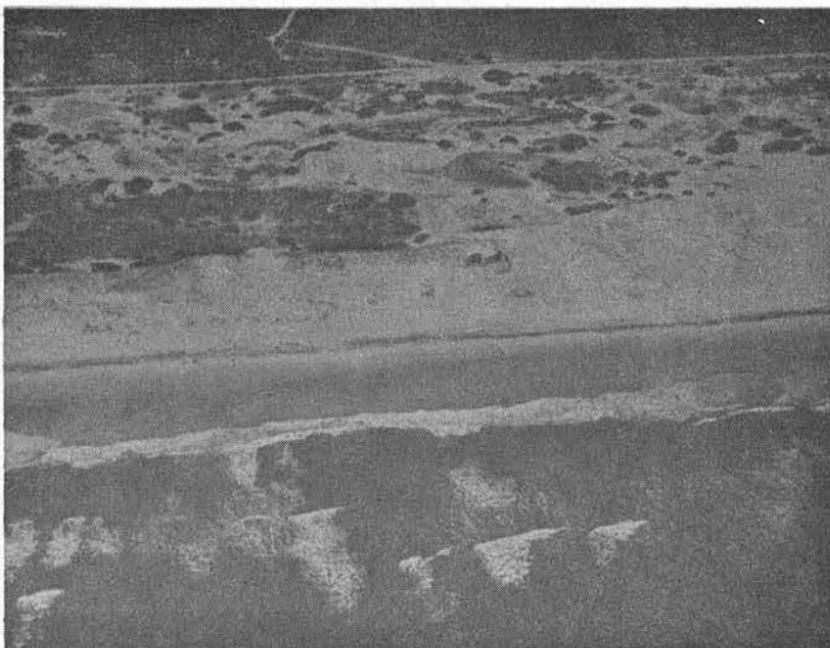


FIGURE 13

FIGURE 13: Back Bay National Wildlife Refuge, Ocean-side, Subsegment 10A. The many dunes here retard flooding of backshore areas.

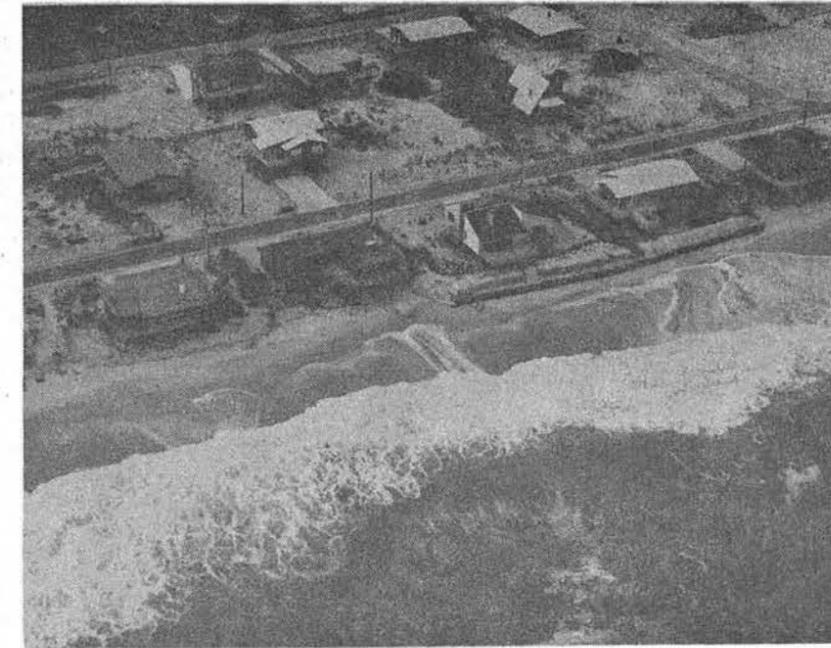


FIGURE 14

FIGURE 14: Sandbridge, Subsegment 9A. Taken after a northeast storm on November 4, 1977. Note high tide line, in places underneath house pilings. The block to the left of the bulkhead is an exposed septic tank.

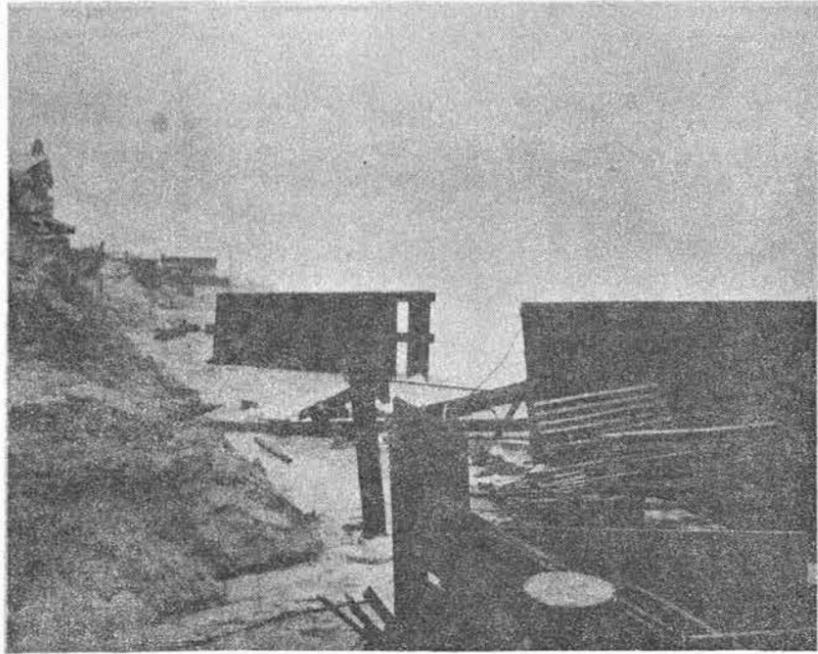


FIGURE 15

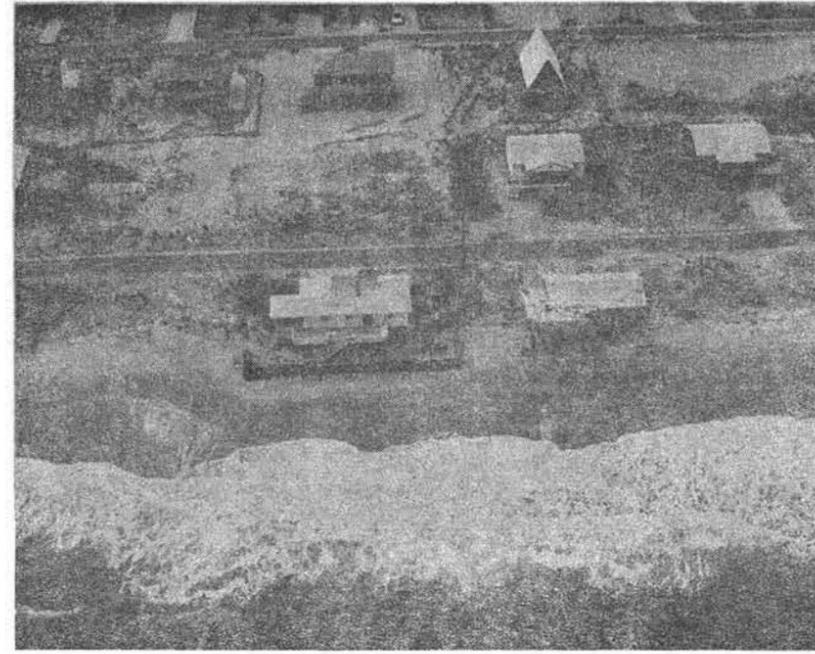


FIGURE 16



FIGURE 17

FIGURE 15: Failed bulkhead at Sandbridge, Subsegment 9A. Taken November 3, 1977 during a northeast storm, waves were cutting into the sand dunes behind the failed structure.

FIGURES 16 and 17: Sandbridge, Subsegment 9A. Also taken during the northeaster November 4, 1977, note the failed section of bulkhead in Figure 16 and the upper limit of wave runup in both figures. The black block in front of the house in Figure 17 is an exposed septic tank.

FIGURES 18 and 19: Swimming pool in the tidal zone, Sandbridge, Subsegment 9A. Taken during the November northeaster, the storm has undermined the pool (Figure 18) and has caused two concrete slabs to fall. Waves are attacking the northern corner of the bulkhead (Figure 19). Note the slope of the beach near this corner.

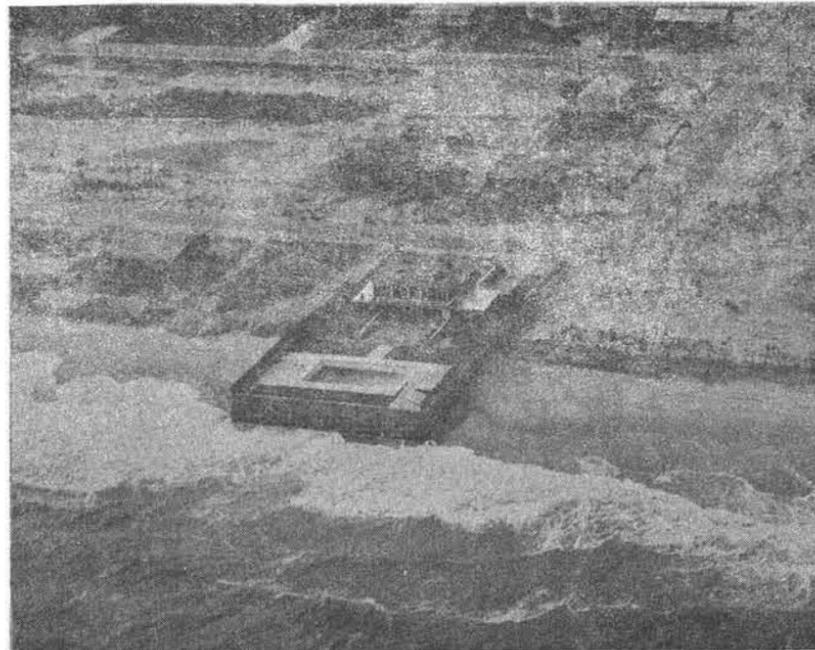


FIGURE 18

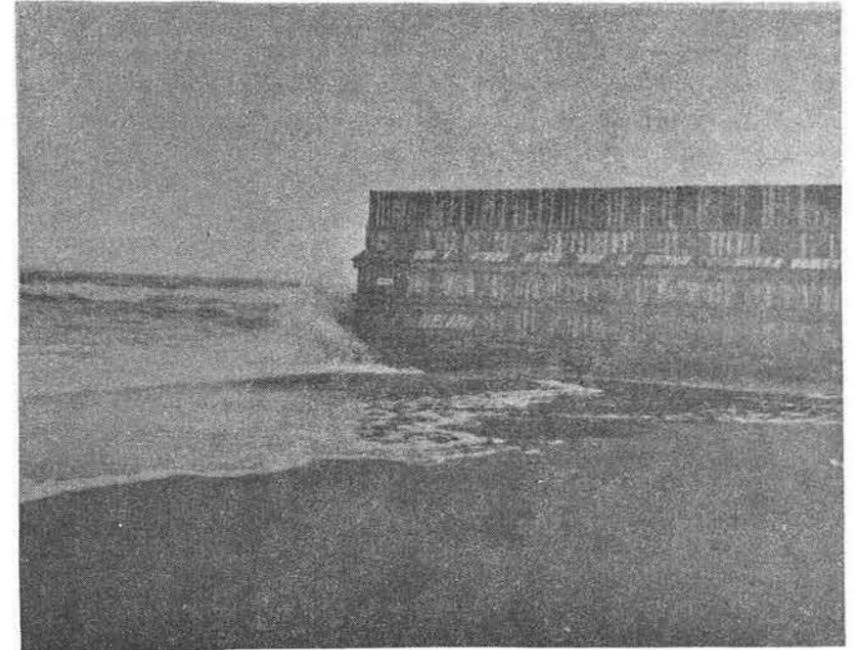
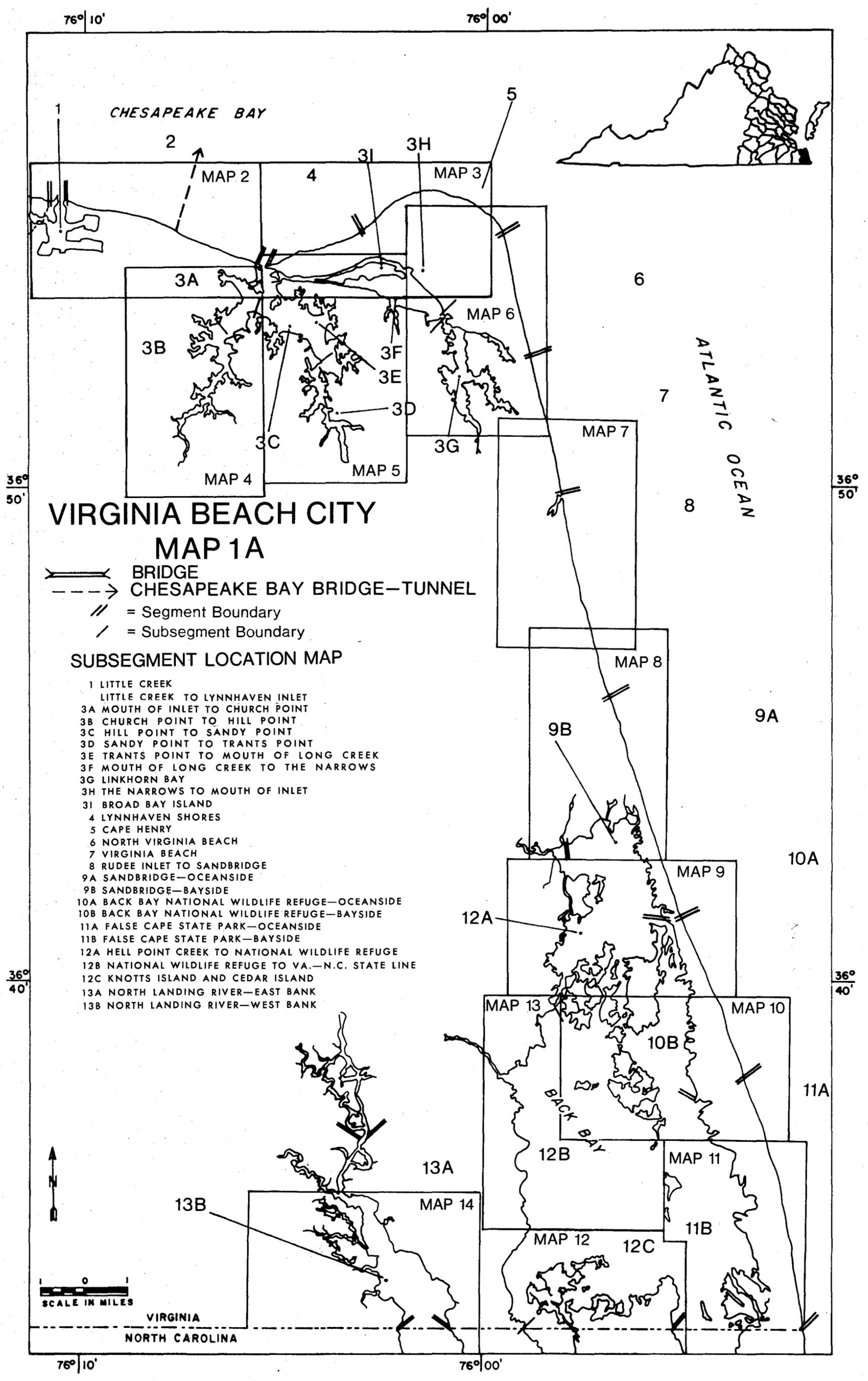


FIGURE 19



VIRGINIA BEACH CITY MAP 1A

- BRIDGE
- CHESAPEAKE BAY BRIDGE-TUNNEL
- = Segment Boundary
- = Subsegment Boundary

SUBSEGMENT LOCATION MAP

- 1 LITTLE CREEK
- LITTLE CREEK TO LYNNHAVEN INLET
- 3A MOUTH OF INLET TO CHURCH POINT
- 3B CHURCH POINT TO HILL POINT
- 3C HILL POINT TO SANDY POINT
- 3D SANDY POINT TO TRANTS POINT
- 3E TRANTS POINT TO MOUTH OF LONG CREEK
- 3F MOUTH OF LONG CREEK TO THE NARROWS
- 3G LINKHORN BAY
- 3H THE NARROWS TO MOUTH OF INLET
- 3I BROAD BAY ISLAND
- 4 LYNNHAVEN SHORES
- 5 CAPE HENRY
- 6 NORTH VIRGINIA BEACH
- 7 VIRGINIA BEACH
- 8 RUDEE INLET TO SANDBRIDGE
- 9A SANDBRIDGE—OCEANSIDE
- 9B SANDBRIDGE—BAYSIDE
- 10A BACK BAY NATIONAL WILDLIFE REFUGE—OCEANSIDE
- 10B BACK BAY NATIONAL WILDLIFE REFUGE—BAYSIDE
- 11A FALSE CAPE STATE PARK—OCEANSIDE
- 11B FALSE CAPE STATE PARK—BAYSIDE
- 12A HELL POINT CREEK TO NATIONAL WILDLIFE REFUGE
- 12B NATIONAL WILDLIFE REFUGE TO VA.—N.C. STATE LINE
- 12C KNOTTS ISLAND AND CEDAR ISLAND
- 13A NORTH LANDING RIVER—EAST BANK
- 13B NORTH LANDING RIVER—WEST BANK

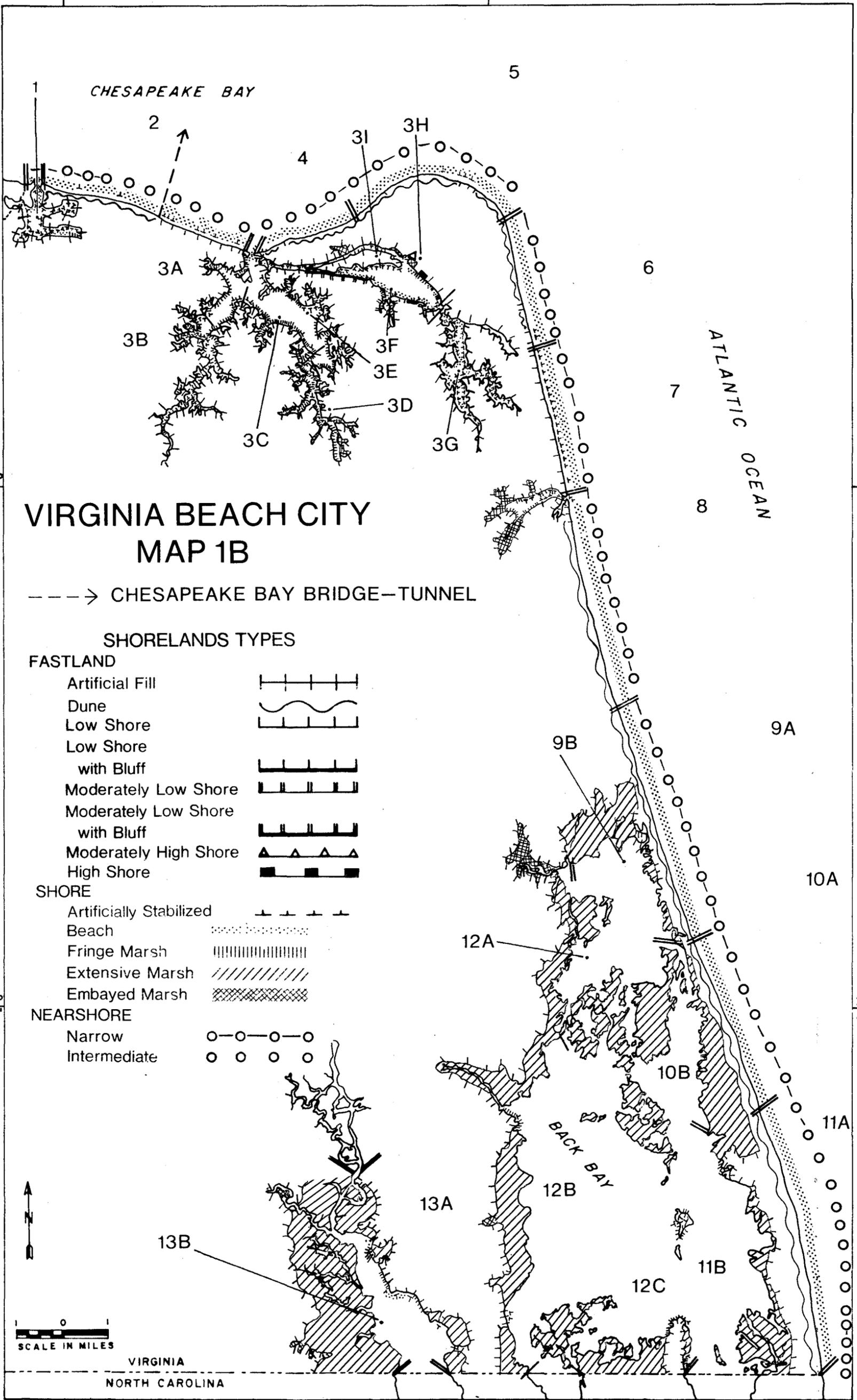
SCALE IN MILES

VIRGINIA
NORTH CAROLINA

17

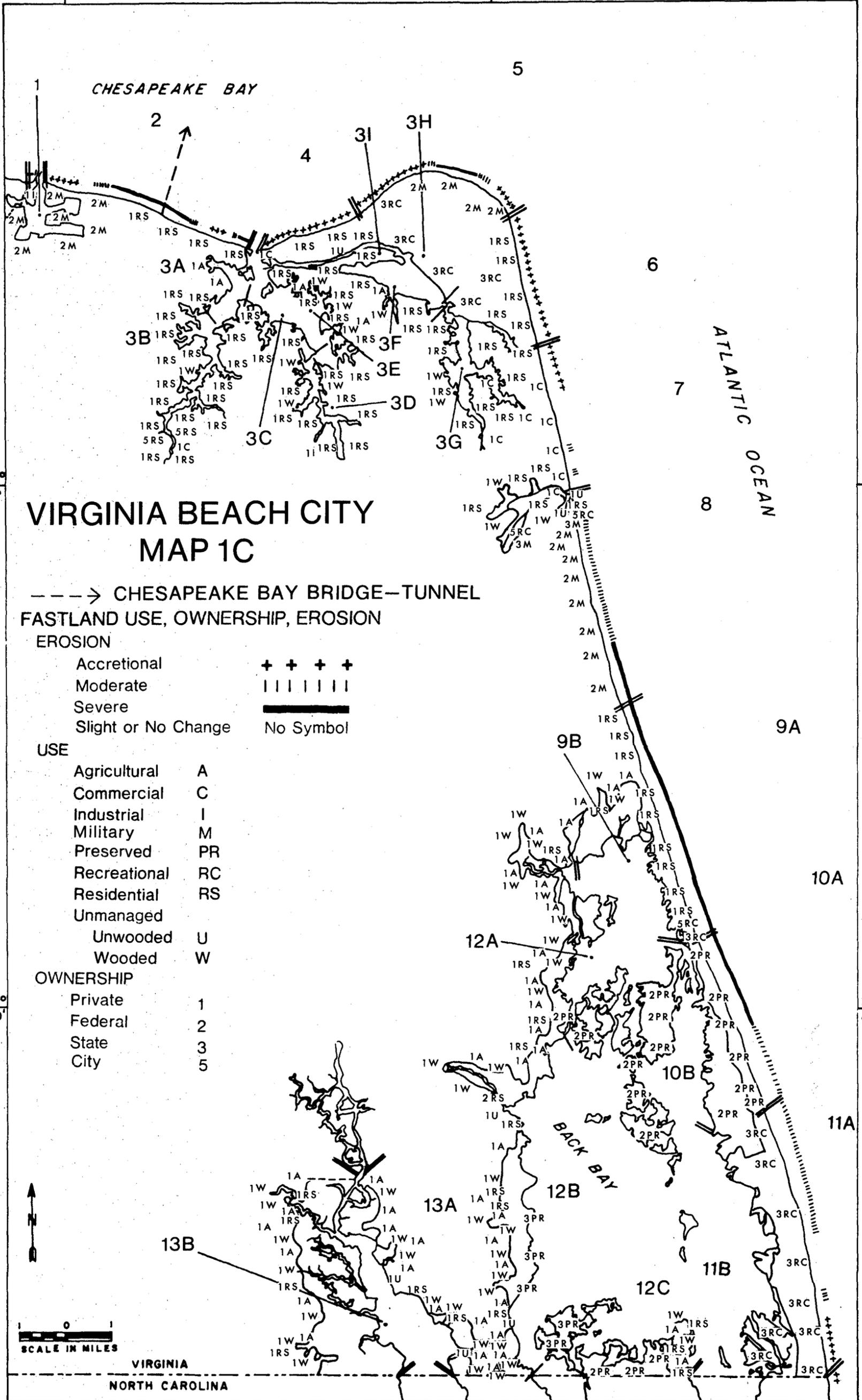
76° 10'

76° 00'



76° 10'

76° 00'



VIRGINIA BEACH CITY MAP 1C

---> CHESAPEAKE BAY BRIDGE-TUNNEL
FASTLAND USE, OWNERSHIP, EROSION

EROSION

- Accretional + + + +
- Moderate || || || ||
- Severe —————
- Slight or No Change No Symbol

USE

- Agricultural A
- Commercial C
- Industrial I
- Military M
- Preserved PR
- Recreational RC
- Residential RS
- Unmanaged U
- Unwooded U
- Wooded W

OWNERSHIP

- Private 1
- Federal 2
- State 3
- City 5



VIRGINIA
NORTH CAROLINA

76° 10'

76° 00'

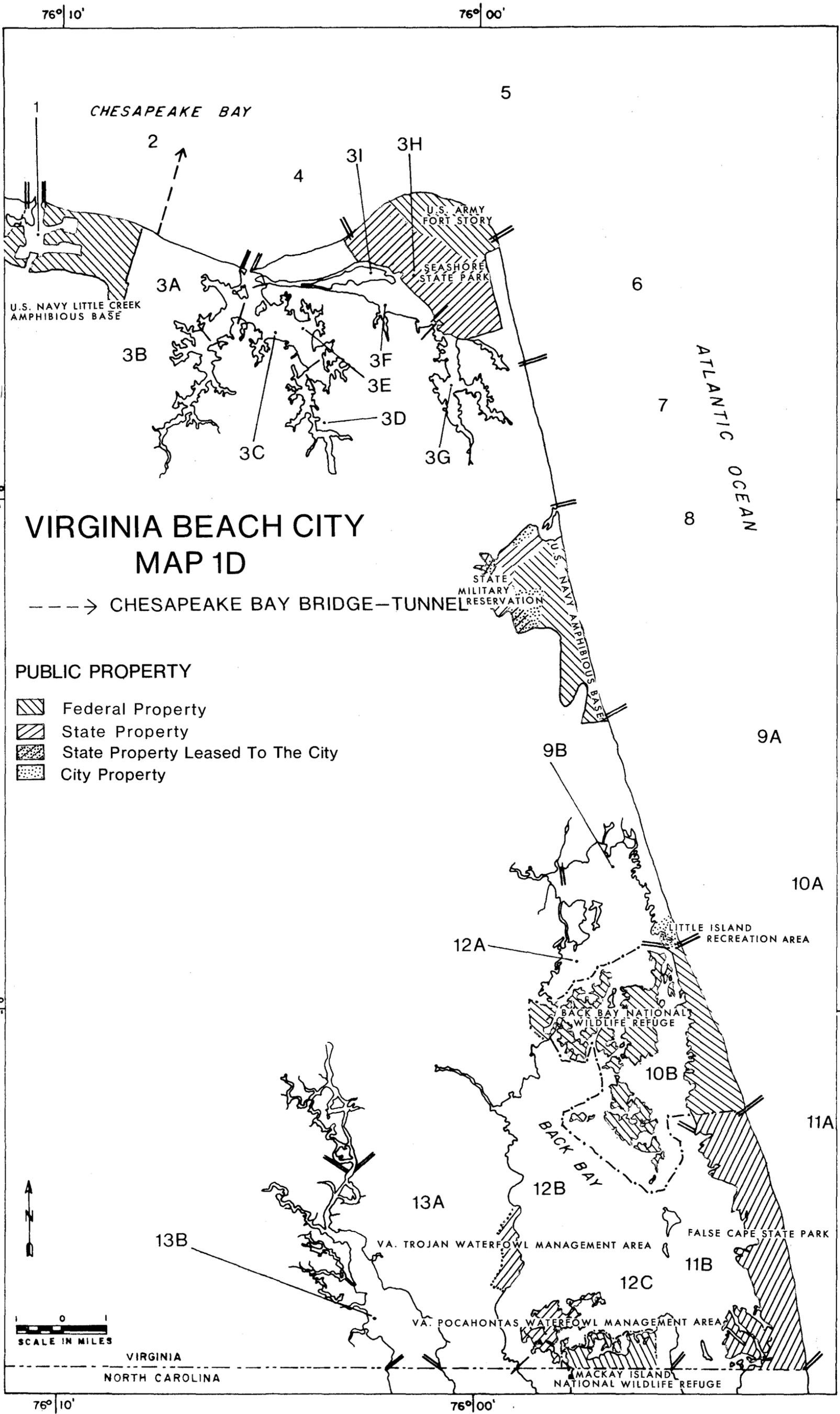
36° 50'

36° 50'

36° 40'

36° 40'

19



VIRGINIA BEACH CITY MAP 1D

---> CHESAPEAKE BAY BRIDGE-TUNNEL

PUBLIC PROPERTY

-  Federal Property
-  State Property
-  State Property Leased To The City
-  City Property

0 1
SCALE IN MILES

VIRGINIA
NORTH CAROLINA

20

36°
50'

36°
40'

76° 10'

76° 00'

36°
50'

36°
40'

76° 10'

76° 00'

TABLE 3. VIRGINIA BEACH, VIRGINIA SHORELANDS PHYSIOGRAPHY, FASTLANDS USE, OWNERSHIP (STATUTE MILES)

Physiographic, use, and ownership classification	SHORELANDS PHYSIOGRAPHY										SHORELANDS USE								OWNERSHIP				TOTAL MILES				
	FASTLAND					SHORE					NEARSHORE		AGRICULTURAL	COMMERCIAL	INDUSTRIAL	MILITARY	PRESERVED	RECREATIONAL	RESIDENTIAL	UNMANAGED, WOODED	UNMANAGED, UNWOODED	PRIVATE	FEDERAL	STATE	CITY	SHORELINE	FASTLAND
	DUNES	ARTIFICIAL FILL	LOW SHORE	LOW SHORE WITH BLUFF	MODERATELY LOW SHORE	ARTIFICIALLY STABILIZED	BEACH	FRINGE MARSH	EXTENSIVE MARSH	EMBAYED MARSH	NARROW	INTERMEDIATE															
1	0.6	5.3	1.4			4.9	1.9	0.5			5.7			0.4	5.7		0.1			1.1	1.5	5.7		0.1	7.3	7.3	
2	3.4		1.6			0.7	4.3				1.6	3.3						2.6			2.7	2.3			5.0	5.0	
3A	0.8	1.5	3.8	0.2		0.1	0.9	5.4	0.6				2.1					1.8	1.5	0.8	6.2				7.0	6.2	
3B		1.7	41.3	0.2		1.1	0.3	38.4	1.8				0.6	0.2	0.3			39.7	2.4		41.9		1.3		41.6	43.2	
3C			10.0	0.1		0.6	0.2	8.9	0.3				0.1					9.4	0.6		10.1				10.1	10.1	
3D		0.6	32.9			2.8		25.1	3.0						0.4			26.7	6.3		33.5				30.8	33.5	
3E		0.3	21.8			1.8	0.1	18.4	0.7				0.4					18.1	3.7		22.1		0.1		21.0	22.2	
*3F		0.2	6.4	0.7	0.7	2.2	1.8	4.2	1.8				1.0					7.7	0.7		9.5				10.1	9.5	
3G		5.0	31.9	0.2		19.0	2.2	15.7	0.1					1.0			1.1	33.7	1.3		36.0		1.1		37.0	37.1	
*3H		8.6	3.1	0.1	0.1	8.8	0.5	1.6	1.3					1.7			3.1	6.7		0.8	9.2		3.1		12.3	12.3	
3I		10.3				8.7	0.1	1.5										9.9		0.4	10.3				10.3	10.3	
4	1.6		0.4			0.1	1.9			0.5	1.5			0.4				1.3		0.2	2.0				2.0	2.0	
5	4.1		0.6			0.5	4.2			4.7					3.7			1.0				3.7	1.0		4.7	4.7	
6	1.9		0.8			0.5	2.2			2.7				0.2				2.5			2.7				2.7	2.7	
7			3.4			3.1	0.3			3.4				2.9				0.5			3.4				3.4	3.4	
8	4.4	1.4	10.2			2.4	5.7	1.8		4.9			0.1	1.1	4.6		1.1	4.2	4.3	0.6	10.3	4.0	0.6	1.1	12.2	16.0	
9A	5.3					0.1	5.3			5.3				0.1				0.7	4.5		4.6			0.7	5.3	5.3	
9B	0.6	10.9	4.1			2.9		8.8	11.6				1.7				0.6	11.9	1.4		15.0			0.6	23.4	15.7	
10A	4.4						4.4			4.4						4.4						4.4			4.4	4.4	
10B	5.0							0.3	12.8							5.0						5.0			13.2	5.0	
11A	5.8					5.8				1.5	4.2						5.8						5.8		5.8	5.8	
11B	0.6		10.6					2.2	14.7								11.2						11.2		16.9	11.2	
12A			15.1					0.6	15.9	2.4			6.3					3.1	5.6		14.9	0.2			19.0	15.1	
12B		2.4	10.6			0.3		0.8	13.2				5.3			0.1		1.5	4.7	1.4	12.8	0.1	0.1		14.3	13.0	
12C			5.0			0.4		2.1	8.3				0.3					1.5	3.1		5.0				10.9	5.0	
13A		2.6	7.3			0.3	0.8	3.6	7.1				3.9					1.7	1.6	2.7	9.9				11.8	9.9	
13B			12.6					0.5	14.5	5.4			3.2					0.7	8.7		12.6				20.4	12.6	
TOTAL	38.5	50.8	234.9	1.5	0.8	61.3	42.9	140.4	98.1	19.7	34.7	9.0	25.0	7.7	1.2	16.3	9.5	24.8	189.7	45.9	8.0	276.2	25.4	23.0	3.8	362.9	328.5
% of FASTLAND	12%	15%	72%	1%	1%								8%	2%	1%	5%	3%	8%	58%	14%	2%	84%	8%	7%	1%		100%
% of SHORELINE						17%	12%	39%	27%	5%	10%	2%															100%

*NOTE: Several fastland type classifications in Subsegments 3F and 3H were too small to be included in this table. For specific statistics, see Subsegment Descriptions, Chapter 4.

CHAPTER 4

4.1 Table of Subsegment Summaries

4.2 Segment and Subsegment Descriptions

4.3 Segment and Subsegment Maps

TABLE 4. SHORELINE SITUATION REPORT SUBSEGMENT SUMMARY FOR VIRGINIA BEACH, VIRGINIA

SUBSEGMENT	SHORELANDS TYPE	SHORELANDS USE	OWNERSHIP	FLOOD HAZARD	WATER QUALITY	BEACH QUALITY	SHORE EROSION SITUATION	ALTERNATE SHORE USE
1 LITTLE CREEK 7.3 miles (7.3 miles of fastland)	FASTLAND: Dunes 8%, artificial fill 73%, and low shore 19%. SHORE: Artificially stabilized 67%, beach 26%, and fringe marsh 7%. NEARSHORE: Narrow 78%. The remainder of the segment is too narrow and shallow for classification.	FASTLAND: Military 78%, industrial 5%, recreational 1%, and unmanaged, unwooded 16%. SHORE: Industrial use at the railroad docks, military use for the rest of Little Creek; recreational use along the Chesapeake Bay shoreline. NEARSHORE: Military and commercial shipping.	Private 217, federal 78%, and city 1%.	Moderate, noncritical except for a few isolated structures along the shoreline which could be damaged during the 100-year flood.	Unsatisfactory. Water quality problems stem from boating activities and leachate from failing septic tanks.	Fair to good. Most beaches in the segment are fairly long and wide.	The Chesapeake Bay portion of the segment has an average historical erosion rate of 2.5 feet per year. There are approximately 25,900 feet of artificially stabilized shoreline in the segment, most of which is for industrial and cosmetic purposes.	Low. There is little land available for any alternate shore use.
2 LITTLE CREEK TO LYNNHAVEN INLET 5.0 miles (5.0 miles of fastland)	FASTLAND: Dunes 69% and low shore 31%. SHORE: Artificially stabilized 13% and beach 87%. NEARSHORE: Narrow 33% and intermediate 67%.	FASTLAND: Military 46%, industrial 1%, and residential 53%. SHORE: Military use along the federally owned lands; recreational use for the remainder of the segment. NEARSHORE: Commercial and sport boating and fishing.	Private 547 and federal 46%.	High, critical. Past floods show that this area is very susceptible to flooding especially the Ocean Park area.	Satisfactory. This segment meets the State Water Control Board's 305 (b)(1)(B) criteria and the Bureau of Shellfish Sanitation standards.	Good. The beaches in this segment are wide, with dunes in some areas.	The average historical erosion rate for most of the shoreline is 4.3 feet per year. However, the majority of this has now been effectively stabilized. Snow fencing has been employed in several areas in an effort to trap and retain sand.	Low. The shorelands of this segment are already extensively used.
3A LESNER BRIDGE TO CHURCH POINT 7.0 miles (6.2 miles of fastland)	FASTLAND: Dunes 13%, artificial fill 24%, low shore 60%, and low shore with bluff 3%. SHORE: Artificially stabilized 2%, beach 12%, fringe marsh 77%, and embayed marsh 9%. RIVER: This segment of the Lynnhaven River has depths of 1 to 10 feet.	FASTLAND: Agricultural 34%, residential 29%, unmanaged, wooded 23%, and unmanaged, unwooded 14%. SHORE: Some private recreational use, but mostly unused. RIVER: Sport boating and fishing.	Private.	High, critical. Much of the inland area between Pleasure House Creek and Route 60 would be flooded during the 100-year storm, endangering the structures located there.	Unsatisfactory for the Pleasure House Creek area. The area around Bayville Creek was opened for the taking of shellfish in September 1977.	Good. The area at the mouth of the River has wide beaches with vegetated dunes on the interior.	No data. The area appears to be stable. There are approximately 800 feet of bulkhead in the subsegment which is used mainly for cosmetic purposes.	Moderate to low. The only area available for public, recreational purposes is the beach and dune area near the Lesner Bridge.
3B WESTERN BRANCH- LYNNHAVEN RIVER 41.6 miles (43.2 miles of fastland)	FASTLAND: Artificial fill 4%, low shore 96%, and low shore with bluff <1%. SHORE: Artificially stabilized 3%, beach 1%, fringe marsh 92%, and embayed marsh 4%. RIVER: The Western Branch of the river has average depths of 4 to 8 feet.	FASTLAND: Agricultural 1%, commercial <1%, industrial 1%, residential 92%, and unmanaged, wooded 6%. SHORE: Some private recreational use, but mostly unused. RIVER: Sport boating, fishing, and other water sports.	Private 97% and city 3%.	High, critical. Much of the shoreline in this subsegment would be inundated during the 100-year flood, endangering many structures.	Satisfactory for the area north of Witch Duck Bay, which is now open for the taking of shellfish. Unsatisfactory for the rest of the subsegment.	Poor. There are only small pocket beaches in the subsegment.	No data. The area appears to be stable. There are approximately 5,700 feet of artificially stabilized shoreline in the subsegment, most of which is for cosmetic purposes rather than erosion control.	Low. There is little available land for any alternate shore use.
3C LYNNHAVEN BAY 10.1 miles (10.1 miles of fastland)	FASTLAND: Low shore 99% and low shore with bluff 1%. SHORE: Artificially stabilized 6%, beach 2%, fringe marsh 89%, and embayed marsh 3%. RIVER: The Lynnhaven Bay has average depths of 2 feet.	FASTLAND: Agricultural 1%, residential 93%, and unmanaged, wooded 6%. SHORE: Some private recreational use, but mostly unused. RIVER: Sport boating, fishing, and other water sports.	Private.	High, critical. Much of this subsegment would be flooded during the 100-year storm, endangering many structures.	Satisfactory for the entire subsegment except for Dix Creek.	Poor. There are only small pocket beaches in the subsegment.	No data. The area appears to be stable. There are approximately 3,300 feet of artificially stabilized shoreline in the subsegment, most of which is for cosmetic purposes rather than erosion control.	Low. The present use of the shorelands effectively limits any alternate shore use.
3D EASTERN BRANCH- LYNNHAVEN RIVER 30.8 miles (33.5 miles of fastland)	FASTLAND: Artificial fill 2% and low shore 98%. SHORE: Artificially stabilized 9%, fringe marsh 81%, and embayed marsh 10%. RIVER: The Eastern Branch has average depths of 2 to 3 feet.	FASTLAND: Commercial <1%, industrial 1%, residential 80%, and unmanaged, wooded 19%. SHORE: Some private recreational use. RIVER: Sport boating, fishing, and other water sports.	Private.	High, critical. The 100-year storm would affect areas up to elevations of 8 feet, endangering many structures.	Unsatisfactory. The entire subsegment is closed for the taking of shellfish.	There are no beaches in this subsegment.	No data. The area appears to be stable. There are approximately 14,600 feet of artificially stabilized shoreline in the subsegment, most of which is for cosmetic purposes rather than erosion control.	Low to moderate. The wooded area near Little Haven could be developed for public recreational facilities.
3E LYNNHAVEN BAY 21.0 miles (22.2 miles of fastland)	FASTLAND: Artificial fill 1% and low shore 99%. SHORE: Artificially stabilized 8%, beach <1%, fringe marsh 88%, and embayed marsh 4%. RIVER: Lynnhaven Bay has average depths of 2 to 4 feet, with isolated areas 12 to 13 feet deep.	FASTLAND: Agricultural 27, residential 82%, and unmanaged, wooded 16%. SHORE: Some private recreational use. RIVER: Sport boating, fishing, and other water sports.	Private. Less than 1% of the shoreline is owned by the state.	High, critical. The 100-year storm would flood areas up to elevations of 8 feet, endangering many structures.	The main section of Lynnhaven Bay is open for the taking of shellfish. The remainder of the subsegment has unsatisfactory water quality.	Poor. There are only small pocket beaches in the subsegment.	No data. The area appears to be stable. There are approximately 9,400 feet of artificially stabilized shoreline in the subsegment, all of which is effective.	Low. Although some continued residential development is possible for isolated areas, there is little land available for public recreational facilities.

TABLE 4 (CONT'D)

SUBSEGMENT	SHORELANDS TYPE	SHORELANDS USE	OWNERSHIP	FLOOD HAZARD	WATER QUALITY	BEACH QUALITY	SHORE EROSION SITUATION	ALTERNATE SHORE USE
3F BROAD BAY 10.1 miles (9.5 miles of fastland)	FASTLAND: Artificial fill 2%, low shore 68%, low shore with bluff 7%, moderately low shore 7%, and moderately low shore with bluff 16%. SHORE: Artificially stabilized 22%, beach 18%, fringe marsh 42%, and embayed marsh 18%. RIVER: Long Creek has average depths of 2 to 4 feet. Broad Bay has 7 to 8-foot depths.	FASTLAND: Agricultural 11%, residential 81%, and unmanaged, wooded 8%. SHORE: Access to the water. RIVER: Sport boating, fishing, and other water sports.	Private.	High, critical. Much of the subsegment would be inundated during the 100-year storm, endangering many structures.	Satisfactory for the Broad Bay section. The remainder of the subsegment has unsatisfactory water quality.	Poor to fair. A spit near The Narrows has a wide, clean beach.	No data. The area appears to be stable. There are approximately 11,600 feet of artificial stabilization in the subsegment. All structures are for cosmetic purposes rather than erosion control.	Low. There is little available land suitable for public recreational facilities.
3G LINKHORN BAY 37.0 miles (37.1 miles of fastland)	FASTLAND: Artificial fill 14%, low shore 86%, and low shore with bluff < 1%. SHORE: Artificially stabilized 51%, beach 6%, fringe marsh 42%, and embayed marsh < 1%. RIVER: Linkhorn Bay has average depths of 6 to 10 feet.	FASTLAND: Commercial 3%, recreational 3%, residential 91%, and unmanaged, wooded 3%. SHORE: Private use in front of the residences. Public recreational use at the marinas and country club. RIVER: Sport boating, fishing, and other water sports.	Private 97% and state 3%.	High, critical. The 100-year storm would inundate areas up to 8 feet, endangering many shoreline structures.	Unsatisfactory. This subsegment does not meet the State Water Control Board's 305(b)(1)(B) criteria or the Bureau of Shellfish Sanitation standards.	Poor to good. The Narrows generally has clean, wide beaches.	No data. Some erosion is occurring along the Seashore State Park. There are approximately 100,200 feet of effective artificial stabilization in the subsegment.	Low. There is little land available for any alternate shore use.
3H THE NARROWS TO LESNER BRIDGE 12.3 miles (12.3 miles of fastland)	FASTLAND: Artificial fill 70%, low shore 25%, low shore with bluff < 1%, moderately low shore 1%, moderately high shore 1%, moderately high shore with bluff 1%, and high shore with bluff 2%. SHORE: Artificially stabilized 72%, beach 4%, fringe marsh 13%, and embayed marsh 10%. RIVER: Broad Bay has average depths of 6 to 10 feet. Long Creek has 2 to 4-foot depths.	FASTLAND: Commercial 14%, recreational 25%, residential 54%, and unmanaged, unwooded 7%. SHORE: Private and public recreational use. RIVER: Sport boating, fishing, and other water sports.	Private 75% and state 25%.	High, critical. With the exception of the Seashore State Park, the entire subsegment would be inundated during the 100-year storm.	Satisfactory from The Narrows to Long Creek. The remainder of the subsegment has poor water quality.	Fair. There are several areas along the Seashore State Park shoreline that have fairly wide beaches.	No data. Several of the dune areas along the Seashore State Park are eroding, according to recent field investigations. There are approximately 46,700 feet of artificially stabilized shoreline in the subsegment. Most of this is for retaining fill along the dredged canals.	Low. There is little available land for any alternate use.
3I BAY ISLAND 10.3 miles (10.3 miles of fastland)	FASTLAND: Entirely artificial fill. SHORE: Artificially stabilized 84%, beach 1%, and fringe marsh 15%. RIVER: Long Creek has average depths of 2 to 4 feet. Broad Bay has 6 to 9-foot depths.	FASTLAND: Residential 96% and unmanaged, unwooded 4%. SHORE: Private recreational use. RIVER: Sport boating and fishing.	Private.	High, critical. The majority of the island would be flooded during the 100-year storm.	Satisfactory from Carter Point west along Broad Bay. The remainder of the subsegment has poor water quality.	Poor. There are only narrow stretches of beach in the subsegment.	No data. Field investigations reveal one area north of Carter Point which is experiencing slight erosion. Eighty-four percent of the shoreline has been effectively stabilized.	Low. There is little available land for any alternate shore use.
4 LYNNHAVEN SHORES 2.0 miles (2.0 miles of fastland)	FASTLAND: Dunes 80% and low shore 20%. SHORE: Artificially stabilized 6% and beach 94%. NEARSHORE: Narrow 27% and intermediate 73%.	FASTLAND: Commercial 18%, recreational 68%, and unmanaged, unwooded 10%. SHORE: Various recreational uses. NEARSHORE: Sport boating and fishing. Commercial shipping in Thimble Shoal Channel.	Private.	High, critical. The area behind the protective dunes would be flooded from the Lynnhaven River side during the 100-year storm.	Satisfactory. The Chesapeake Bay has good water quality.	Good. The entire shoreline has wide, clean beaches.	This area has an average historical accretion rate of 4.5 to 6.7 feet per year. There are several small areas of bulkhead in the segment.	Low. There is little land available for any alternate shore use.
5 CAPE HENRY 4.7 miles (4.7 miles of fastland)	FASTLAND: Dunes 88% and low shore 12%. SHORE: Artificially stabilized 10% and beach 90%. NEARSHORE: Narrow.	FASTLAND: Military 79% and recreational 21%. SHORE: The majority of the shoreline is used for public recreational purposes. The Fort Story area is used by the military. NEARSHORE: Sport boating and fishing. Some military use in the water off Fort Story.	State 21% and federal 79%.	Low to moderate, noncritical. The wide beach and dune system would greatly diminish any storm-related flooding in this area.	Satisfactory. The Chesapeake Bay and Atlantic Ocean have good water quality.	Good. The Cape Henry area has excellent beaches.	Slight or no change to severe, noncritical. The area of most historical erosion is from the tip of Cape Henry to the seawall, with a rate of 3.2 to 4.3 feet per year. There are several thousand feet of effective riprap in the segment. The Fort Story area has employed snow fencing in an effort to trap and retain sand.	None, unless control of the Fort Story area is relinquished by the military.
6 NORTH VIRGINIA BEACH 2.7 miles (2.7 miles of fastland)	FASTLAND: Dunes 70% and low shore 30%. SHORE: Artificially stabilized 18% and beach 82%. NEARSHORE: Narrow.	FASTLAND: Commercial 6% and residential 94%. SHORE: Public recreational use. NEARSHORE: Sport and commercial boating and fishing.	Private.	High, critical. Past floods indicate that this area is highly susceptible to flooding.	Satisfactory. The Atlantic Ocean has good water quality.	Good. North Virginia Beach has excellent beaches, usually backed by dunes.	North Virginia Beach has an average historical accretion rate of 0.6 to 3.8 feet per year. There are approximately 2,600 feet of effectively stabilized shoreline in the segment.	Low. There are no available lands for alternate development.

TABLE 4 (CONT'D)

SUBSEGMENT	SHORELANDS TYPE	SHORELANDS USE	OWNERSHIP	FLOOD HAZARD	WATER QUALITY	BEACH QUALITY	SHORE EROSION SITUATION	ALTERNATE SHORE USE
7 VIRGINIA BEACH 3.4 miles (3.4 miles of fastland)	FASTLAND: Entirely low shore. SHORE: Artificially stabilized 91% and beach 9%. NEARSHORE: Narrow.	FASTLAND: Commercial 87% and residential 13%. SHORE: Public recreational use. NEARSHORE: Sport boating, fishing, and other water sports.	Private.	High, critical. Past floods show that this area is highly susceptible to flooding.	Satisfactory. The Atlantic Ocean has good water quality.	Good. The beaches in this segment are excellent. The City of Virginia Beach, in conjunction with the federal government, has an active beach nourishment program for this section of shoreline.	The entire segment has portrayed a slight erosional trend in the past 100 years. However, with the artificial nourishment, there is no way to accurately determine the recent erosion rates. 16,400 feet of the segment is protected by a concrete seawall behind the beach zone.	Low. There is no land available for any alternate use.
8 RUDEE INLET TO SANDBRIDGE 12.2 miles (16.0 miles of fastland)	FASTLAND: Dunes 28%, artificial fill 9%, and low shore 63%. SHORE: Artificially stabilized 19%, beach 47%, fringe marsh 15%, and embayed marsh 19%. NEARSHORE: Narrow 40%. The remainder of the segment is too narrow and shallow for classification.	FASTLAND: Agricultural <1%, commercial 7%, military 29%, recreational 7%, residential 26%, unmanaged, wooded 27%, and unmanaged, unwooded 4%. SHORE: Most of the ocean-fronting shoreline is used by the military. The remainder is mostly used for private recreation. NEARSHORE: Sport boating, fishing, and other water sports, except in the area controlled by the military.	Private 64%, federal 25%, state 4%, and city 7%.	High, critical. Past floods indicate that Lake Rudee and the area south of Rudee Inlet are vulnerable to flooding. The dunes along the military lands generally are of sufficient height to withstand flooding.	Rudee Inlet is closed for the taking of shellfish. The Atlantic Ocean has good water quality.	Good. The ocean-fronting section has wide, clean beaches.	Moderate to severe, noncritical. Most of the ocean shoreline has an average historical erosion rate of 1.3 to 2.7 feet per year. The southern end of the segment has eroded at an average rate of 3.0 to 3.9 feet per year. There are approximately 12,500 feet of artificially stabilized shoreline in the segment, as well as two riprap jetties at the mouth of Rudee Inlet.	Low. There is no land available for public recreational facilities. Some residential development will probably continue in this area.
9A SANDBRIDGE-OCEAN SIDE 5.3 miles (5.3 miles of fastland)	FASTLAND: Entirely dunes. SHORE: Artificially stabilized 1% and beach 99%. NEARSHORE: Narrow.	FASTLAND: Commercial 1%, recreational 14%, and residential 85%. SHORE: Private and public recreation. NEARSHORE: Sport boating, fishing, and other water sports.	Private 86% and city 14%.	High, critical. Past floods indicate that this area is highly susceptible to flooding.	Satisfactory. The Atlantic Ocean has good water quality.	Good. The entire subsegment has a wide, clean beach.	Severe, noncritical and critical. The entire shoreline has experienced severe erosion over the past 100 years, with a slight decline in retreat for the past 43 years. There are two areas of bulkhead at Sandbridge.	Low. The major portion of the shoreline is used for residential purposes, with continuing development along the Sandbridge area.
9B SANDBRIDGE-NORTH BAY SIDE 23.4 miles (15.7 miles of fastland)	FASTLAND: Dunes 4%, artificial fill 70%, and low shore 26%. SHORE: Artificially stabilized 12%, fringe marsh 38%, and extensive marsh 50%. NEARSHORE: North Bay is too shallow for classification.	FASTLAND: Agricultural 11%, recreational 4%, residential 76%, and unmanaged, wooded 9%. SHORE: Waterfowl hunting in the marshes. NEARSHORE: Sport fishing.	Private 96% and city 4%.	High, critical. The marshes and new residential developments would be inundated during the 100-year storm.	Unsatisfactory. Most of the water quality problems stem from natural swamp conditions, which cannot be altered.	There are no beaches in the subsegment.	No data; the area appears to be stable. There are approximately 15,400 feet of artificially stabilized shoreline in the subsegment, most of which is for retaining fill.	Low. Due to the existing large amounts of city, state, and federal lands in the Back Bay area, other public acquisitions do not seem probable.
10A BACK BAY NATIONAL WILDLIFE REFUGE-OCEAN SIDE 4.4 miles (4.4 miles of fastland)	FASTLAND: Entirely dunes. SHORE: Beach. NEARSHORE: Narrow.	FASTLAND: Preserved. SHORE: Public recreation. NEARSHORE: Sport and commercial boating and fishing.	Federal.	High, noncritical. The dunes along this section of shoreline would probably be breached during the 100-year storm.	Satisfactory. The Atlantic Ocean has good water quality.	Good. This section of shoreline has wide, clean beaches.	Moderate to severe, noncritical. The average historical erosion rate for this area was 2.1 to 8.4 feet per year. Recent rates have ranged from accretion along the southern section to erosion of 1.1 to 5.2 feet per year for the rest of the subsegment.	None. The area has no alternate use potential as long as it remains a National Wildlife Refuge.
10B BACK BAY NATIONAL WILDLIFE REFUGE-BACK BAY SIDE 13.2 miles (5.0 miles of fastland)	FASTLAND: Entirely dunes. SHORE: Fringe marsh 3% and extensive marsh 97%. NEARSHORE: Back Bay is too shallow for classification.	FASTLAND: Preserved. SHORE: Wildlife refuge. NEARSHORE: Sport fishing.	Federal.	High, noncritical. The entire subsegment, with the exception of some dunes, would be inundated during the 100-year storm.	Unsatisfactory. Most of the water quality problems stem from natural swamp conditions, which cannot be altered.	There are no beaches in this subsegment.	No data. Field investigations show no evidence of significant erosion.	None. The area has no alternate use potential as long as it remains a National Wildlife Refuge.
11A FALSE CAPE-OCEAN SIDE 5.8 miles (5.8 miles of fastland)	FASTLAND: Entirely dunes. SHORE: Beach. NEARSHORE: Narrow 27% and intermediate 73%.	FASTLAND: Public recreational park. SHORE: The area is preserved and mostly unused at present. NEARSHORE: Commercial and sport boating and fishing.	State.	High, noncritical except for a few isolated structures which would be inundated during the 100-year storm.	Satisfactory. This subsegment meets the State Water Control Board's 305 (b)(1)(B) criteria and the Bureau of Shellfish Sanitation standards.	Good. The entire shoreline has wide, clean beaches.	Slight to moderate, noncritical. The southern portion of the shoreline has been accreting.	None. There is no alternate use potential for this area as long as it remains a State Park.

TABLE 4 (CONT'D)

SUBSEGMENT	SHORELANDS TYPE	SHORELANDS USE	OWNERSHIP	FLOOD HAZARD	WATER QUALITY	BEACH QUALITY	SHORE EROSION SITUATION	ALTERNATE SHORE USE
11B FALSE CAPE- BACK BAY SIDE 16.9 miles (11.2 miles of fastland)	FASTLAND: Dunes 5% and low shore 95%. SHORE: Fringe marsh 13% and extensive marsh 87%. NEARSHORE: Back Bay is too shallow for classification.	FASTLAND: Public recreation. SHORE: The area is preserved and mostly unused at present. NEARSHORE: Some sport fishing.	State.	High, noncritical except for a few structures which would be inundated during the 100-year storm.	Unsatisfactory. Most of the water quality problems stem from natural swamp conditions, which cannot be altered.	There are no beaches in this subsegment.	No data; the area appears to be stable. There is one section of cosmetic bulkhead in the subsegment.	None. There is no alternate use potential for this area as long as it remains a State Park.
12A HELL POINT CREEK TO BACK BAY REFUGE LIMITS 19.0 miles (15.1 miles of fastland)	FASTLAND: Entirely low shore. SHORE: Fringe marsh 3%, embayed marsh 13%, and extensive marsh 84%. NEARSHORE: North and Shipps Bays are too shallow for classification.	FASTLAND: Agricultural 42%, residential 21%, and unmanaged, wooded 37%. SHORE: Some waterfowl hunting, but mostly unused. NEARSHORE: Sport fishing.	Private 99% and federal 1%.	High, noncritical except for a few structures at the mouth of Muddy Creek, which would be inundated during the 100-year storm.	Unsatisfactory. Most of the water quality problems stem from natural swamp conditions, which cannot be altered.	There are no beaches in this subsegment.	No data. The area appears to be stable.	Low. Any alternate development would be at the sacrifice of the agricultural lands.
12B BACK BAY REFUGE TO STATE LINE 14.3 miles (13.0 miles of fastland)	FASTLAND: Artificial fill 18% and low shore 82%. SHORE: Artificially stabilized 2%, fringe marsh 6%, and extensive marsh 92%. NEARSHORE: Back Bay is too shallow for classification.	FASTLAND: Agricultural 41%, preserved 1%, residential 11%, unmanaged, wooded 36%, and unmanaged, unwooded 11%. SHORE: Waterfowl hunting in the marshes. NEARSHORE: Sport fishing.	Private 98%, federal 1%, and state 1%.	High, noncritical except for a few structures which would be inundated during the 100-year storm.	Unsatisfactory. Most of the water quality problems stem from natural swamp conditions, which cannot be altered.	There are no beaches in this subsegment.	No data. The area appears to be stable. There are approximately 1,600 feet of wooden bulkhead in the subsegment, for retaining fill.	Low. Back Bay is a unique ecosystem which should remain unspoiled.
12C KNOTTS ISLAND AND CEDAR ISLAND 10.9 miles (5.0 miles of fastland)	FASTLAND: Entirely low shore. SHORE: Artificially stabilized 4%, fringe marsh 20%, and extensive marsh 76%. NEARSHORE: Back Bay is too shallow for classification.	FASTLAND: Agricultural 7%, residential 31%, and unmanaged, wooded 62%. SHORE: The marshes at Knotts Island are preserved wildlife refuges. NEARSHORE: Sport boating and fishing.	Private. The marshes are owned by state and federal governments.	High, critical. Several structures on Knotts and Cedar Islands would be inundated during the 100-year storm.	Unsatisfactory. Most of the water quality problems stem from natural swamp conditions, which cannot be altered.	There are no beaches in this subsegment.	No data. The area appears to be stable. There are approximately 2,300 feet of artificially stabilized shoreline in the subsegment, mainly for cosmetic purposes.	Low. Though some isolated residential development is possible on Knotts Island, the land is already mostly used.
13A NORTH LANDING RIVER- EAST BANK 11.8 miles (9.9 miles of fastland)	FASTLAND: Artificial fill 26% and low shore 74%. SHORE: Artificially stabilized 2%, beach 7%, fringe marsh 31%, and extensive marsh 60%. RIVER: The North Landing River has average depths of 2 to 6 feet.	FASTLAND: Agricultural 39%, residential 17%, unmanaged, wooded 16%, and unmanaged, unwooded 28%. SHORE: Waterfowl hunting in the marshes. RIVER: The Intracoastal Waterway is used by a variety of pleasure craft.	Private.	High, noncritical except for a few structures which would be inundated during a severe hurricane.	Low. The North Landing River does not meet the State Water Control Board's 305(b)(1)(B) criteria.	Poor to fair. The shoreline at Munden generally has fair beaches.	No data. The area appears to be stable. There are approximately 1,500 feet of effective artificial stabilization in the subsegment.	Moderate. The City of Virginia Beach is considering the purchase of a site near Munden for use as a public park.
13B NORTH LANDING RIVER- WEST BANK 20.4 miles (12.6 miles of fastland)	FASTLAND: Entirely low shore. SHORE: Fringe marsh 2%, embayed marsh 27%, and extensive marsh 71%. RIVER: The North Landing River has average depths of 2 to 6 feet.	FASTLAND: Agricultural 25%, residential 5%, and unmanaged, wooded 69%. SHORE: Waterfowl hunting in the marshes. RIVER: Various pleasure craft use the Intracoastal Waterway.	Private.	High, noncritical. The North Landing River area would be flooded during severe hurricanes.	Unsatisfactory. This area does not meet the State Water Control Board's 305(b)(1)(B) criteria.	There are no beaches in this subsegment.	No data. The area appears to be stable.	Low. The wide extensive marsh system fronting the fastland limits access to the water. These marshes should be preserved in their natural state.

SEGMENT 1
LITTLE CREEK

Map 2

EXTENT: 38,600 feet (7.3 mi.) of shoreline in the Virginia Beach portion of Little Creek. The segment includes 38,600 feet (7.3 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Dunes 8% (0.6 mi.), artificial fill 73% (5.3 mi.), and low shore 19% (1.4 mi.).

SHORE: Artificially stabilized 67% (4.9 mi.), beach 26% (1.9 mi.), and fringe marsh 7% (0.5 mi.).

NEARSHORE: Narrow 78%. The remainder of the shoreline is located in the Desert Cove section of Little Creek which has 6-foot depths.

SHORELANDS USE

FASTLAND: Military 78% (5.7 mi.), industrial 5% (0.4 mi.), recreational 1% (0.1 mi.), and unmanaged, unwooded 16% (1.1 mi.).

SHORE: Industrial use at the railroad docks; military use for the rest of Little Creek; recreational use along the Chesapeake Bay fronting shoreline.

NEARSHORE: Military and commercial shipping along the Bay and in Little Creek.

WIND AND SEA EXPOSURE: The Little Creek Channel trends basically N - S, with two E - W intersections. Virtually unlimited fetches both across the Chesapeake Bay and from the Atlantic affect the mouth of Little Creek from the NW - SE.

OWNERSHIP: Private 21%, federal 78% and city 1%.

FLOOD HAZARD: Moderate, noncritical except for several isolated structures along the shoreline which could be damaged or destroyed during the 100-year flood.

WATER QUALITY: Unsatisfactory. Little Creek does not meet the Bureau of Shellfish Sanitation's standards or the State water quality standards. Water quality problems are due to the intense boating activities on the creek and leachate from failing septic tanks in the area.

BEACH QUALITY: Fair to good. Most beaches in Little Creek are of fair length and moderate width. Those bordering the Chesapeake Bay are wide and fairly clean.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data for the interior of Little Creek. The Chesapeake Bay portion of the segment has an historical average erosion rate of 2.5 feet per year.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are approximately 25,900 feet of artificially stabilized shoreline in the segment, 6,800 feet of which is riprap and the remainder bulkhead. These structures are mostly for industrial and cosmetic purposes and appear to be effective. There are two effective rubble riprap jetties at the entrance to Little Creek.

OTHER SHORE STRUCTURES: There are numerous docks for military and commercial vessels in Little Creek. Several piers are also located in the segment.

SHORE USE LIMITATIONS: Seventy-eight percent of the shorelands in this segment are included in the U.S. Navy Little Creek Amphibious Base. These lands are not available for private development. The land along the west side of the entrance to Little Creek is mostly used for industrial purposes. A small area along the Chesapeake Bay is a city-owned parcel which might eventually be used for a park.

ALTERNATE SHORE USE: Low. There is little land available for any alternate shore use. The only area with any unused land is along the western side of the Little Creek Channel. However, industrial development has already begun for parts of the area, thus restricting any alternate use.

MAPS: USGS, 7.5 Min.Ser. (Topo.), LITTLE CREEK Quadr., 1964, pr. 1970.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 22Oct76 VB-1/1-32.

SEGMENT 2

LITTLE CREEK TO LYNNHAVEN INLET

Map 2

EXTENT: 26,200 feet (5.0 mi.) of shoreline along the Chesapeake Bay from Little Creek to the mouth of Lynnhaven Inlet. The segment includes 26,200 feet (5.0 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Dunes 69% (3.4 mi.) and low shore 31% (1.6 mi.).

SHORE: Artificially stabilized 13% (0.7 mi.) and beach 87% (4.3 mi.). Beaches also front the stabilized areas.

NEARSHORE: Narrow 33% and intermediate 67%.

SHORELANDS USE

FASTLAND: Military 46% (2.3 mi.), industrial 1% (0.1 mi.), and residential 53% (2.6 mi.).

SHORE: Military use along that section of shoreline owned by the government; mostly private recreational use for the remainder of the segment.

NEARSHORE: Commercial shipping offshore; sport boating, sport and commercial fishing, and other water sports.

WIND AND SEA EXPOSURE: The shoreline trends basically WNW - ESE. The segment is exposed to virtually unlimited fetches across the Chesapeake Bay from the north through the east quadrants.

OWNERSHIP: Private 54% and federal 46%.

FLOOD HAZARD: High, critical. Past floods show that this area is very vulnerable to storm damage, especially the Ocean Park area. Many of the protective dunes which were once located along this shoreline were reduced when the area was developed, severely limiting their effectiveness in control of wave washovers. Many structures and roads would be damaged or destroyed during the 100-year storm.

WATER QUALITY: Satisfactory. The waters of the Chesapeake Bay meet the Bureau of Shellfish Sanitation's standards and the State Water Control Board's 305(b)(1)(B) criteria.

BEACH QUALITY: Good. The beaches in this segment are wide and sandy with dunes in some areas.

PRESENT SHORE EROSION SITUATION

EROSION RATE: The area from 1½ miles west of the Bay Bridge-Tunnel to Lynnhaven Inlet has an historical average erosion rate of 4.3 feet per year prior to stabilization. The area just east of the entrance to Little Creek is accreting. Much of the eroding shoreline has been artificially stabilized.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are approximately 3,500 feet of artificially stabilized shoreline, several hundred feet of which is riprap and the remainder bulkhead. The bulkhead is located in front of residences between the Bridge-Tunnel and Lynnhaven Inlet. All structures appear to be effective. Snow fencing has been employed in several areas in an effort to trap and retain sand.

OTHER SHORE STRUCTURES: The Chesapeake Bay Bridge-Tunnel is located in this segment.

SHORE USE LIMITATIONS: Forty-six percent of the shoreline is owned by the federal government and is not available for other use. The rest of the segment is already extensively used for residences and businesses.

ALTERNATE SHORE USE: Low. The shorelands of this segment are already extensively used. Although some continued residential/commercial growth is possible for the privately owned section, no change in the present use for the segment seems probable.

MAPS: USGS, 7.5 Min.Ser. (Topo.), LITTLE CREEK Quadr., 1964, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY Quadr., 1964, pr. 1970.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 22Oct76 VB-2/33-85.

SUBSEGMENT 3A

LESNER BRIDGE TO CHURCH POINT

Map 4

EXTENT: 37,200 feet (7.0 mi.) of shoreline along the Lynnhaven River from the Lesner Bridge to Church Point, including Pleasure House and Bayville Creeks. The subsegment also includes 32,900 feet (6.2 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Dunes 13% (0.8 mi.), artificial fill 24% (1.5 mi.), low shore 60% (3.8 mi.), and low shore with bluff 3% (0.2 mi.).

SHORE: Artificially stabilized 2% (0.1 mi.), beach 12% (0.9 mi.), fringe marsh 77% (5.4 mi.), and embayed marsh 9% (0.6 mi.).

RIVER: The Lynnhaven River has depths of 1 to 10 feet along this subsegment.

SHORELANDS USE

FASTLAND: Agricultural 34% (2.1 mi.), residential 29% (1.8 mi.), unmanaged, wooded 23% (1.5 mi.), and unmanaged, unwooded 14% (0.8 mi.).

SHORE: Access to the water along residential sections; otherwise, mostly unused.

RIVER: The Lynnhaven River is used extensively by private pleasure craft for fishing and other water sports.

WIND AND SEA EXPOSURE: The subsegment trends basically NE - SW. No significant fetches affect the interior portions of the Lynnhaven River. Fetches at Lynnhaven Inlet are virtually unlimited from the north through the northeast quadrants across the Chesapeake Bay.

OWNERSHIP: Private.

FLOOD HAZARD: High, critical. According to the Corps of Engineers "Flood Plain Information" for Virginia Beach, much of the inland area between Pleasure House Creek and Route 60 would be inundated during the 100-year flood, endangering the structures located there.

WATER QUALITY: Unsatisfactory for the Pleasure House Creek area. This section does not meet the Bureau of Shellfish Sanitation's standards. The area around Bayville Creek was opened for the taking of shellfish on September 14, 1977.

BEACH QUALITY: Good. The only beaches in the subsegment are located at the mouth of the river. This area has nice wide sand beaches with vegetated dunes on the interior.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are 800 feet of bulkhead in the subsegment which is used mainly for cosmetic purposes and retaining fill. All structures appear to be effective.

OTHER SHORE STRUCTURES: There are several piers in the subsegment.

SHORE USE LIMITATIONS: The major limiting factor along this section of shoreline is the high flood hazard for most areas of the subsegment. Also, the section from Pleasure House Creek to Bayville Creek is one of the few large agricultural areas remaining along the Lynnhaven River. Any development here would be at the sacrifice of the agriculture. Elsewhere, the shorelands are either already consumed or are in the process of being developed.

ALTERNATE SHORE USE: Moderate to low. Most of the subsegment is actively used either for agriculture or for residences. The only section which could be developed for public recreation is the beach and dune area near the Lesner Bridge.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY Quadr., 1964, pr. 1970.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 11Apr77 VB-3A/86-101.

SUBSEGMENT 3B

WESTERN BRANCH OF LYNNHAVEN RIVER

Map 4

EXTENT: 219,800 feet (41.6 mi.) of shoreline along the Western Branch of the Lynnhaven River from Church Point to Hill Point. This subsegment contains 227,900 feet (43.2 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 4% (1.7 mi.), low shore 96% (41.3 mi.), and low shore with bluff 1% (0.2 mi.).

SHORE: Artificially stabilized 3% (1.1 mi.), beach 1% (0.3 mi.), fringe marsh 92% (38.4 mi.), and embayed marsh 4% (1.8 mi.).

RIVER: The Western Branch of the Lynnhaven River is shallow with average depths of 4 to 8 feet.

SHORELANDS USE

FASTLAND: Agricultural 1% (0.6 mi.), commercial 1% (0.2 mi.), industrial 1% (0.3 mi.), residential 92% (39.7 mi.), and unmanaged, wooded 6% (2.4 mi.).

SHORE: The shore zone in this subsegment is generally too narrow to be used. There is some private recreational use in several sections of the subsegment.

RIVER: The Western Branch of the Lynnhaven River is extensively used by small craft for sport boating, fishing, and other water sports.

WIND AND SEA EXPOSURE: The Western Branch trends basically N - S from mouth to head, with many small creeks branching off to the SW and SE.

OWNERSHIP: Private 97% and city 3%.

FLOOD HAZARD: High, critical. Much of the shoreline in this subsegment would be inundated during the 100-year flood, according to "Flood Plain Information" for Virginia Beach (Corps of Engineers, 1969). Especially susceptible to damage would be the peninsula south of Thoroughgood Cove and the developments along the south bank of Buchanan Creek. Many structures would be endangered by flood waters.

WATER QUALITY: Satisfactory for the portion of

the subsegment north of a line drawn from the mouth of Witch Duck Bay across to the opposite shoreline. This area was opened to the taking of shellfish on September 14, 1977. The rest of the subsegment has unsatisfactory water quality.

BEACH QUALITY: Poor. There are only small pocket beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The shoreline appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are approximately 5,700 feet of artificially stabilized shoreline in the subsegment, fifty feet of which is rubble riprap and the remainder bulkhead. These structures all seem to be effective, though they are mainly for cosmetic purposes rather than for erosion protection.

OTHER SHORE STRUCTURES: There are numerous piers and several boat ramps in this subsegment.

SHORE USE LIMITATIONS: The existing shore use effectively limits other development along the Western Branch, as ninety-four percent of the shorelands are either used for residential, commercial, and industrial purposes, or are being so developed.

ALTERNATE SHORE USE: Low. There is little available land for any alternate shore use. Continued residential development will probably take place along this shoreline until a high density is reached.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY Quadr., 1964, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), LITTLE CREEK Quadr., 1964, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), PRINCESS ANNE Quadr., 1965, pr. 1970 and 1973;
USGS, 7.5 Min.Ser. (Topo.), KEMPSVILLE Quadr., 1965, pr. 1970.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 11Apr77 VB-3B/102-181.

SUBSEGMENT 3C

LYNNHAVEN BAY

Maps 4 and 5

EXTENT: 53,200 feet (10.1 mi.) of shoreline from Hill Point to Sandy Point along Lynnhaven Bay. The subsegment includes 53,300 feet (10.1 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Low shore 99% (10.0 mi.) and low shore with bluff 1% (0.1 mi.).

SHORE: Artificially stabilized 6% (0.6 mi.), beach 2% (0.2 mi.), fringe marsh 89% (8.9 mi.), and embayed marsh 3% (0.3 mi.).

RIVER: The Lynnhaven Bay section of the Lynnhaven River is generally shallow, with average depths of 2 feet.

SHORELANDS USE

FASTLAND: Agricultural 1% (0.1 mi.), residential 93% (9.4 mi.), and unmanaged, wooded 6% (0.6 mi.).

SHORE: The only shore use would be for private recreation in front of residences. Generally, the shore zone is too narrow for much use.

RIVER: Lynnhaven Bay is used for sport boating, fishing, and other water sports.

WIND AND SEA EXPOSURE: The subsegment trends basically NW - SE. No significant fetches affect the shoreline.

OWNERSHIP: Private.

FLOOD HAZARD: High, critical. The 100-year storm would inundate areas up to the 8-foot contour. According to "Flood Plain Information", much of the shoreline in this subsegment would be flooded, especially the Sandy Point area. Numerous structures would be endangered by such flooding.

WATER QUALITY: Satisfactory for most of the subsegment. This area was opened to the taking of shellfish on September 14, 1977. The only area with unsatisfactory water quality is Dix Creek.

BEACH QUALITY: Poor. There are only thin pocket beaches in this subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are approximately 3,300 feet of artificially stabilized shoreline in the subsegment, 150 feet of which is riprap and the rest bulkhead. These structures are mainly for cosmetic purposes rather than for erosion protection. All structures appear to be effective at controlling erosion.

OTHER SHORE STRUCTURES: There are numerous piers in the subsegment.

SHORE USE LIMITATIONS: Like most of the Lynnhaven area, the vast majority of shorelands in this subsegment (93%) have been consumed for residential purposes. New structures along the shoreline should be built at elevations sufficient to withstand flooding or have adequate flood proofing.

ALTERNATE SHORE USE: Low. The present use of the shorelands effectively limits the development of alternate land uses.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY Quadr., 1964, pr. 1970.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 14Apr77 VB-3C/182-201.

SUBSEGMENT 3D

EASTERN BRANCH OF LYNNHAVEN RIVER

Map 5

EXTENT: 162,700 feet (30.8 mi.) of shoreline along the Eastern Branch of the Lynnhaven River from Sandy Point to Trants Point. The subsegment includes 176,800 feet (33.5 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 2% (0.6 mi.) and low shore 98% (32.9 mi.).

SHORE: Artificially stabilized 9% (2.8 mi.), fringe marsh 81% (25.1 mi.), and embayed marsh 10% (3.0 mi.).

RIVER: The Eastern Branch of the Lynnhaven River has average depths of 2 to 3 feet.

SHORELANDS USE

FASTLAND: Commercial 1% (0.1 mi.), industrial 1% (0.4 mi.), residential 80% (26.7 mi.), and unmanaged, wooded 19% (6.3 mi.).

SHORE: Private recreational use in front of residences, otherwise unused.

RIVER: Sport boating, fishing, and other water sports.

WIND AND SEA EXPOSURE: The Eastern Branch of the Lynnhaven River trends basically NNW - SSE. There are numerous creeks branching off the main stream. No significant fetches affect the shorelands in this subsegment.

OWNERSHIP: Private.

FLOOD HAZARD: High, critical. The 100-year flood would affect areas with elevations up to 8 feet, which would endanger many structures along the shoreline.

WATER QUALITY: Unsatisfactory. The entire subsegment does not meet applicable Bureau of Shellfish Sanitation standards and is closed to the taking of shellfish.

BEACH QUALITY: There are no beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are approximately 14,600 feet of artificially stabilized shoreline in the subsegment, several hundred feet of which is rubble riprap and the remainder bulkhead. These structures are mainly for cosmetic purposes rather than for erosion control.

OTHER SHORE STRUCTURES: There are numerous piers in the subsegment.

SHORE USE LIMITATIONS: As with most of the Lynnhaven area, the present shorelands use is the greatest limiting factor in the subsegment. Also, the high flood hazard limits development directly bordering the water.

ALTERNATE SHORE USE: Low to moderate. Most of the subsegment is already developed. However, the wooded area near Little Haven could be developed as a low intensity public park with picnic facilities. (The shorelands along this section are generally too low to be developed as residential areas.) However, water related facilities would probably be impractical here since the nearby waters are very shallow.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY Quadr., 1964, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), PRINCESS ANNE Quadr., 1965, pr. 1970 and 1973.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 14Apr77 VB-3D/202-250.

SUBSEGMENT 3E

LYNNHAVEN BAY

Map 5

EXTENT: 110,700 feet (21.0 mi.) of shoreline from Trants Point to the mouth of Long Creek at Fish House Island. The subsegment also includes 117,000 feet (22.2 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 1% (0.3 mi.) and low shore 99% (21.8 mi.).

SHORE: Artificially stabilized 8% (1.8 mi.), beach 1% (0.1 mi.), fringe marsh 88% (18.4 mi.), and embayed marsh 4% (0.7 mi.).

RIVER: The Eastern Branch of the Lynnhaven River and Lynnhaven Bay are shallow, with average depths of 2 to 4 feet. Isolated areas in Lynnhaven Bay can reach as deep as 12 to 13 feet.

SHORELANDS USE

FASTLAND: Agricultural 2% (0.4 mi.), residential 82% (18.1 mi.), and unmanaged, wooded 16% (3.7 mi.).

SHORE: Some private recreational use in front of residences, otherwise mostly unused.

RIVER: Sport boating, fishing, and other water sports.

WIND AND SEA EXPOSURE: The shoreline trends basically NW - SE in this subsegment. No significant fetches affect this area.

OWNERSHIP: Private. Less than one percent of the shorelands are owned by the state.

FLOOD HAZARD: High, critical. The 100-year storm would flood areas up to elevations of 8 feet, which would endanger many structures along the shoreline.

WATER QUALITY: Unsatisfactory from Trants Point to Avery Island, Brack Cove, and at the mouth of Long Creek. The main section of Lynnhaven Bay was opened to the taking of shellfish on September 14, 1977.

BEACH QUALITY: Poor. There are only small pocket beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are approximately 9,400 feet of artificially stabilized shoreline in the subsegment, several hundred feet of which is rubble riprap and the remainder bulkhead. Several areas have employed riprap at the base of the bulkhead to protect the toe. These structures all appear effective at controlling erosion.

OTHER SHORE STRUCTURES: There are numerous piers along the shoreline.

SHORE USE LIMITATIONS: Eighty-two percent of the shorelands are either used or are being developed for residential purposes. The unused lands generally front agricultural fields or residential areas. However, those lands near the shoreline are very susceptible to flooding and thus have a limited use potential.

ALTERNATE SHORE USE: Low. Although some continued residential development is possible for several areas in the subsegment, there are no lands that appear suitable for public recreational facilities.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY Quadr., 1964, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), PRINCESS ANNE Quadr., 1965, pr. 1970 and 1973.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 11Apr77 VB-3E/251-282.

SUBSEGMENT 3F

BROAD BAY

Maps 5 and 6

EXTENT: 53,100 feet (10.1 mi.) of shoreline from the mouth of Long Creek to The Narrows along the south bank of Broad Bay. The subsegment includes 50,000 feet (9.5 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 2% (0.2 mi.), low shore 68% (6.4 mi.), low shore with bluff 7% (0.7 mi.), moderately low shore 7% (0.7 mi.), and moderately low shore with bluff 16% (1.5 mi.).

SHORE: Artificially stabilized 22% (2.2 mi.), beach 18% (1.8 mi.), fringe marsh 42% (4.2 mi.), and embayed marsh 18% (1.8 mi.).

RIVER: Long Creek has average depths of 2 to 4 feet. Broad Bay has 7 to 8-foot depths.

SHORELANDS USE

FASTLAND: Agricultural 11% (1.0 mi.), residential 81% (7.7 mi.), and unmanaged, wooded 8% (0.7 mi.).

SHORE: Access to the water.

RIVER: Pleasure boating, fishing, and other water sports.

WIND AND SEA EXPOSURE: The shoreline trends basically WNW - ESE. No significant fetches affect the shorelands in this subsegment.

OWNERSHIP: Private.

FLOOD HAZARD: High, critical. Much of the western portion of the subsegment from the mouth of the creek to Great Neck Bridge would be inundated during the 100-year flood. Numerous structures are endangered by the flood. East of the bridge, only isolated structures are endangered, since elevations reach 25 to 30 feet above MSL.

WATER QUALITY: Satisfactory for the Broad Bay section. Unsatisfactory for Dey and Mill Dam Creeks and for the Long Creek area.

BEACH QUALITY: Poor to fair. Most of the subsegment has thin strip beaches. However, a spit

near The Narrows has a fairly nice beach with clean sand.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are 11,600 feet of artificially stabilized shoreline in the subsegment, several thousand feet of which is riprap and the rest bulkhead. All structures are for cosmetic purposes rather than for erosion protection.

OTHER SHORE STRUCTURES: There are several piers in the subsegment.

SHORE USE LIMITATIONS: This area is used extensively for residential purposes. The few unused areas have bluffs along the shoreline. The relatively high flood hazard limits the potential for development of much of the low area.

ALTERNATE SHORE USE: Low. The few unused or sparsely used areas of shoreline will probably be developed for residential use. There is little available land which is suitable for a public recreational facility.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY Quadr., 1964, pr. 1970.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 11Apr77 VB-3F/283-325.

SUBSEGMENT 3G

LINKHORN BAY

Map 6

EXTENT: 195,300 feet (37.0 mi.) of shoreline along Linkhorn Bay including Little Neck Creek, Rainey Gut, and Crystal Lake. The subsegment includes 195,900 feet (37.1 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 14% (5.0 mi.), low shore 86% (31.9 mi.), and low shore with bluff 1% (0.2 mi.).

SHORE: Artificially stabilized 51% (19.0 mi.), beach 6% (2.2 mi.), fringe marsh 42% (15.7 mi.), and embayed marsh 1% (0.1 mi.).

RIVER: Linkhorn Bay has average depths of 6 to 10 feet.

SHORELANDS USE

FASTLAND: Commercial 3% (1.0 mi.), recreational 3% (1.1 mi.), residential 91% (33.7 mi.), and unmanaged, wooded 3% (1.3 mi.).

SHORE: Private recreation in front of residences and public recreation at the marinas and country club.

RIVER: Linkhorn Bay is used for sport boating, fishing and other water sports.

WIND AND SEA EXPOSURE: Linkhorn Bay trends basically N - S; Little Neck Creek trends NW - SE. No significant fetches affect this subsegment.

OWNERSHIP: Private 97% and state 3%.

FLOOD HAZARD: High, critical. The 100-year storm would inundate areas up to elevations of 8 feet, endangering many shoreline structures.

WATER QUALITY: Unsatisfactory. This section does not meet the Bureau of Shellfish Sanitation's standards and is closed to the taking of shellfish.

BEACH QUALITY: Poor to good. The only good beaches in this subsegment are at The Narrows. This area generally has clean sandy beaches of good width.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. Most of the shorelands

appear stable. Some erosion is occurring along the Seashore State Park shoreline west of Rainey Gut.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are approximately 100,200 feet of artificially stabilized shoreline in this subsegment, several thousand feet of which is rubble riprap and the remainder bulkhead. These structures are mainly for cosmetic purposes and are effective at retaining fill.

OTHER SHORE STRUCTURES: There are numerous piers, several boat ramps and a marine railway along the shoreline. Several marinas and country clubs have covered boat slips for some vessels.

SHORE USE LIMITATIONS: The shorelands in this subsegment are already intensely used for residential, commercial, and recreational purposes. Only three percent of the lands are unused.

ALTERNATE SHORE USE: Low. There are few lands available in this subsegment for any alternate shore use. The only change would be in the density of use for the shorelands.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY Quadr., 1964, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), PRINCESS ANNE Quadr., 1965, pr. 1970 and 1973;
USGS, 7.5 Min.Ser. (Topo.), VIRGINIA BEACH Quadr., 1965, pr. 1970.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 11Apr77 VB-3G/326-423.

SUBSEGMENT 3H

THE NARROWS TO LESNER BRIDGE

Maps 5 and 6

EXTENT: 64,700 feet (12.3 mi.) of shoreline from The Narrows along the north bank of Broad Bay to the Lesner Bridge at the mouth of Lynnhaven Inlet. The subsegment includes 64,700 feet (12.3 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 70% (8.6 mi.), low shore 25% (3.1 mi.), low shore with bluff 1% (0.1 mi.), moderately low shore 1% (0.1 mi.), moderately high shore 1% (0.1 mi.), moderately high shore with bluff 1% (0.1 mi.), and high shore with bluff 2% (0.2 mi.).

SHORE: Artificially stabilized 72% (8.8 mi.), beach 4% (0.5 mi.), fringe marsh 13% (1.6 mi.), and embayed marsh 10% (1.3 mi.).

RIVER: Broad Bay has average depths of 6 to 10 feet. Long Creek has 2 to 4-foot depths.

SHORELANDS USE

FASTLAND: Commercial 14% (1.7 mi.), recreational 25% (3.1 mi.), residential 54% (6.7 mi.), and unmanaged, unwooded 7% (0.8 mi.).

SHORE: Private and public recreation, access to boats at marinas.

RIVER: Sport boating, fishing, and other water sports.

WIND AND SEA EXPOSURE: The subsegment trends basically E - W. No significant fetches affect the shoreline of this subsegment.

OWNERSHIP: Private 75% and state 25%.

FLOOD HAZARD: High, critical. The Seashore State Park section of the subsegment has old dunes which protect much of the Park area. However, the rest of the subsegment, where there are many residential developments, would be inundated during the 100-year flood.

WATER QUALITY: Satisfactory from The Narrows to the mouth of Long Creek across from Carter Point. This area was opened to the taking of shellfish on September 14, 1977. Unsatisfactory for the rest of the subsegment.

BEACH QUALITY: Fair. There are several areas along the Seashore State Park shoreline that have fairly wide beaches.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. Most of the area seems stable. Several sections of dunes along the Seashore State Park shoreline are eroding, according to recent field investigations.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: All but 200 feet of the 46,700 feet of artificially stabilized shoreline is bulkhead. These structures are for retaining fill along the many dredged canals found in the subsegment. All seem to be effective.

OTHER SHORE STRUCTURES: There are numerous piers in the subsegment. The marinas near the Lesner Bridge have many piers and several boat ramps.

SHORE USE LIMITATIONS: The privately owned section of this subsegment is very low and is susceptible to flooding. This area is constantly being developed for residential and commercial purposes. However, there is little available land for continued development. The rest of the subsegment is owned by the state.

ALTERNATE SHORE USE: Low. Seashore State Park is partially located in this subsegment. There is no available land for any other public facilities or alternate shore use.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY Quadr., 1964, pr. 1970.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 11Apr77 VB-3H/424-458;
487-489;
14Apr77 VB-3H/490-491.

SUBSEGMENT 3I

BAY ISLAND

Map 5

EXTENT: 54,300 feet (10.3 mi.) of shoreline around Bay Island, including the numerous dredged canals. The island also contains 54,300 feet (10.3 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Entirely artificial fill.

SHORE: Artificially stabilized 84% (8.7 mi.), beach 1% (0.1 mi.), and fringe marsh 15% (1.5 mi.).

RIVER: Long Creek has average depths of 2 to 4 feet. Broad Bay has 6 to 9-foot depths.

SHORELANDS USE

FASTLAND: Residential 96% (9.9 mi.) and unmanaged, unwooded 4% (0.4 mi.).

SHORE: Private recreational access to the water at the marinas and private docks.

RIVER: Sport boating and fishing in Broad Bay.

WIND AND SEA EXPOSURE: Bay Island is situated in a WSW - ENE direction in Broad Bay. No significant fetches affect the shoreline.

OWNERSHIP: Private.

FLOOD HAZARD: High, critical. Much of the island would be inundated during the 100-year storm. Numerous structures are located in the flood plain and are endangered by the flood.

WATER QUALITY: Satisfactory from Carter Point west along Broad Bay for approximately one mile. This section was opened to the taking of shellfish on September 14, 1977. The rest of the subsegment has unsatisfactory water quality.

BEACH QUALITY: Poor. There are several narrow stretches of beach in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. Most of the shoreline is stabilized. Field investigations reveal one small area north of Carter Point which is experiencing a slight erosion problem. Erosion here can be attributed to some rain runoff and to boat wakes along the narrow Long Creek.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: Eighty-four percent of the island has been artificially stabilized. Several thousand feet of shoreline has rubble riprap, mainly concentrated at the beach spit west of Great Neck Bridge. The rest of the stabilized shoreline is bulkhead, which is used to retain fill. All structures appear to be effective.

OTHER SHORE STRUCTURES: There are numerous piers and docks along the shoreline, and a marine railway and docks at the marinas near Great Neck Bridge.

SHORE USE LIMITATIONS: Bay Island is almost entirely used for residential purposes. There is little room on the island for other development.

ALTERNATE SHORE USE: Low. There is little available land on the island for any alternate shore use.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY Quadr., 1964, pr. 1970.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 11Apr77 VB-3I/459-486.

SEGMENT 4

LYNNHAVEN SHORES

Map 3

EXTENT: 10,500 feet (2.0 mi.) of shoreline along the Chesapeake Bay from Lynnhaven Inlet to Seashore State Park. The segment includes 10,500 feet (2.0 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Dunes 80% (1.6 mi.) and low shore 20% (0.4 mi.).

SHORE: Artificially stabilized 6% (0.1 mi.) and beach 94% (1.9 mi.).

NEARSHORE: Narrow 27% and intermediate 73%.

SHORELANDS USE

FASTLAND: Commercial 18% (0.4 mi.), recreational 4% (0.1 mi.), residential 68% (1.3 mi.), and unmanaged, unwooded 10% (0.2 mi.).

SHORE: Various recreational uses including sun bathing, walking, and access to the water.

NEARSHORE: Fishing, swimming and sport boating. Commercial shipping in Thimble Shoal Channel.

WIND AND SEA EXPOSURE: The segment trends basically WSW - ENE. The area is exposed to virtually unlimited fetches across the Chesapeake Bay and parts of the Atlantic Ocean from the northwest through the northeast quadrants.

OWNERSHIP: Private.

FLOOD HAZARD: High, critical. The dunes along the shoreline protect the area from most flooding and wave runup from the Bay. However, since the segment is on a peninsula, the area behind the dunes would be flooded from the Lynnhaven River side during the 100-year storm, endangering most structures.

WATER QUALITY: Satisfactory. The waters of the Chesapeake Bay meet the State Water Control Board's 305(b)(1)(B) criteria and the Bureau of Shellfish Sanitation standards.

BEACH QUALITY: Good. The entire shoreline has good wide sandy beaches.

PRESENT SHORE EROSION SITUATION

EROSION RATE: This area has an historical accretion rate of 4.5 to 6.7 feet per year. However, the shoreline in front of a newly constructed motel approximately 2,500 feet east of the bridge has recently been retreating at a moderate rate.

ENDANGERED STRUCTURES: One new motel, with a swimming pool and parking lot near the shore, is endangered by continued erosion.

SHORE PROTECTIVE STRUCTURES: There are several small areas of bulkhead in the segment. These structures are in front of buildings recently constructed in the dune zone.

OTHER SHORE STRUCTURES: The fishing pier at Lynnhaven Shores is the only other shore structure in the segment.

SHORE USE LIMITATIONS: This area is used extensively for residential and commercial purposes. Though several sections have large open spaces between developed areas and the shore, no structures should be built on or in front of the dunes. The dunes should be left in their natural state, as they are important flood and erosion control agents.

ALTERNATE SHORE USE: Low. There is little available land in the segment for any additional development.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY Quadr., 1964, pr. 1970.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 14Apr77 VB-4/492-501.

SEGMENT 5

CAPE HENRY

Maps 3 and 6

305(b)(1)(B) criteria and the Bureau of Shellfish Sanitation standards.

BEACH QUALITY: Good. The Cape Henry area has excellent beaches of good width and generally clean sand.

PRESENT SHORE EROSION SITUATION

EROSION RATE: Slight or no change to severe, noncritical. The area of most historical change has been at the tip of Cape Henry, from 26th Street east to the seawall. This shoreline has an average historical erosion rate of 3.2 to 4.3 feet per year. On either end of this area, the shoreline has a moderate, noncritical average historical erosion rate. Most of the remaining shoreline has an historical trend of accretion.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: The area northwest of the Cape Henry Memorial Monument has a riprap seawall several thousand feet long. This structure is for erosion and flood control and appears to be effective. There is a small section of bulkhead east of 26th Street. This structure is built behind the dune line. Elsewhere at Fort Story, there are several sections with snow fencing, used for catching wind driven sand and for stabilizing existing dunes.

OTHER SHORE STRUCTURES: None.

SHORE USE LIMITATIONS: The shorelands are owned by the state and federal governments, which effectively limits other use.

ALTERNATE SHORE USE: None, unless control of the Fort Story area is relinquished by the federal government.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY
Quadr., 1964, pr. 1970.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk
Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 14Apr77 VB-5/503-527;
11May77 VB-5/528.

EXTENT: 24,700 feet (4.7 mi.) of shoreline from the Seashore State Park limits to the Fort Story limits, including Seashore State Park and Fort Story. The segment includes 24,700 feet (4.7 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Dunes 88% (4.1 mi.) and low shore 12% (0.6 mi.).

SHORE: Artificially stabilized 10% (0.5 mi.) and beach 90% (4.2 mi.). Beach is also located in front of the artificially stabilized areas.

NEARSHORE: Narrow.

SHORELANDS USE

FASTLAND: Military 79% (3.7 mi.) and recreational 21% (1.0 mi.).

SHORE: The shore zone of Seashore State Park is used for a variety of recreational uses including sun bathing, walking, camping, and access to the water. Along the Fort Story shoreline, the major user is the military. However, the dunes and beaches are also used for recreation by Army personnel, their families and friends.

NEARSHORE: Sport boating, fishing, and other water sports. Some military use in the waters off Fort Story.

WIND AND SEA EXPOSURE: The segment trends first SW - NE, then W - E, and finally NW - SE around Cape Henry. Since Cape Henry is located at the mouth of the Chesapeake Bay, the entire segment is exposed to essentially unlimited fetches across both the Bay and the Atlantic Ocean.

OWNERSHIP: State 21% and federal 79%.

FLOOD HAZARD: Low to moderate, noncritical.

Though some areas of the segment could be flooded during the 100-year storm, the wide beach and extensive dune system along the shoreline would diminish the high storm tides.

WATER QUALITY: Satisfactory. The waters of the Chesapeake Bay and the Atlantic Ocean near Cape Henry meet both the State Water Control Board's

SEGMENT 6

NORTH VIRGINIA BEACH

Map 6

EXTENT: 14,400 feet (2.7 mi.) of shoreline from the Fort Story limits to 49th Street. The segment also includes 14,400 feet (2.7 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Dunes 70% (1.9 mi.) and low shore 30% (0.8 mi.).

SHORE: Artificially stabilized 18% (0.5 mi.) and beach 82% (2.2 mi.).

NEARSHORE: Narrow.

SHORELANDS USE

FASTLAND: Commercial 6% (0.2 mi.) and residential 94% (2.5 mi.).

SHORE: The entire beach is open to the public, with access at the ends of all intercepting streets. The beach is used for a variety of recreational purposes.

NEARSHORE: Swimming and some fishing near to shore. Sport boating, fishing, and commercial traffic further offshore.

WIND AND SEA EXPOSURE: The shoreline of North Virginia Beach trends basically NNW - SSE. The entire segment is open to unlimited fetches across the Atlantic Ocean from the north through the southeast quadrants.

OWNERSHIP: Private.

FLOOD HAZARD: High, critical. Past floods have shown that this area of Virginia Beach is highly susceptible to flood damage during periods of abnormally high water. The "northeaster" of March 1962 caused much destruction of structures well into the fastland. Along the oceanfront 45 homes were either severely damaged or destroyed. Little has been done since that time to lessen future flood losses.

WATER QUALITY: Satisfactory. The waters of the Atlantic Ocean meet the water quality standards of both the State Water Control Board and the Bureau of Shellfish Sanitation.

BEACH QUALITY: Good. The oceanfront shoreline of Virginia Beach has sand beaches usually several hundred feet wide. Most of the North Virginia Beach shore is backed by dunes.

PRESENT SHORE EROSION SITUATION

EROSION RATE: The shoreline of North Virginia Beach has fluctuated in the past, showing periods of both erosion and accretion. The average behavior has been accretion varying between 0.6 to 3.8 feet per year. Several areas in recent years show a slight erosional trend.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are approximately 2,600 feet of bulkhead in the segment, located from 58th Street south to the end of the segment. This structure appears to be effective.

OTHER SHORE STRUCTURES: None.

SHORE USE LIMITATIONS: There is little available shoreland which could be developed. No construction should take place seaward of the dunes.

ALTERNATE SHORE USE: North Virginia Beach is a residential area which is totally consumed. There is no space for any alternate development, although redevelopment of already used lands is an ongoing process. Care should be taken to ensure the maintenance of the public beaches and the valuable dune system found in this area.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY Quadr., 1964, pr. 1970.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 11May77 VB-6/529-540.

SEGMENT 7

VIRGINIA BEACH

Maps 6 and 7

EXTENT: 18,000 feet (3.4 mi.) of shoreline along the Atlantic Ocean from 49th Street to Rudee Inlet. The segment also includes 18,000 feet (3.4 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Entirely low shore.

SHORE: Artificially stabilized 91% (3.1 mi.) and beach 9% (0.3 mi.). Large expanses of beach also front the stabilized areas.

NEARSHORE: Narrow.

SHORELANDS USE

FASTLAND: Commercial 87% (2.9 mi.) and residential 13% (0.5 mi.).

SHORE: The beaches of this section of Virginia Beach are used by millions of tourists for sun bathing, strolling, and access to the Atlantic Ocean.

NEARSHORE: The waters of the Atlantic Ocean near to shore are used for swimming. The waters further from shore are used for pleasure boating and fishing. Commercial traffic is extensive in the offshore shipping lanes.

WIND AND SEA EXPOSURE: The shoreline trends basically NNW - SSE in this segment. There are unlimited fetches along the entire shoreline from the northeast through the southeast quadrants.

OWNERSHIP: Private.

FLOOD HAZARD: High, critical. Past storms have shown that this section of Virginia Beach is very vulnerable to flood inundation and damage. The boardwalk and numerous structures along the shoreline could be damaged or destroyed during a severe storm.

WATER QUALITY: Satisfactory. The waters of the Atlantic Ocean near this section of Virginia Beach meet all applicable water quality standards.

BEACH QUALITY: Good. This segment is the resort center of Virginia Beach. The beaches are very wide with clean sand. The City of Virginia

Beach, in conjunction with the federal government, has an active program of beach nourishment for this section of shoreline.

PRESENT SHORE EROSION SITUATION

EROSION RATE: The entire segment has portrayed a slight erosional trend in the past 100 years. However, with the program of beach restoration and artificial nourishment since the March 1962 storm, there is no way to accurately determine the recent erosion rate.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: 16,400 feet of the segment is protected by a concrete seawall behind the beach zone. The seawall has been damaged during past storms and then repaired or replaced. While the structure is effective, it again could fail during severe storms or hurricanes.

OTHER SHORE STRUCTURES: There are two fishing piers in the segment.

SHORE USE LIMITATIONS: The shorelands in this segment are completely used for residential and commercial purposes.

ALTERNATE SHORE USE: Given the lack of unused space, no alternate shore use seems likely. It is assumed that commercial interests will continue to redevelop existing residential areas for commercial purposes, mainly restaurants, motels and other tourist oriented concerns.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CAPE HENRY Quadr., 1964, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), VIRGINIA BEACH Quadr., 1965, pr. 1970.
NOS# 12222 (562), 1:40,000 scale,
CHESAPEAKE BAY, Cape Charles to Norfolk Harbor, VA, 16th ed., 1976.

PHOTOS: Aerial-VIMS 11May77 VB-7/541-560.

SEGMENT 8

RUDEE INLET TO SANDBRIDGE

Maps 7 and 8

EXTENT: 64,400 feet (12.2 mi.) of shoreline from Rudee Inlet to the end of the Dam Neck Anti-Air Warfare Training Center at Sandbridge, including Lake Rudee and Lake Wesley. The segment contains 84,600 feet (16.0 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Dunes 28% (4.4 mi.), artificial fill 9% (1.4 mi.), and low shore 63% (10.2 mi.).
SHORE: Artificially stabilized 19% (2.4 mi.), beach 47% (5.7 mi.), fringe marsh 15% (1.8 mi.), and embayed marsh 19% (2.3 mi.).
NEARSHORE: Narrow 40%. The remainder of the shoreline is found in Lake Rudee and Lake Wesley, which are too narrow and shallow for classification.

SHORELANDS USE

FASTLAND: Agricultural 1% (0.1 mi.), commercial 7% (1.1 mi.), military 29% (4.6 mi.), recreational 7% (1.1 mi.), residential 26% (4.2 mi.), unmanaged, wooded 27% (4.3 mi.), and unmanaged, unwooded 4% (0.6 mi.).
SHORE: Most of the ocean fronting shoreline is used for military purposes. The beach south of Rudee Inlet is used for private and public recreation. In Lake Rudee and Lake Wesley, there is some access to the water and some private recreation along the shore.
NEARSHORE: Boating in the interior of Rudee Inlet. Swimming, boating, surfing, and other water sports along the nearshore zone from Rudee Inlet to Camp Pendleton. The rest of the nearshore is controlled by the military.

WIND AND SEA EXPOSURE: The ocean shoreline trends NNW - SSE. This section of the segment is exposed to unlimited fetches across the Atlantic Ocean.

OWNERSHIP: Private 64%, federal 25%, state 4%, and city 7%.

FLOOD HAZARD: High, critical. Past floods indicate that Lake Rudee and the area south of Rudee Inlet are vulnerable to flood damage during the 100-year storm. The dunes further south along

the military lands are generally of sufficient height to withstand most flooding due to wave overwash. However, if the dune system is breached, the lands behind would be inundated.

WATER QUALITY: Rudee Inlet is closed to the taking of shellfish. The Atlantic Ocean has good water quality.

BEACH QUALITY: Good. The ocean fronting sections of shoreline have wide expanses of clean beach.

PRESENT SHORE EROSION SITUATION

EROSION RATE: Moderate to severe, noncritical. Most of the ocean shoreline from Croatan Beach to the Dam Neck area has an average historical erosion rate of 1.3 to 2.7 feet per year. The southern section of the segment has eroded at an average rate of 3.0 to 3.9 feet per year.
ENDANGERED STRUCTURES: None.
SHORE PROTECTIVE STRUCTURES: There are approximately 12,500 feet of artificially stabilized shoreline in the segment located in Rudee Inlet. The mouth of the inlet is riprap, while the remaining structures on Lake Rudee and Lake Wesley are bulkhead. These structures are effective at retaining fill in several locations and at combatting erosion in other sites. There are two riprap jetties at the mouth of the inlet.

OTHER SHORE STRUCTURES: Piers and boat ramps in the interior of Rudee Inlet.

SHORE USE LIMITATIONS: The only private land is in Rudee Inlet and Croatan Beach. Most of these lands are already developed. The marshes at the head of Lake Rudee should be preserved.

ALTERNATE SHORE USE: Although some continued residential development is probable for the Rudee Inlet area, there are no lands available for a public park. The area will probably continue to be used for residential purposes.

MAPS: USGS, 7.5 Min.Ser. (Topo.), VIRGINIA BEACH Quadr., 1965, pr. 1970.
NOS# 12045 (1227), 1:80,000 scale,
Cape Henry to Currituck Beach Light, VA and NC, 10th ed., 1972.

PHOTOS: Aerial-VIMS 11May77 VB-8/561-597.

SUBSEGMENT 9A

SANDBRIDGE - OCEAN SIDE

Maps 8 and 9

EXTENT: 28,200 feet (5.3 mi.) of shoreline along the Atlantic Ocean from the Dam Neck Naval Reservation to the northern limit of Back Bay National Wildlife Refuge. The subsegment includes 28,200 feet (5.3 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Entirely dunes.

SHORE: Artificially stabilized 1% (0.1 mi.) and beach 99% (5.3 mi.).

NEARSHORE: Narrow.

SHORELANDS USE

FASTLAND: Commercial 1% (0.1 mi.), recreational 14% (0.7 mi.), and residential 85% (4.5 mi.).

SHORE: The beaches are used for private and public recreation.

NEARSHORE: Sport boating, fishing, swimming and other water sports. The offshore waters of the Atlantic Ocean are used for a variety of purposes.

WIND AND SEA EXPOSURE: The shoreline trends basically NNW - SSE. The entire subsegment is exposed to unlimited fetches across the Atlantic Ocean.

OWNERSHIP: Private 86% and city 14%.

FLOOD HAZARD: High, critical. Past floods have shown that this area is very vulnerable to flood damage. Sandbridge would be mostly inundated during the 100-year storm and many structures would be completely demolished or severely damaged. However, past storms do not give an accurate picture of the extent of flooding that could now take place, since the important dunes that once protected Sandbridge have been either destroyed or reduced in height, increasing the likelihood of flood and wave damage.

WATER QUALITY: Satisfactory.

BEACH QUALITY: Good. The entire shore is nice sand beach, usually of good width.

PRESENT SHORE EROSION SITUATION

EROSION RATE: Severe, critical and noncritical. The entire shoreline has experienced a severe average erosion rate over the past 100 years. However, the average erosion rate over the past 43 years has been moderate for most sections of the shoreline, with only a half mile stretch of shore along Sandbridge still showing a severe shoreline retreat.

ENDANGERED STRUCTURES: Several structures at Sandbridge are endangered by continued erosion.

SHORE PROTECTIVE STRUCTURES: There are two areas of bulkhead at Sandbridge. These structures would be ineffective at stopping storm erosion or flooding.

OTHER SHORE STRUCTURES: There is a pier at the Little Island Municipal Park. A swimming pool is in the shore zone at Sandbridge.

SHORE USE LIMITATIONS: The entire subsegment has a high flood hazard and is susceptible to erosion. The area is already mostly used for residences and a recreational park.

ALTERNATE SHORE USE: Low. The major portion of the subsegment is used for residential purposes. There is continuing development along the Sandbridge shoreline. New structures should have an adequate set-back from the shore and have some sort of flood proofing such as being built on pilings.

MAPS: USGS, 7.5 Min.Ser. (Topo.), VIRGINIA BEACH Quadr., 1965, pr. 1970;
USGS, 7.5 Min.Ser. (Topo.), NORTH BAY Quadr., 1953, pr. 1971.
NOS# 12047 (1227), 1:80,000 scale, Cape Henry to Currituck Beach Light, VA and NC, 10th ed., 1972.

PHOTOS: Aerial-VIMS 11May77 VB-9A/598-638.

SUBSEGMENT 9B

SANDBRIDGE - NORTH BAY SIDE

Maps 8 and 9

EXTENT: 123,400 feet (23.4 mi.) of shoreline in North Bay from the mouth of Hell Point Creek to Back Bay National Wildlife Refuge. The subsegment includes 82,700 feet (15.7 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Dunes 4% (0.6 mi.), artificial fill 70% (10.9 mi.), and low shore 26% (4.1 mi.).

SHORE: Artificially stabilized 12% (2.9 mi.), fringe marsh 38% (8.8 mi.), and extensive marsh 50% (11.6 mi.).

NEARSHORE: North Bay is too shallow for classification.

SHORELANDS USE

FASTLAND: Agricultural 11% (1.7 mi.), recreational 4% (0.6 mi.), residential 76% (11.9 mi.), and unmanaged, wooded 9% (1.4 mi.).

SHORE: Waterfowl hunting in the marshes.

NEARSHORE: Most of the bay is too shallow for sport boating. However, this area is popular for sport fishing.

WIND AND SEA EXPOSURE: The marshes trend WSW - ENE from Hell Point Creek to Sandbridge. The barrier beach at Sandbridge trends NNW - SSE. No significant fetches directly affect the North Bay shorelands.

OWNERSHIP: Private 96% and city 4%.

FLOOD HAZARD: High, critical. The extensive dune system at Sandbridge which once largely protected the North Bay shorelands from most flooding has been defeated by the extensive residential buildup at Sandbridge. The marshes and newly developed residential communities in this subsegment would be inundated during the 100-year storm due to wave overwash from the ocean.

WATER QUALITY: Unsatisfactory. The Back Bay system does not meet applicable State water quality standards due to high fecal coliform counts and high nutrients. The high fecal coliforms will be controlled as animal waste discharges

are stopped. However, much of the water quality problems are due to natural swamp conditions and the poor flushing action in the Back Bay area. Since the conditions are mostly natural and cannot be changed, the area does not violate the 305(b)(1)(B) criteria.

BEACH QUALITY: There are no beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. Field investigations show no significant evidence of erosion.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are approximately 15,400 feet of artificially stabilized shoreline in the subsegment, all of which is along the dredged canals at Sandbridge. The majority of structures are bulkhead, with several thousand feet of riprap. All appear to be effective at holding fill.

OTHER SHORE STRUCTURES: There are numerous boat docks in the canals of the subsegment.

SHORE USE LIMITATIONS: Seventy-six percent of the fastland is already used or is in the process of being developed for residential purposes. Another four percent is a city-owned recreational park. The remaining lands, located behind the extensive marshes are either used for agriculture or are woods. Any development here would be at the sacrifice of these rural lands.

ALTERNATE SHORE USE: Low. The only undeveloped lands in the subsegment are behind the marshes. Given the large amounts of city, state, and federal lands in the Back Bay area, other public acquisitions in the area do not seem probable.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORTH BAY
Quadr., 1953, pr. 1971.
NOS# 12047 (1227), 1:80,000 scale,
Cape Henry to Currituck Beach Light, VA
and NC, 10th ed., 1972.

PHOTOS: Aerial-VIMS 11May77 VB-9B/733-778.

SUBSEGMENT 10A

BACK BAY NATIONAL WILDLIFE REFUGE - OCEAN SIDE

Maps 9 and 10

EXTENT: 23,100 feet (4.4 mi.) of shoreline along the Atlantic Ocean of Back Bay National Wildlife Refuge. The subsegment includes 23,100 feet (4.4 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Entirely dunes.

SHORE: Beach.

NEARSHORE: Narrow.

SHORELANDS USE

FASTLAND: Preserved.

SHORE: The shore zone is used by the public for various recreational purposes.

NEARSHORE: Commercial shipping, sport boating, fishing, and other water sports.

WIND AND SEA EXPOSURE: The shoreline trends basically NNW - SSE in the subsegment. The entire shoreline is exposed to unlimited fetches across the Atlantic Ocean from the north through the southeast quadrants.

OWNERSHIP: Federal.

FLOOD HAZARD: High, noncritical. The dunes along this section of shoreline, while offering some protection from storm surges, could be severely breached during the 100-year storm. No structures would be endangered in the refuge.

WATER QUALITY: Satisfactory. The Atlantic Ocean has good water quality.

BEACH QUALITY: Good. The ocean fronting shoreline of Virginia Beach has wide sandy beaches.

PRESENT SHORE EROSION SITUATION

EROSION RATE: Moderate to severe, noncritical. The average historical erosion rates for this shoreline have ranged from 2.1 to 8.4 feet per year. However, recent rates have ranged from accretion along the southern section of shoreline to erosion of 1.1 to 5.2 feet per year along the rest of the subsegment.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: None.

OTHER SHORE STRUCTURES: None.

SHORE USE LIMITATIONS: The entire subsegment is owned by the federal government and is preserved, which prohibits other use.

ALTERNATE SHORE USE: None. The area has no alternate use potential as long as it retains its status as a National Wildlife Refuge.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORTH BAY Quadr., 1953, pr. 1971.
NOS# 12047 (1227), 1:80,000 scale, Cape Henry to Currituck Beach Light, VA and NC, 10th ed., 1972.

PHOTOS: Aerial-VIMS 11May77 VB-10A/639-661.

SUBSEGMENT 10B

BACK BAY NATIONAL WILDLIFE REFUGE - BACK BAY SIDE

Maps 9 and 10

EXTENT: 69,500 feet (13.2 mi.) of shoreline along the interior of the barrier beach of Sand Ridge in Back Bay National Wildlife Refuge. The subsegment includes 26,300 feet (5.0 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Dunes.

SHORE: Fringe marsh 3% (0.3 mi.) and extensive marsh 97% (12.8 mi.).

NEARSHORE: Back Bay is too shallow for classification.

SHORELANDS USE

FASTLAND: Preserved.

SHORE: Preserved. The marshes in the Back Bay National Wildlife Refuge are wildlife habitats. There is some fishing in the area.

NEARSHORE: Sport fishing in the waters of Back Bay.

WIND AND SEA EXPOSURE: Sand Ridge is oriented basically NNW - SSE. The many extensive marsh islands included in the Back Bay National Wildlife Refuge are oriented basically N - S in Back Bay. No significant fetches directly affect this area.

OWNERSHIP: Federal.

FLOOD HAZARD: High, noncritical. The entire subsegment, with the exception of several dune areas, would be inundated during the 100-year storm. No structures are endangered.

WATER QUALITY: Unsatisfactory. The Back Bay system does not meet applicable State water quality standards due to high fecal coliform counts and high nutrients. Much of the water quality problems are due to natural swamp conditions and the poor flushing in Back Bay. Since the conditions are mostly natural, the area does not violate the 305(b)(1)(B) criteria.

BEACH QUALITY: There are no beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. Field investigations show no evidences of significant ongoing erosion.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: None.

OTHER SHORE STRUCTURES: None.

SHORE USE LIMITATIONS: The area is a National Wildlife Refuge, which limits other uses.

ALTERNATE SHORE USE: None.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORTH BAY
Quadr., 1953, pr. 1971;
USGS, 7.5 Min.Ser. (Topo.), KNOTTS ISLAND
Quadr., 1954, pr. 1971.
NOS# 12047 (1227), 1:80,000 scale,
Cape Henry to Currituck Beach Light, VA
and NC, 10th ed., 1972.

PHOTOS: None.

SUBSEGMENT 11A

FALSE CAPE - OCEAN SIDE

Maps 10 and 11

EXTENT: 30,400 feet (5.8 mi.) of shoreline along the Atlantic Ocean from Back Bay National Wildlife Refuge to the Virginia - North Carolina state line. The subsegment contains 30,400 feet (5.8 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Entirely dunes.

SHORE: Beach.

NEARSHORE: Narrow 27% and intermediate 73%.

SHORELANDS USE

FASTLAND: Public recreation. The shorelands in this subsegment are part of False Cape State Park.

SHORE: The area is preserved and is mostly unused.

NEARSHORE: The Atlantic Ocean is used for commercial shipping, sport boating, fishing and other water sports.

WIND AND SEA EXPOSURE: The shoreline trends basically NNW - SSE. The entire subsegment is exposed to unlimited fetches over the Atlantic Ocean from the north through the southeast quadrants.

OWNERSHIP: State.

FLOOD HAZARD: High, noncritical except for isolated structures which would be damaged or destroyed during the 100-year storm.

WATER QUALITY: Satisfactory.

BEACH QUALITY: Good. The subsegment has nice wide sand beaches for the entire shoreline length.

PRESENT SHORE EROSION SITUATION

EROSION RATE: Historical average erosion rates for this area range from slight to moderate erosion to accretion, with most accretion to the south.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: None.

OTHER SHORE STRUCTURES: None.

SHORE USE LIMITATIONS: This subsegment is False Cape State Park, which is in the early stages of development for public use.

ALTERNATE SHORE USE: None. Present ownership and use precludes any other use for this area.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORTH BAY Quadr., 1953, pr. 1971;
USGS, 7.5 Min.Ser. (Topo.), KNOTTS ISLAND Quadr., 1954, pr. 1971.
NOS# 12047 (1227), 1:80,000 scale, Cape Henry to Currituck Beach Light, VA and NC, 10th ed., 1972.

PHOTOS: Aerial-VIMS 11May77 VB-11A/662-694.

SUBSEGMENT 11B

FALSE CAPE - BACK BAY SIDE

Maps 10 and 11

EXTENT: 89,500 feet (16.9 mi.) of shoreline along the Back Bay side of False Cape State Park. The subsegment includes 59,300 feet (11.2 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Dunes 5% (0.6 mi.) and low shore 95% (10.6 mi.).

SHORE: Fringe marsh 13% (2.2 mi.) and extensive marsh 87% (14.7 mi.).

NEARSHORE: Back Bay is too shallow for classification.

SHORELANDS USE

FASTLAND: Public recreation.

SHORE: The subsegment is a preserved area. It is presently mostly unused.

NEARSHORE: Some sport fishing.

WIND AND SEA EXPOSURE: The shoreline trends basically NNW - SSE. No significant fetches affect the subsegment.

OWNERSHIP: State.

FLOOD HAZARD: High, noncritical except for several structures which would be damaged or destroyed during the 100-year storm.

WATER QUALITY: Unsatisfactory. The Back Bay system does not meet applicable State water quality standards due to high fecal coliform counts and high nutrients. The fecal coliform has been attributed to hog farms, which have since stopped discharging waste into Back Bay. Much of the remaining water quality problems are due to natural swamp conditions and the poor flushing in Back Bay. However, since the conditions are mostly natural, the area does not violate the 305(b)(1)(B) criteria.

BEACH QUALITY: There are no beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: None. There is one section of cosmetic bulkhead in the subsegment.

OTHER SHORE STRUCTURES: There are several piers in the subsegment.

SHORE USE LIMITATIONS: Present shore use and ownership limits any other development.

ALTERNATE SHORE USE: None. The area is a State park.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORTH BAY
Quadr., 1953, pr. 1971;
USGS, 7.5 Min.Ser. (Topo.), KNOTTS ISLAND
Quadr., 1954, pr. 1971.
NOS# 12047 (1227), 1:80,000 scale,
Cape Henry to Currituck Beach Light, VA
and NC, 10th ed., 1972.

SUBSEGMENT 12A

HELL POINT CREEK TO
BACK BAY NATIONAL WILDLIFE REFUGE LIMITS

Maps 8, 9, and 13

EXTENT: 100,200 feet (19.0 mi.) of shoreline along the west bank of Back Bay from Hell Point Creek to the southern limits of Back Bay National Wildlife Refuge. The subsegment includes 79,500 feet (15.1 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Entirely low shore.

SHORE: Fringe marsh 3% (0.6 mi.), embayed marsh 13% (2.4 mi.), and extensive marsh 84% (15.9 mi.).

NEARSHORE: North and Shipps Bays are too shallow for classification.

SHORELANDS USE

FASTLAND: Agricultural 42% (6.3 mi.), residential 21% (3.1 mi.), and unmanaged, wooded 37% (5.6 mi.).

SHORE: Mostly unused; some waterfowl hunting in the privately owned marshes.

NEARSHORE: Sport fishing.

WIND AND SEA EXPOSURE: The shoreline trends basically N - S in the subsegment. No significant fetches affect the shorelands.

OWNERSHIP: Private 99% and federal 1%.

FLOOD HAZARD: High, noncritical except for several structures at the mouth of Muddy Creek which would be damaged or destroyed during the 100-year storm.

WATER QUALITY: Unsatisfactory. The Back Bay system does not meet applicable State water quality standards due to high fecal coliform counts and high nutrient levels. Much of the water quality problems are due to past discharges of animal wastes combined with natural swamp conditions and the poor flushing in Back Bay. However, there are no present discharges. Since the conditions are mostly natural, the area does not violate the 305(b)(1)(B) criteria.

BEACH QUALITY: There are no beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: None.

OTHER SHORE STRUCTURES: None.

SHORE USE LIMITATIONS: Marshes, either embayed or extensive, comprise ninety-seven percent of the shoreline. These areas are valuable flood control agents and serve as wildlife habitats. The Virginia Wetlands Act of 1972 protects these marsh areas and strictly controls any development or alteration of the system. Also, there is no quick water access from Back Bay to the Atlantic Ocean and the shallowness of the Bay greatly restricts passage of any but very small craft.

ALTERNATE SHORE USE: Low. The rural nature of the fastland bordering on this section of Back Bay is best suited for the area. Any alternate development would be at the expense of the agriculture. Care should be taken to ensure that no pollutants enter the Back Bay system.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORTH BAY Quadr., 1953, pr. 1971.
NOS# 12047 (1227), 1:80,000 scale, Cape Henry to Currituck Beach Light, VA and NC, 10th ed., 1972.

PHOTOS: None.

SUBSEGMENT 12B

BACK BAY NATIONAL WILDLIFE REFUGE TO
THE VIRGINIA - NORTH CAROLINA STATE LINE

Maps 12 and 13

EXTENT: 75,600 feet (14.3 mi.) of shoreline along the west side of Back Bay from the southern limits of Back Bay National Wildlife Refuge to the Virginia - North Carolina state line. The subsegment includes 68,600 feet (13.0 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 18% (2.4 mi.) and low shore 82% (10.6 mi.).

SHORE: Artificially stabilized 2% (0.3 mi.), fringe marsh 6% (0.8 mi.), and extensive marsh 92% (13.2 mi.).

NEARSHORE: Back Bay is too shallow for classification.

SHORELANDS USE

FASTLAND: Agricultural 41% (5.3 mi.), preserved 1% (0.1 mi.), residential 11% (1.5 mi.), unmanaged, wooded 36% (4.7 mi.), and unmanaged, unwooded 11% (1.4 mi.).

SHORE: Waterfowl hunting in the marshes, which are privately owned. The Virginia Trojan Waterfowl Management Area is located around Pellytory Point.

NEARSHORE: Sport fishing.

WIND AND SEA EXPOSURE: The shoreline trends basically N - S in the subsegment. No significant fetches affect the shorelands.

OWNERSHIP: Private 98%, federal 1%, and state 1%. The Virginia Trojan Waterfowl Management Area is located almost entirely in the extensive marshes along the shoreline and is not included in the fastland ownership, except where the actual fastland is state owned.

FLOOD HAZARD: High, noncritical except for several structures near the shoreline which would be damaged or destroyed during the 100-year storm.

WATER QUALITY: Unsatisfactory. The Back Bay system does not meet applicable State water quality standards due to high fecal coliform counts and

high nutrient levels. Many of the water quality problems are due to past discharges of animal wastes combined with natural swamp conditions and the poor flushing in Back Bay. However, there are no present discharges. Since the conditions are mostly natural, the area does not violate the 305(b)(1)(B) criteria.

BEACH QUALITY: There are no beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are approximately 1,600 feet of wooden bulkhead in the subsegment located at the Public Landing and at the mouth of Nawney Creek. These structures appear to be effective at retaining fill.

OTHER SHORE STRUCTURES: There are several isolated piers in the subsegment.

SHORE USE LIMITATIONS: Approximately eighteen percent of the shoreline is part of the Virginia Trojan Waterfowl Management Area. Though almost the entire Management Area is located in the shore zone, it has a direct effect on the available uses for the backing fastland. Ninety-two percent of the fastland is fronted by extensive marshes, which are protected by the Virginia Wetlands Act of 1972. Marshes are valuable flood and erosion control agents and provide food and habitats for wildlife. However, they also limit access to the water, thus limiting the available uses of the fastland.

ALTERNATE SHORE USE: Low. Back Bay is a unique ecosystem which is, for the most part, still virtually unspoiled. It serves as a feeding ground and habitat for numerous waterfowl and other wildlife. As such, care should be taken not to jeopardize the system by developing the surrounding fastland.

MAPS: USGS, 7.5 Min.Ser. (Topo.), NORTH BAY Quadr., 1953, pr. 1971;
USGS, 7.5 Min.Ser. (Topo.), KNOTTS ISLAND Quadr., 1954, pr. 1971.
NOS# 12047 (1227), 1:80,000 scale, Cape Henry to Currituck Beach Light, VA and NC, 10th ed., 1972.

PHOTOS: Aerial-VIMS 29Jul77 VB-12B/780-828.

SUBSEGMENT 12C

KNOTTS ISLAND AND CEDAR ISLAND

Maps 11 and 12

EXTENT: 57,500 feet (10.9 mi.) of shoreline along Knotts, Cedar, and Little Cedar Islands. The subsegment includes 26,400 feet (5.0 mi.) of fastland. The individual measurements for the islands are:

	<u>Shoreline</u>	<u>Fastland</u>
Knotts Island	44,400 ft.	15,900 ft.
Cedar Island	9,600 ft.	8,300 ft.
Little Cedar Island	3,500 ft.	2,200 ft.
Total	57,500 ft.	26,400 ft.

The extensive marshes which comprise the Virginia Pocahontas Waterfowl Management Area are not included in the shoreline measurement. These marshes have an area of approximately 540 acres.

SHORELANDS TYPE

FASTLAND: Entirely low shore.

SHORE: Artificially stabilized 4% (0.4 mi.), fringe marsh 20% (2.1 mi.), and extensive marsh 76% (8.3 mi.).

NEARSHORE: Back Bay is too shallow for classification.

SHORELANDS USE

FASTLAND: Agricultural 7% (0.3 mi.), residential 31% (1.5 mi.), and unmanaged, wooded 62% (3.1 mi.).

SHORE: Much of the shore zone, extensive marshes, are preserved as wildlife refuges.

NEARSHORE: Sport boating and fishing.

WIND AND SEA EXPOSURE: The three islands and the numerous marsh islands are located in the middle of Back Bay along the Virginia - North Carolina border. No significant fetches affect this subsegment.

OWNERSHIP: Private. All fastland is privately owned. However, the extensive marshes adjoining Knotts Island are owned by the federal government (Mackay Island National Wildlife Refuge) and by the state (Pocahontas Waterfowl Management Area).

FLOOD HAZARD: High, critical. Several structures

on Knotts Island and Cedar Island would be damaged or destroyed by flood waters during the 100-year storm.

WATER QUALITY: Unsatisfactory. The Back Bay system does not meet applicable State water quality standards due to high fecal coliform counts and high nutrient levels. Much of the water quality problems are due to past discharges of animal wastes combined with natural swamp conditions and the poor flushing in Back Bay. However, there are no present discharges. Since the conditions are mostly natural, the area does not violate the 305(b)(1)(B) criteria.

BEACH QUALITY: There are no beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are approximately 2,300 feet of artificially stabilized shoreline in the subsegment, 50 feet of which is riprap and the remainder bulkhead. These structures are mainly for cosmetic purposes.

OTHER SHORE STRUCTURES: There are numerous piers in the subsegment, most of which are located on Knotts Island.

SHORE USE LIMITATIONS: The three islands have a total of only 5 miles of fastland. Cedar and Little Cedar Islands can be reached only by boat and Cedar Island is already used for a private residence. Knotts Island is mostly developed for second or vacation homes. This area can only be reached through North Carolina. The surrounding marshes are public wildlife refuges.

ALTERNATE SHORE USE: Low. Some continued residential development is possible for sections of Knotts Island. No alternate use seems probable for the area.

MAPS: USGS, 7.5 Min.Ser. (Topo.), KNOTTS ISLAND Quadr., 1954, pr. 1971.
NOS# 12047 (1227), 1:80,000 scale,
Cape Henry to Currituck Beach Light, VA
and NC, 10th ed., 1972.

PHOTOS: Aerial-VIMS 11May77 VB-12C/702-732.

SUBSEGMENT 13A

NORTH LANDING RIVER - EAST BANK

Map 14

EXTENT: 62,500 feet (11.8 mi.) of shoreline along the east bank of the North Landing River from the Pungo Ferry bridge to the Virginia - North Carolina state line. The subsegment includes 52,200 feet (9.9 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Artificial fill 26% (2.6 mi.) and low shore 74% (7.3 mi.).

SHORE: Artificially stabilized 2% (0.3 mi.), beach 7% (0.8 mi.), fringe marsh 31% (3.6 mi.), and extensive marsh 60% (7.1 mi.).

RIVER: The North Landing River is too narrow and shallow for classification. Average depths range from 2 to 6 feet.

SHORELANDS USE

FASTLAND: Agricultural 39% (3.9 mi.), residential 17% (1.7 mi.), unmanaged, wooded 16% (1.6 mi.), and unmanaged, unwooded 28% (2.7 mi.).

SHORE: Waterfowl hunting in the marshes.

RIVER: The Intracoastal Waterway is used by a variety of pleasure craft.

WIND AND SEA EXPOSURE: The shoreline trends basically N - S, then NW - SE in this subsegment. No significant fetches affect the subsegment.

OWNERSHIP: Private.

FLOOD HAZARD: High, noncritical except for several structures located directly on the shoreline, which would be damaged or destroyed during a severe hurricane. The North Landing River would suffer from flooding during hurricanes, as winds out of the south cause severe flooding in the area. Hurricane Hazel caused water levels to crest at elevations of 3.54 feet in the North Landing River. A slower moving hurricane could have produced a much higher wind tide.

WATER QUALITY: Unsatisfactory. The North Landing River generally has poor water quality due to high nutrient levels, low dissolved oxygen, and high fecal coliform counts. These problems stem from non-point and agricultural runoff and the

high boating and marina activities on the river. Also, the North Landing River has very poor tidal flushing. The area does not meet the State 305(b)(1)(B) criteria.

BEACH QUALITY: Poor to fair. Several areas have thin, strip beaches. The shoreline at Munden generally has fair beaches.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: There are approximately 1,500 feet of bulkhead in the subsegment which appears to be effective at containing the shore.

OTHER SHORE STRUCTURES: There are several piers in the subsegment.

SHORE USE LIMITATIONS: Much of the shoreland is fronted by extensive marshes which should be preserved. These marshes limit access to the water and thus limit the development potential of the fastland. Also, the shallow water of the river limits the recreational potential of the area.

ALTERNATE SHORE USE: Moderate. The City of Virginia Beach is considering a site near Munden for purchase and use as a park. This area could be developed for public access to the water as well as being used for picnic facilities on shore.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CREEDS Quadr., 1954, pr. 1971.
NOS# 12047 (1227), 1:80,000 scale,
Cape Henry to Currituck Beach Light, VA and NC, 10th ed., 1972.

PHOTOS: Aerial-VIMS 29Jul77 VB-13A/829-863.

SUBSEGMENT 13B

NORTH LANDING RIVER - WEST BANK

Map 14

EXTENT: 107,900 feet (20.4 mi.) of shoreline along the west bank of the North Landing River from the Pungo Ferry bridge to the Virginia - North Carolina state line. The subsegment includes 66,600 feet (12.6 mi.) of fastland.

SHORELANDS TYPE

FASTLAND: Entirely low shore.

SHORE: Fringe marsh 2% (0.5 mi.), embayed marsh 27% (5.4 mi.), and extensive marsh 71% (14.5 mi.).

RIVER: The North Landing River is too narrow and shallow for classification. The Intra-coastal Waterway is located at the middle of the river.

SHORELANDS USE

FASTLAND: Agricultural 25% (3.2 mi.), residential 5% (0.7 mi.), and unmanaged, wooded 69% (8.7 mi.).

SHORE: Waterfowl hunting in the marshes.

RIVER: Various pleasure craft use the Intra-coastal Waterway located in the North Landing River.

WIND AND SEA EXPOSURE: The shoreline trends basically N - S then NNW - SSE. No significant fetches affect the subsegment.

OWNERSHIP: Private.

FLOOD HAZARD: High, noncritical. The North Landing River would suffer from flooding during hurricanes, as winds out of the south cause flooding in this area. Hurricane Hazel crested at elevations of 3.54 feet in the North Landing River. A more severe hurricane could produce a much higher wind tide.

WATER QUALITY: Unsatisfactory. The North Landing River generally has poor water quality due to high nutrient levels, low dissolved oxygen, and high fecal coliform counts. These problems stem from non-point and agricultural runoff and the high boating and marina activities on the river. Also, the North Landing River has very

poor tidal flushing. The area does not meet the State Water Control Board's 305(b)(1)(B) criteria.

BEACH QUALITY: There are no beaches in the subsegment.

PRESENT SHORE EROSION SITUATION

EROSION RATE: No data. The area appears to be stable.

ENDANGERED STRUCTURES: None.

SHORE PROTECTIVE STRUCTURES: None.

OTHER SHORE STRUCTURES: None.

SHORE USE LIMITATIONS: The fastland along this section of the river is fronted by an average of 1.1 to 1.5 miles of extensive marsh, which effectively limits access to the water. Except for Blackwater Creek shorelands, none of the fastland could be developed for water-related purposes.

ALTERNATE SHORE USE: Low. The extensive marshes fronting the shorelands of this subsegment should be preserved. No alternate development or use seems probable for this area.

MAPS: USGS, 7.5 Min.Ser. (Topo.), CREEDS
Quadr., 1954, pr. 1971.
NOS# 12047 (1227), 1:80,000 scale,
Cape Henry to Currituck Beach Light, VA
and NC, 10th ed., 1972.

PHOTOS: None.

76° 07' 30"

MAP 2A

LITTLE CREEK AREA

TOPOGRAPHY AND CULTURE

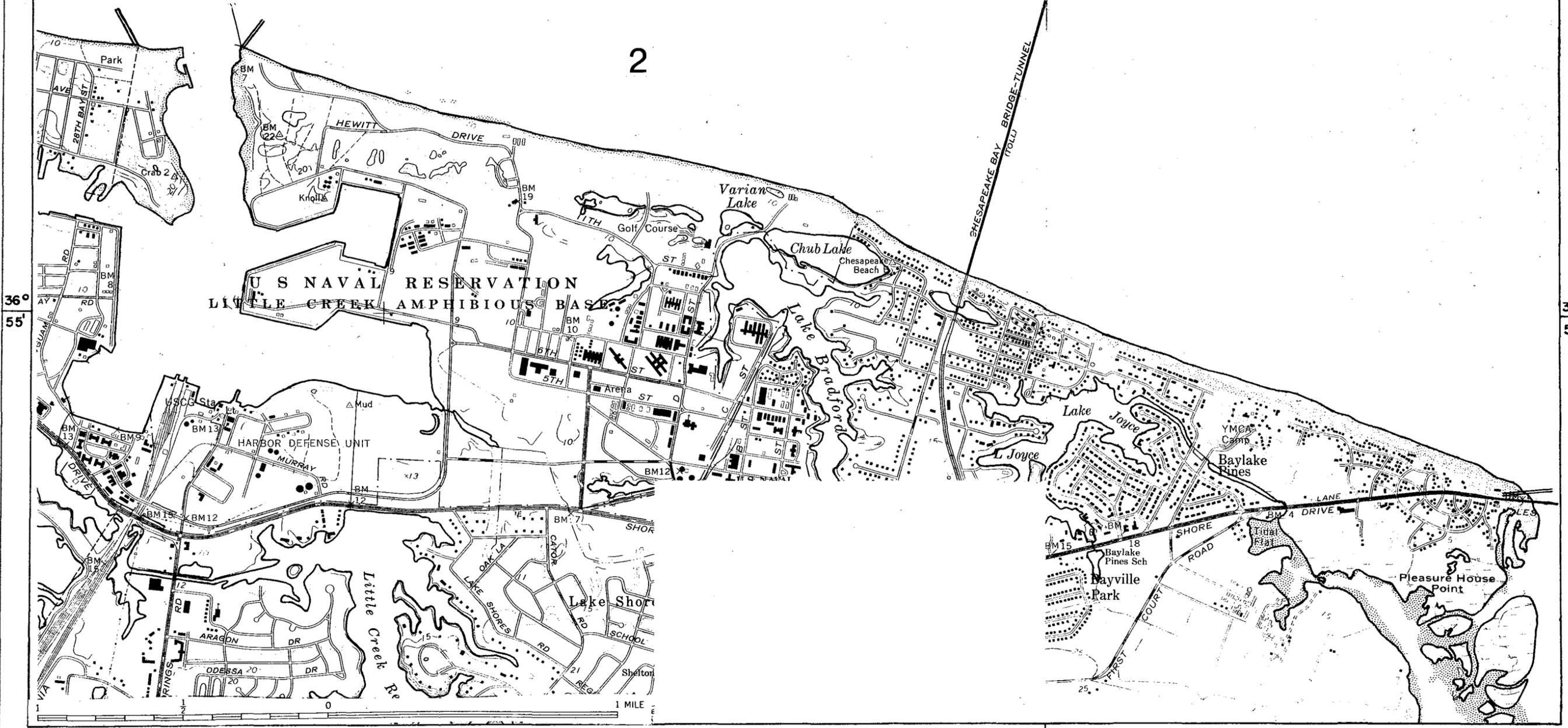
Segments 1 and 2

- // = Segment Boundary
- / = Subsegment Boundary

NORFOLK CITY
VIRGINIA BEACH CITY

1

2



36°
55'

36°
55'

76° 07' 30"

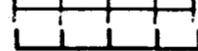
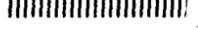
76° 07' 30"

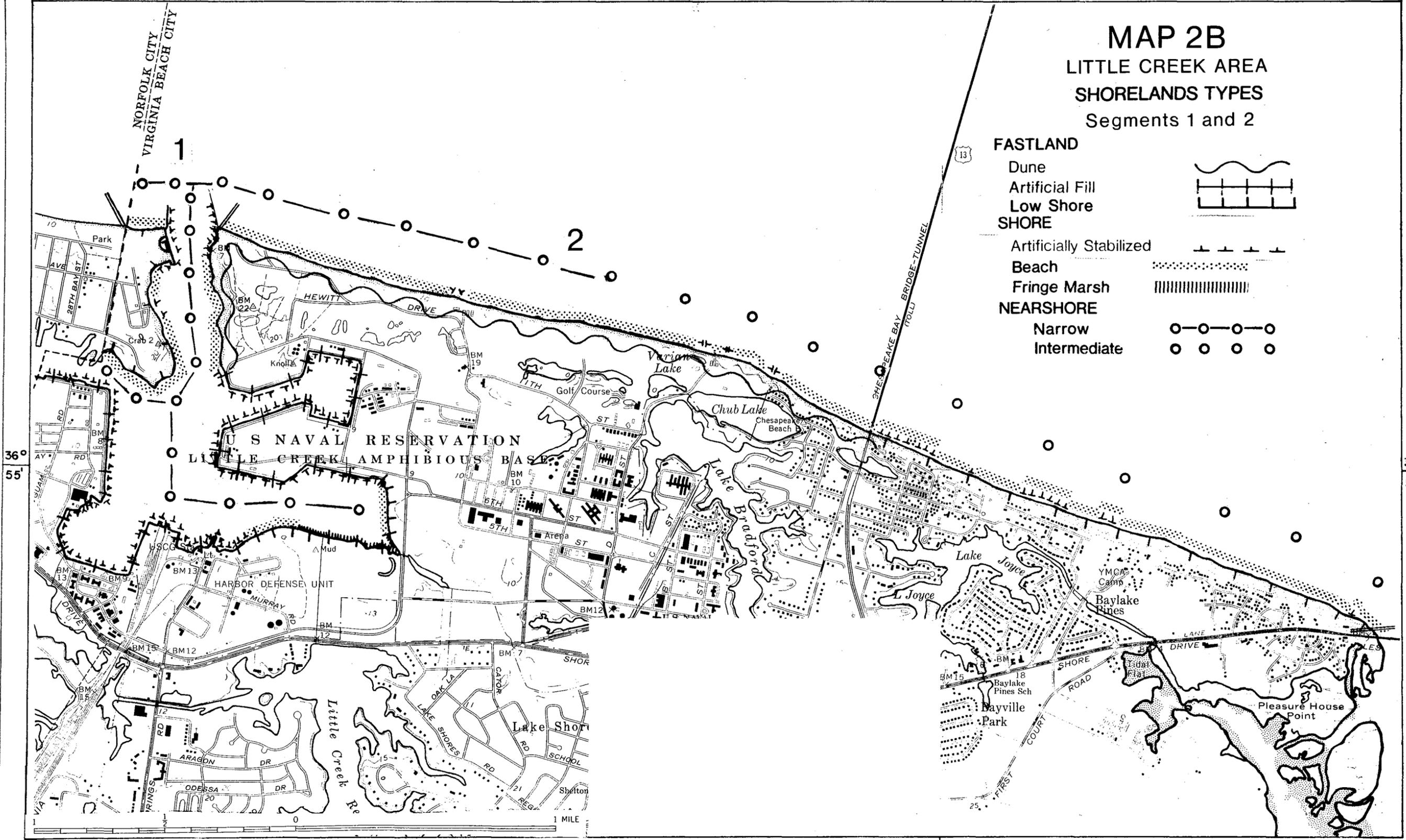
MAP 2B

LITTLE CREEK AREA

SHORELANDS TYPES

Segments 1 and 2

- FASTLAND**
- Dune 
 - Artificial Fill 
 - Low Shore
- SHORE**
- Artificially Stabilized 
 - Beach 
 - Fringe Marsh 
- NEARSHORE**
- Narrow 
 - Intermediate 



76° 07' 30"

76° 02' 30"

MAP 3A CAPE HENRY TOPOGRAPHY AND CULTURE

Segments 4 and 5

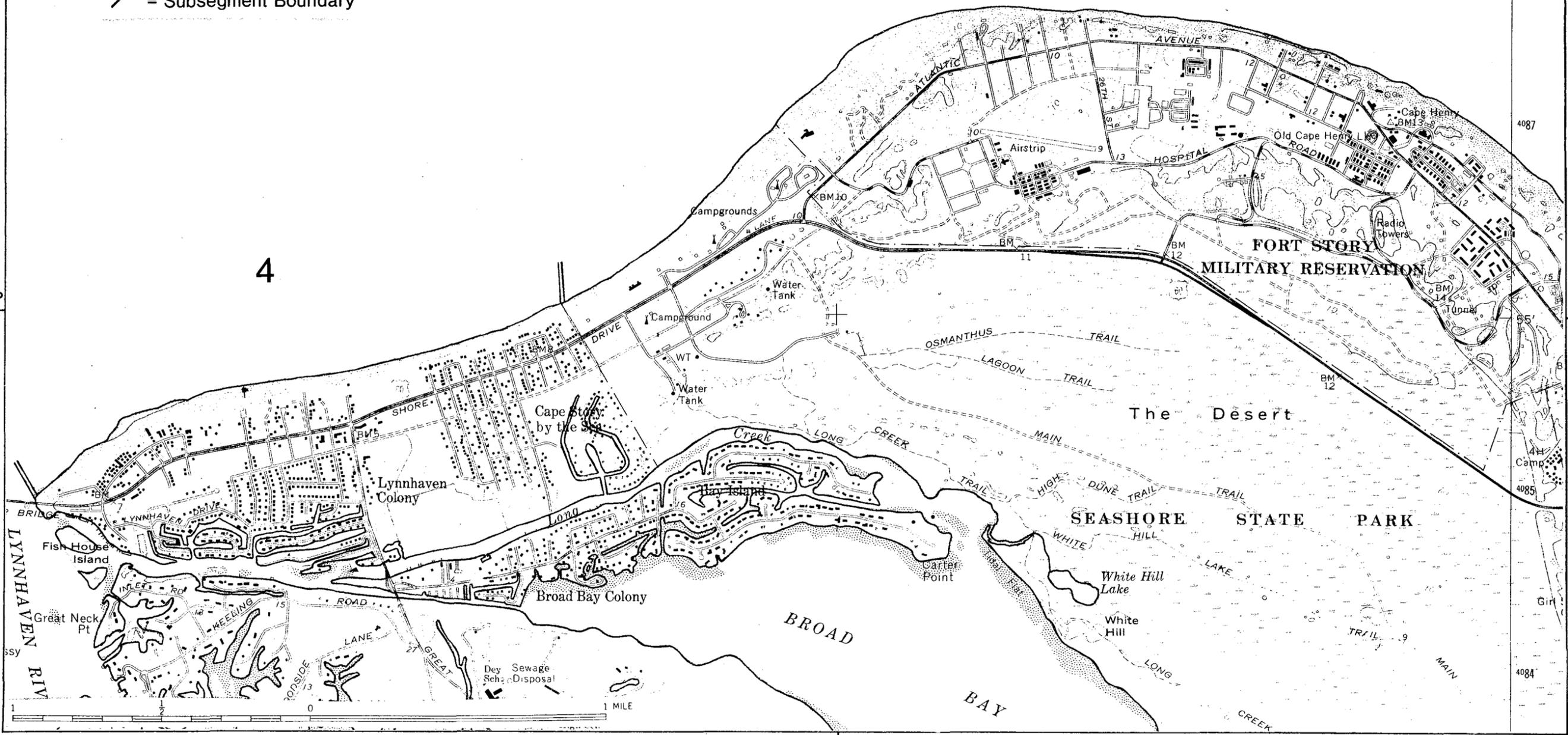
- // = Segment Boundary
- / = Subsegment Boundary

5

4

36°
55'

36°
55'



76° 02' 30"

76° 02' 30"

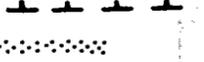
MAP 3B

CAPE HENRY

SHORELANDS TYPES

Segments 4 and 5

FASTLAND

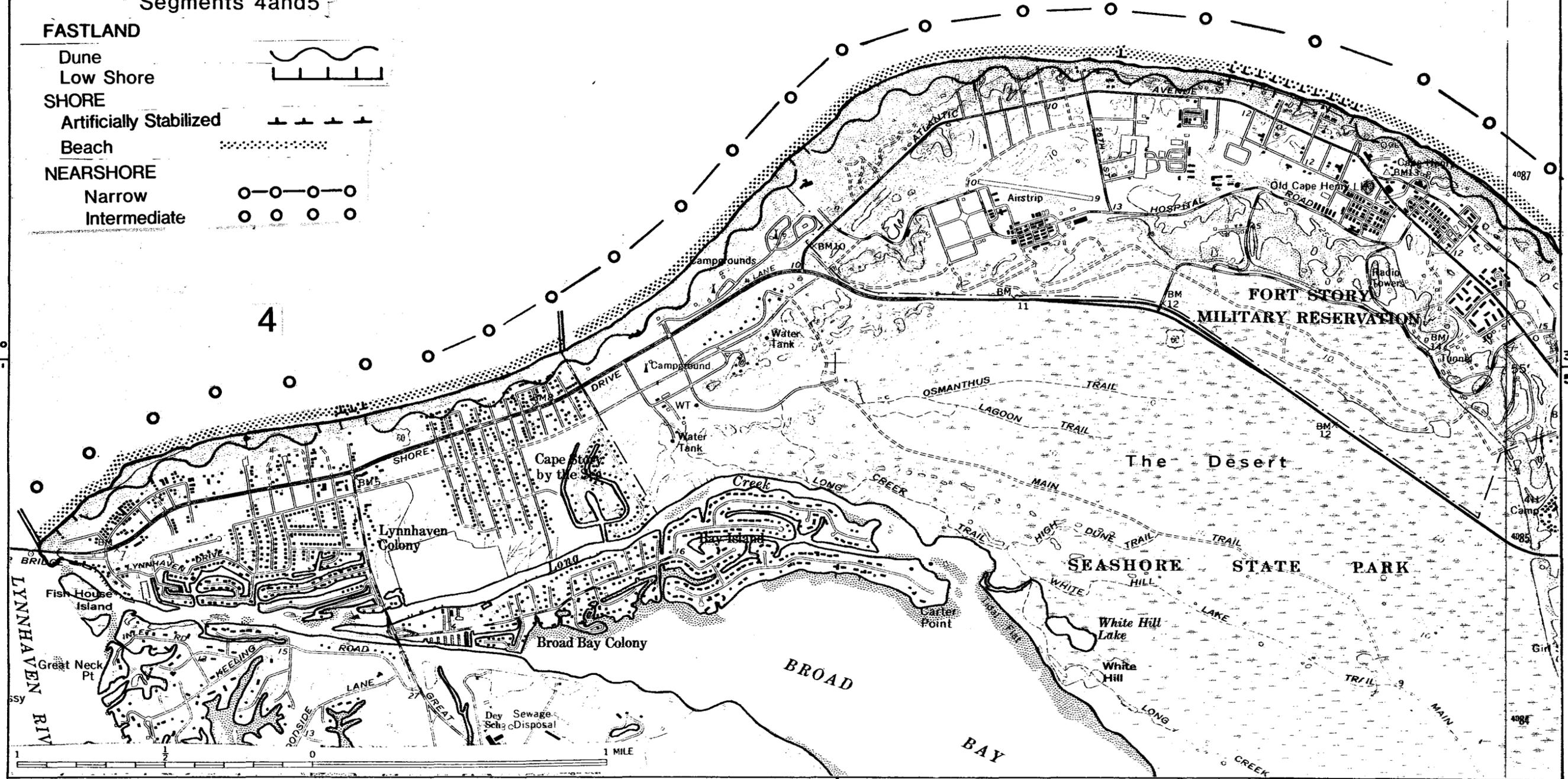
- Dune 
- Low Shore 
- SHORE
- Artificially Stabilized 
- Beach 
- NEARSHORE
- Narrow 
- Intermediate 

5

4

36°
55'

36°
55'



76° 02' 30"

76° 02' 30"

MAP 3C

CAPE HENRY

FASTLAND USE, OWNERSHIP, EROSION

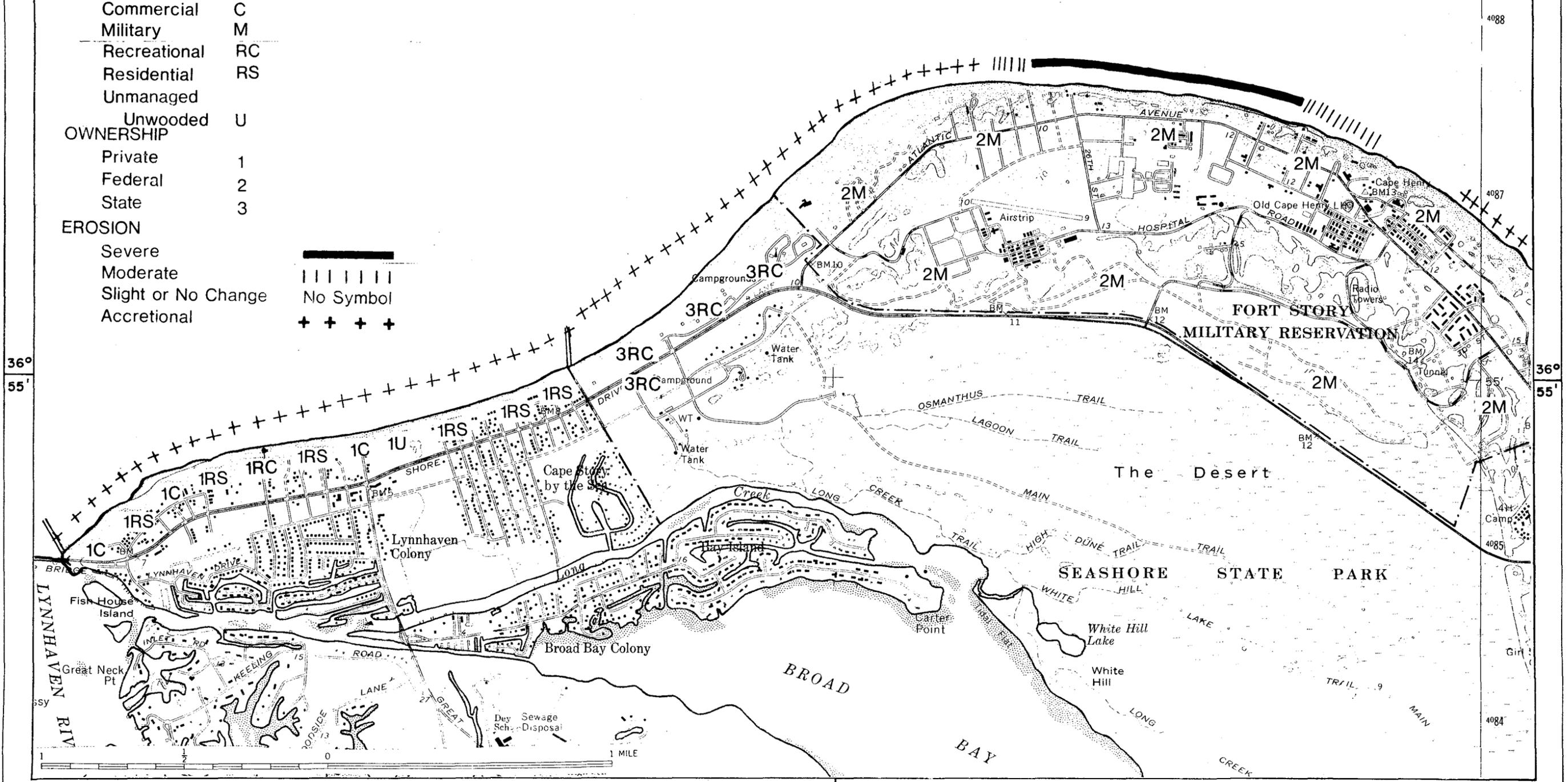
Segments 4 and 5

5

- USE
- Commercial C
 - Military M
 - Recreational RC
 - Residential RS
 - Unmanaged
 - Unwooded U

- OWNERSHIP
- Private 1
 - Federal 2
 - State 3

- EROSION
- Severe 
 - Moderate 
 - Slight or No Change No Symbol
 - Accretional 



36° 55'

36° 55'

76° 02' 30"





MAP 4B

WESTERN BRANCH - LYNNHAVEN RIVER
 SHORELANDS TYPES
 Subsegments 3A, 3B and 3C

FASTLAND

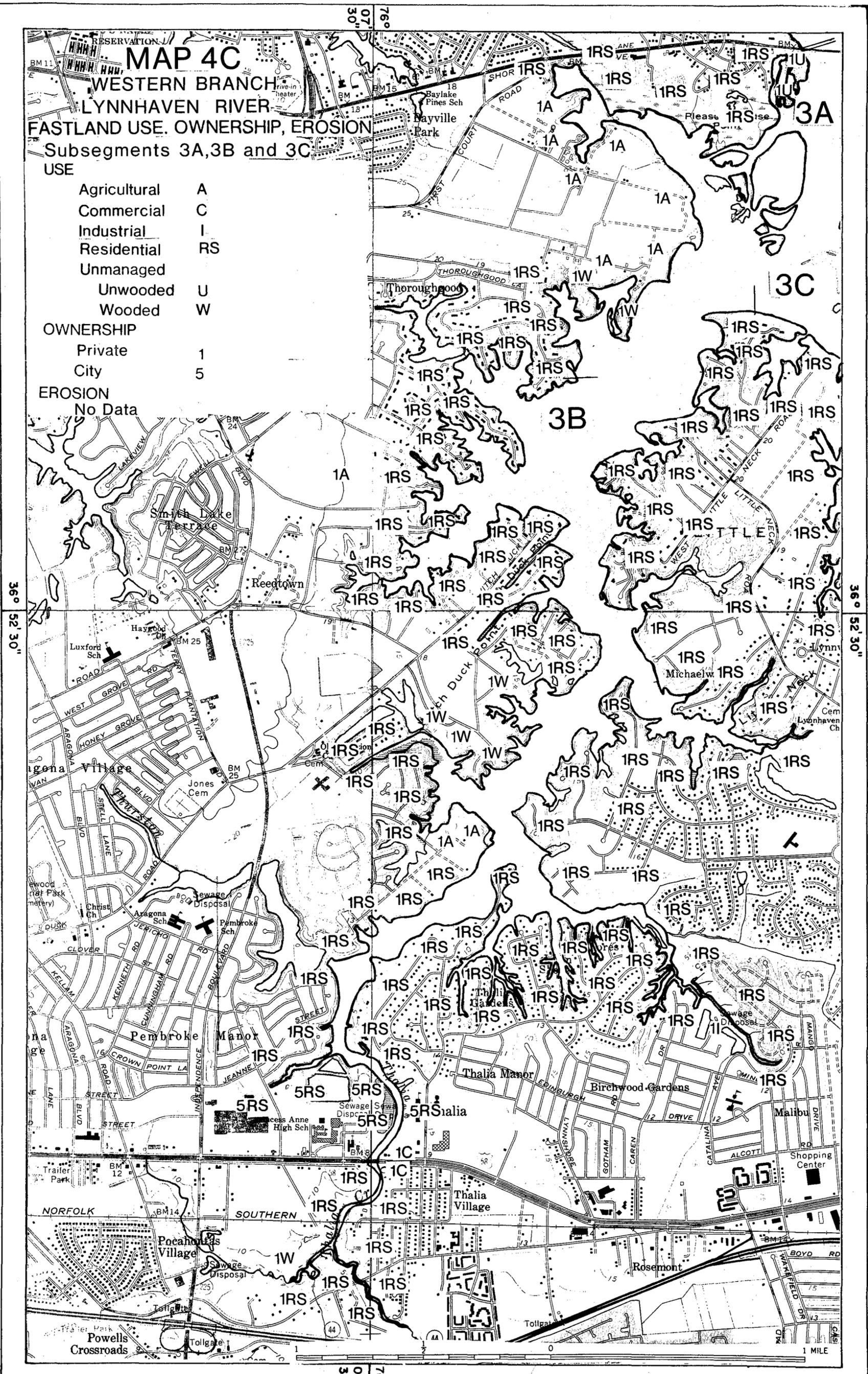
- Artificial Fill
- Dune
- Low Shore
- Low Shore with Bluff

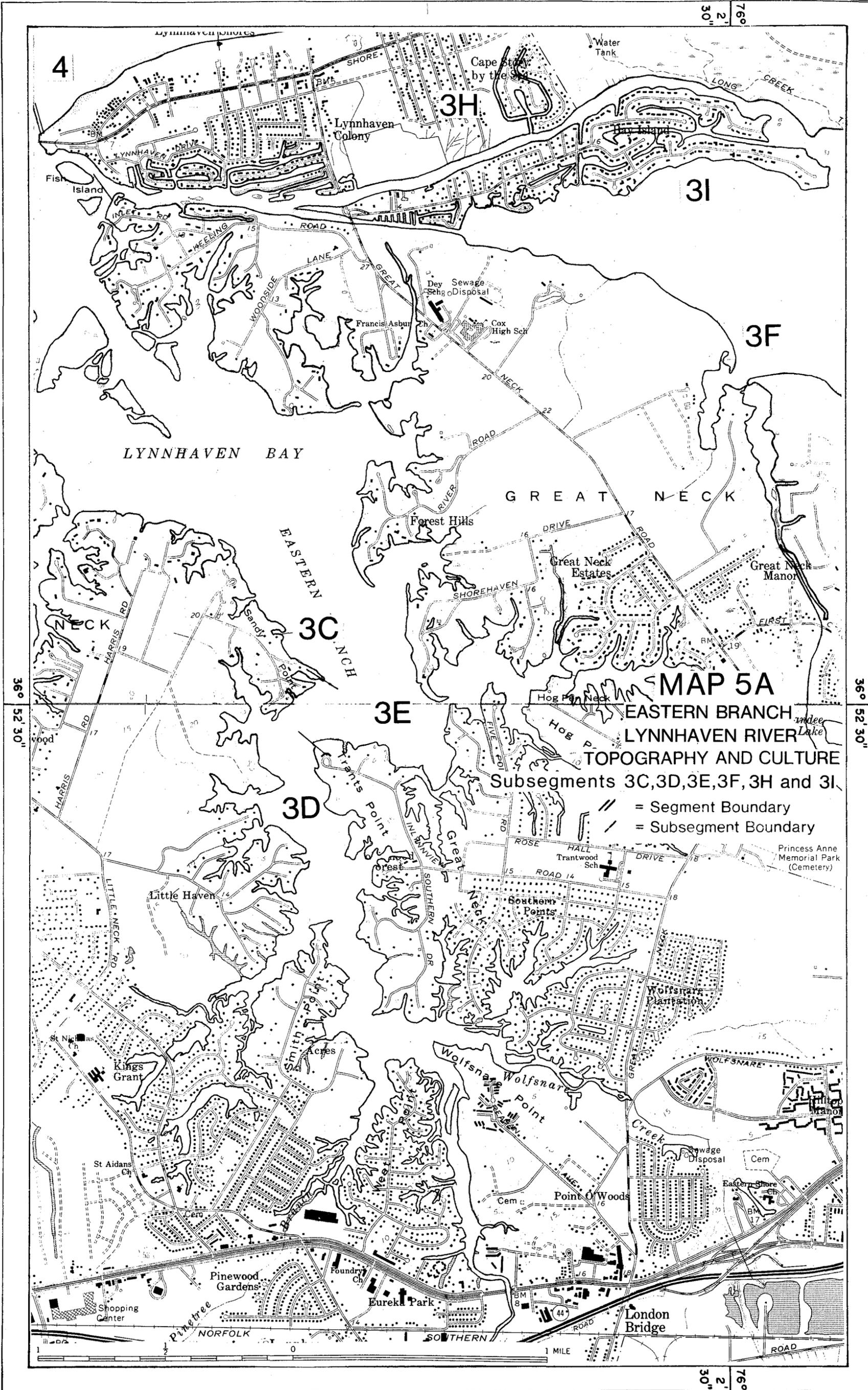
SHORE

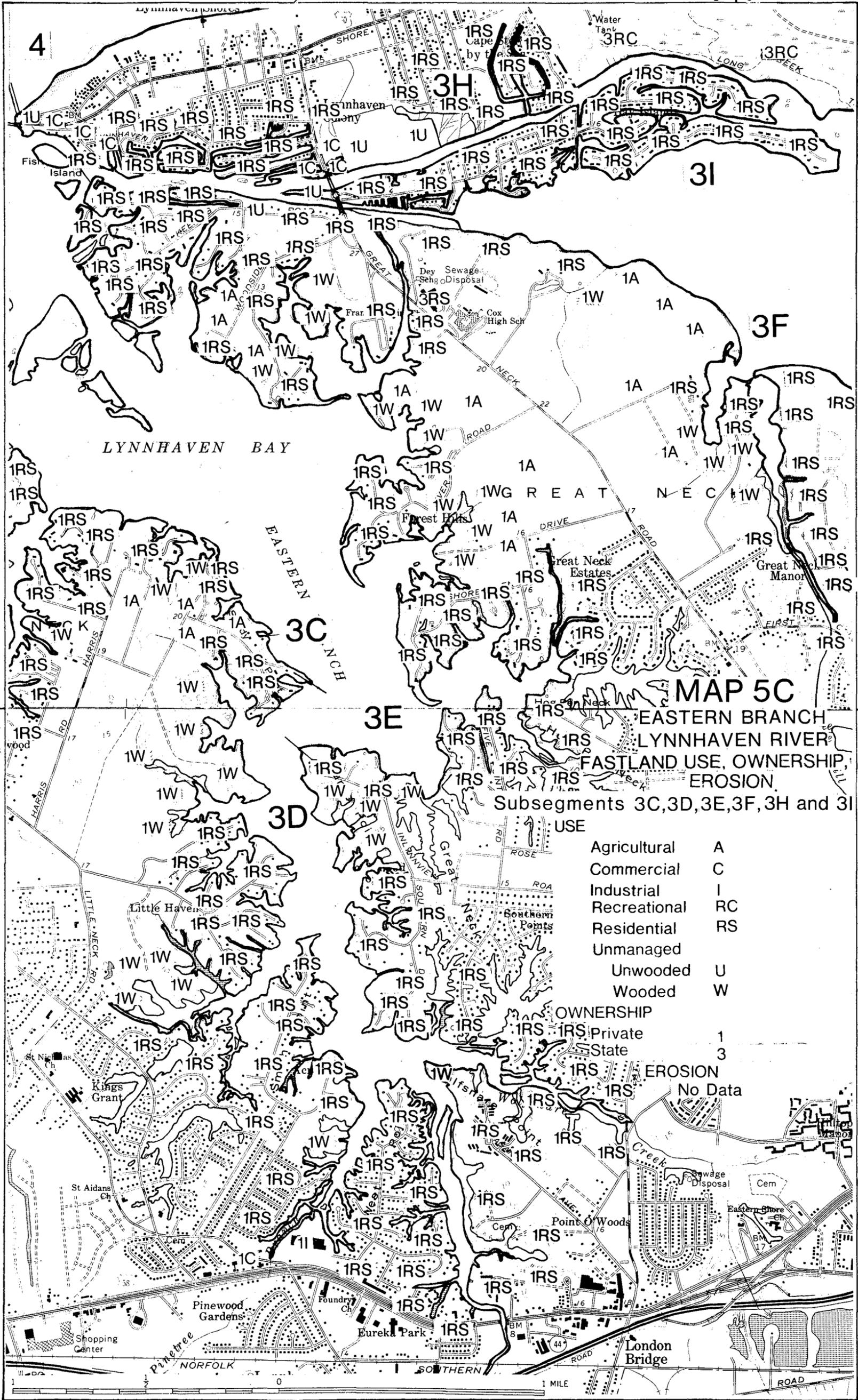
- Beach
- Fringe Marsh
- Extensive Marsh
- Embayed Marsh
- Artificially Stabilized

MAP 4C
WESTERN BRANCH
LYNNHAVEN RIVER
FASTLAND USE, OWNERSHIP, EROSION
Subsegments 3A, 3B and 3C

USE	
Agricultural	A
Commercial	C
Industrial	I
Residential	RS
Unmanaged	
Unwooded	U
Wooded	W
OWNERSHIP	
Private	1
City	5
EROSION	
No Data	







MAP 5C

**EASTERN BRANCH
LYNNHAVEN RIVER
FASTLAND USE, OWNERSHIP,
EROSION.**

Subsegments 3C, 3D, 3E, 3F, 3H and 3I

- Agricultural A
- Commercial C
- Industrial I
- Recreational RC
- Residential RS
- Unmanaged
- Unwooded U
- Wooded W

- OWNERSHIP**
- Private 1
 - State 3
- EROSION**
- No Data

36° 52' 30"

36° 52' 30"

76° 30"

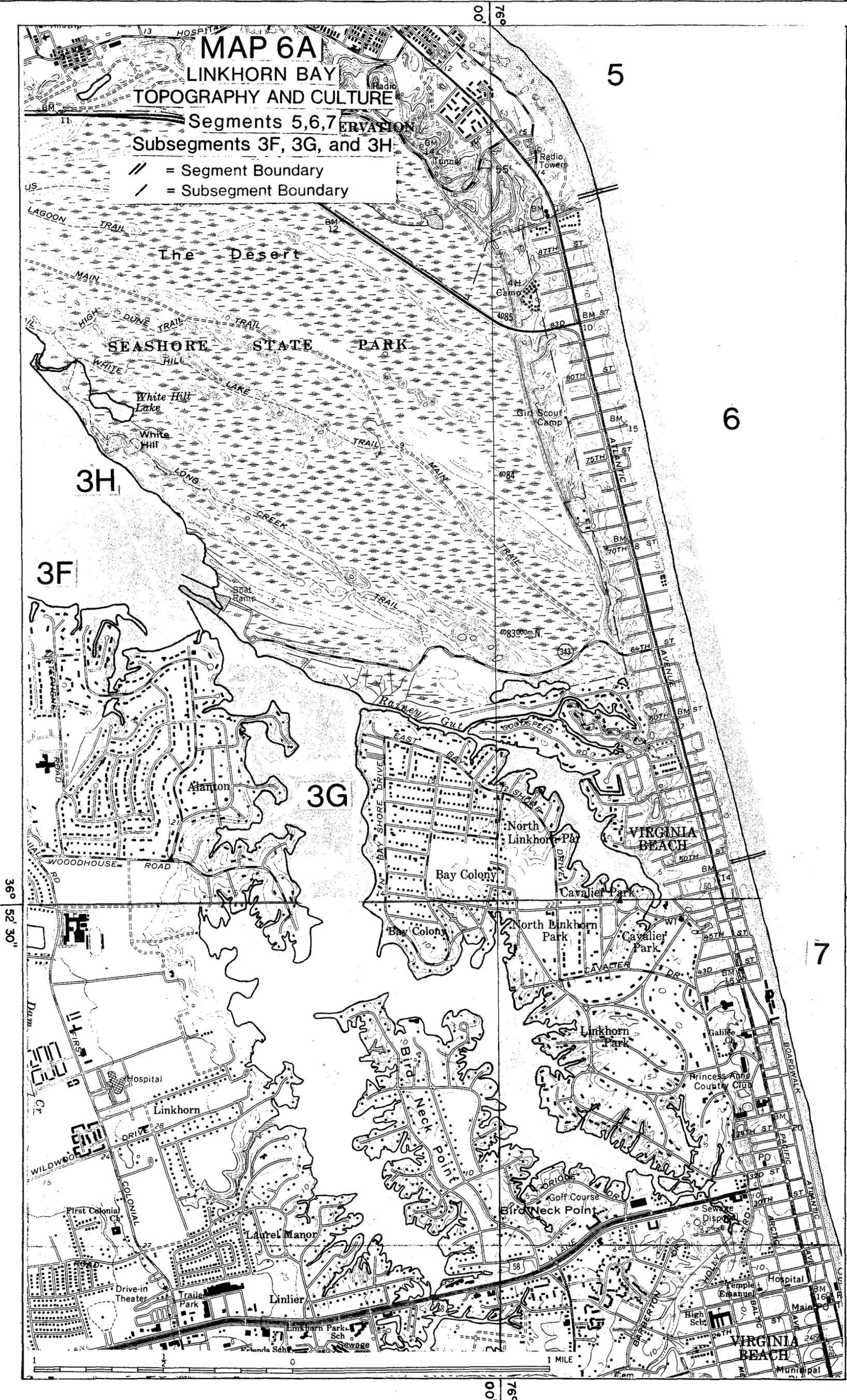
76° 30"

MAP 6A

LINKHORN BAY TOPOGRAPHY AND CULTURE

Segments 5, 6, 7
Subsegments 3F, 3G, and 3H

- // = Segment Boundary
- / = Subsegment Boundary



MAP 6B

LINKHORN BAY SHORELANDS TYPES

Segments 5,6,7 DRY

Subsegments 3F, 3G, and 3HION

FASTLAND

Dune

Artificial Fill

Low Shore

Low Shore

with Bluff

Moderately Low Shore

Moderately High Shore

Moderately High Shore

with Bluff

High Shore

with Bluff

SHORE

Beach

Fringe Marsh

Artificially Stabilized

Embayed Marsh

NEARSHORE

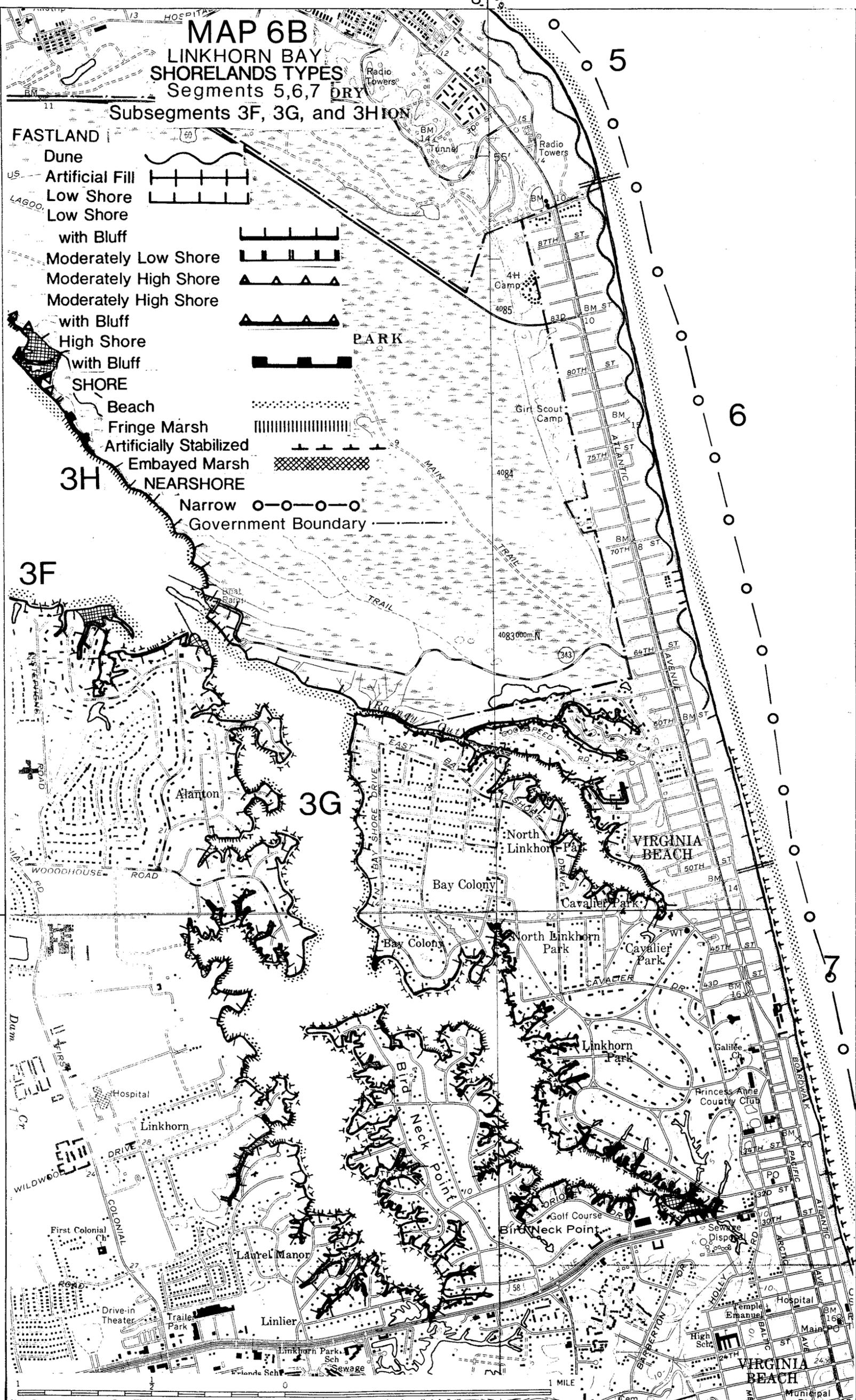
3H

3F

3G

36° 52' 30"

36° 52' 30"

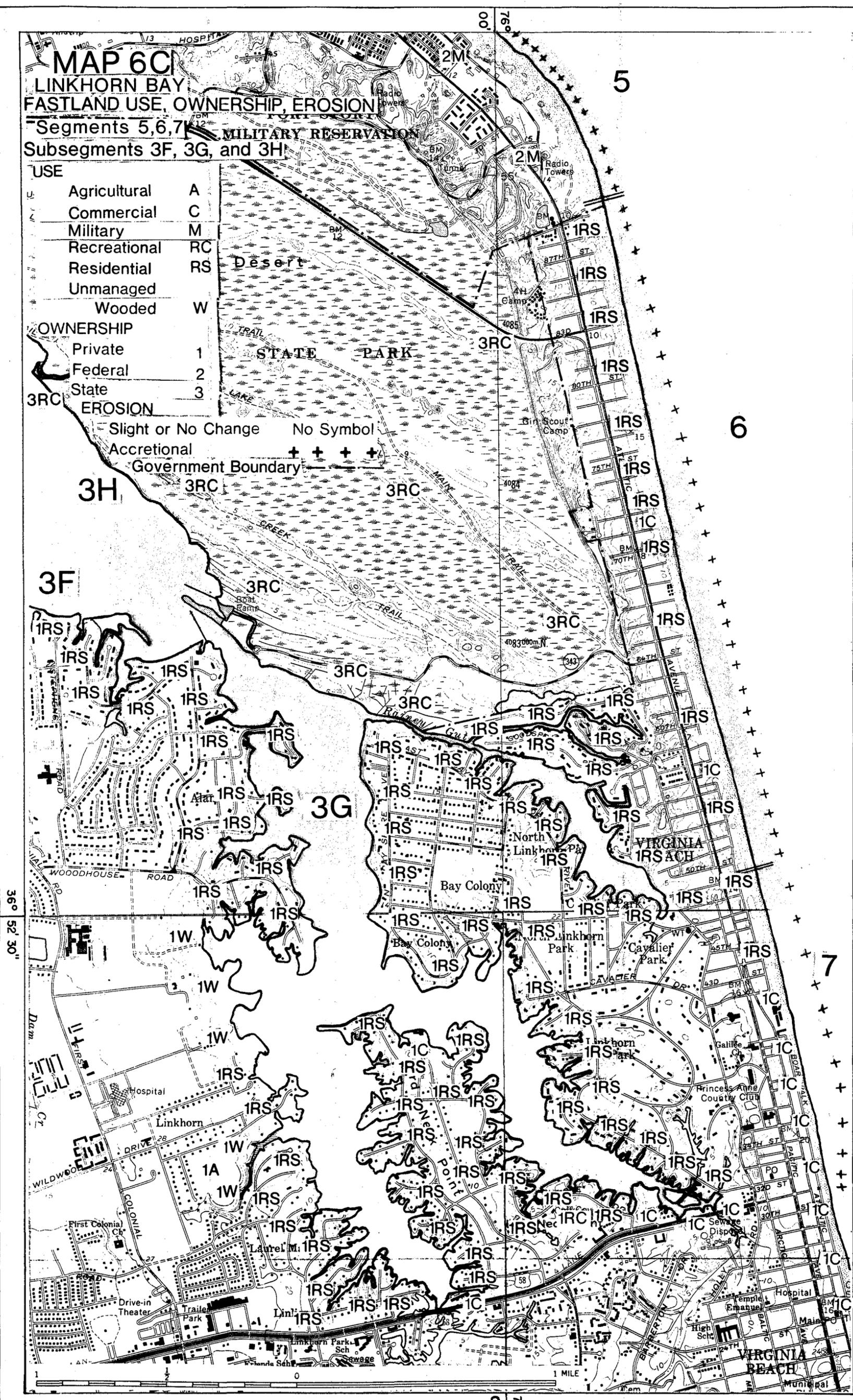


MAP 6C
LINKHORN BAY
FASTLAND USE, OWNERSHIP, EROSION
Segments 5, 6, 7
Subsegments 3F, 3G, and 3H

USE	
Agricultural	A
Commercial	C
Military	M
Recreational	RC
Residential	RS
Unmanaged	
Wooded	W

OWNERSHIP	
Private	1
Federal	2
State	3

3RC EROSION
 Slight or No Change No Symbol
 Accretional Government Boundary



75° 57' 30"

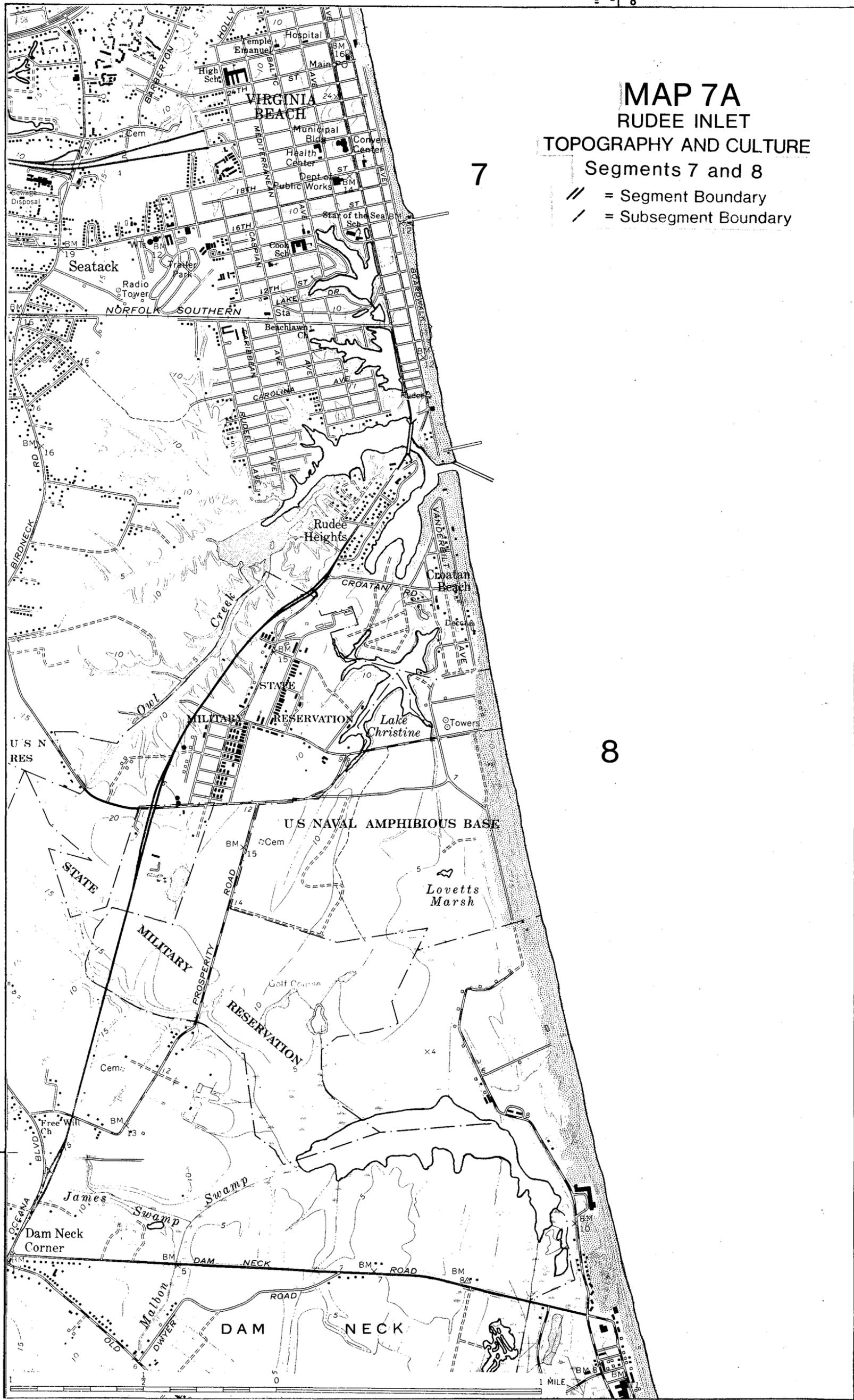
MAP 7A RUDEE INLET TOPOGRAPHY AND CULTURE

Segments 7 and 8

- // = Segment Boundary
- / = Subsegment Boundary

7

8



68

36° 47' 30"

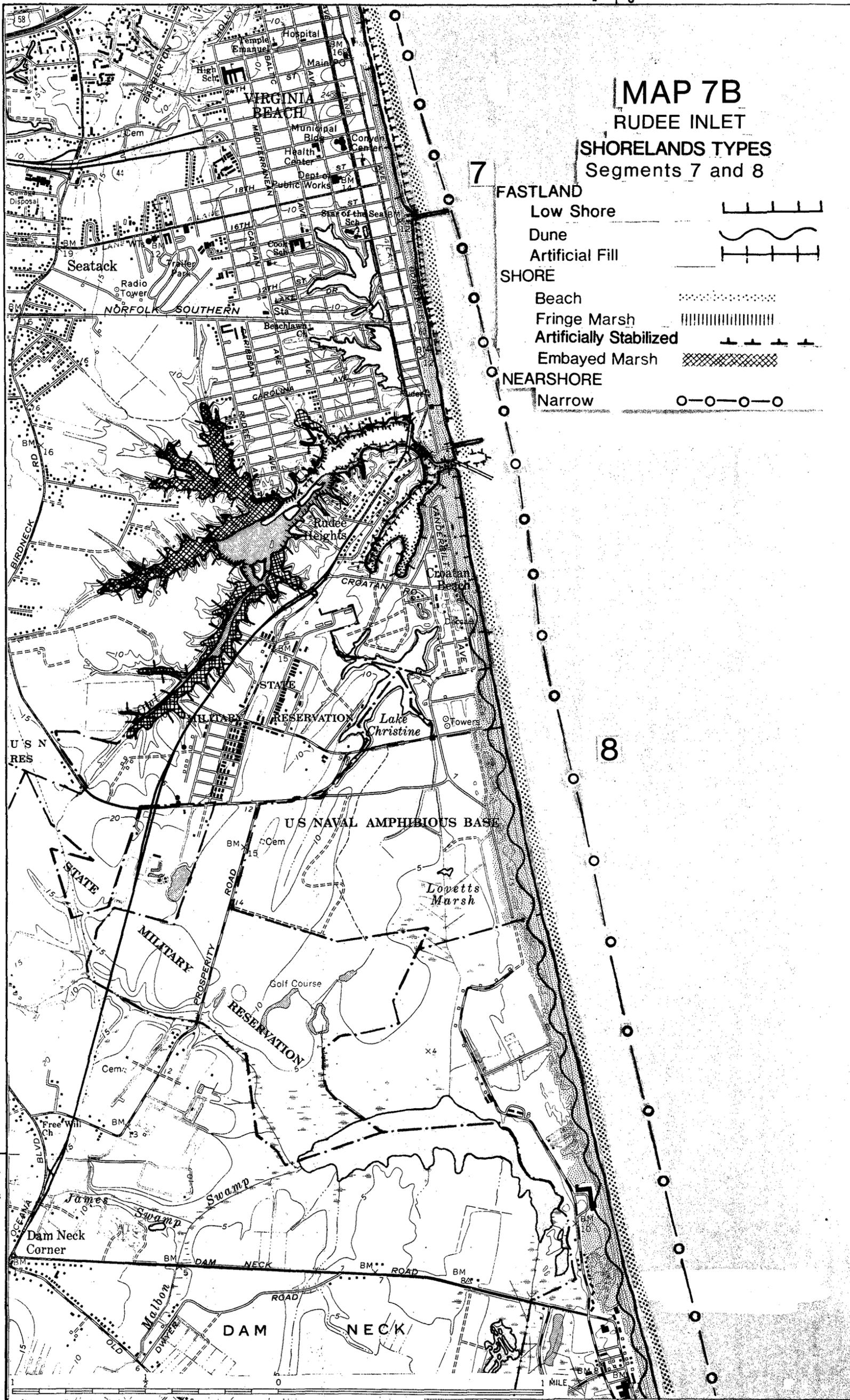
36° 47' 30"

75° 57' 30"

75° 57' 30"

MAP 7B RUDEE INLET SHORELANDS TYPES Segments 7 and 8

- FASTLAND**
 - Low Shore
 - Dune
 - Artificial Fill
- SHORE**
 - Beach
 - Fringe Marsh
 - Artificially Stabilized
 - Embayed Marsh
- NEARSHORE**
 - Narrow

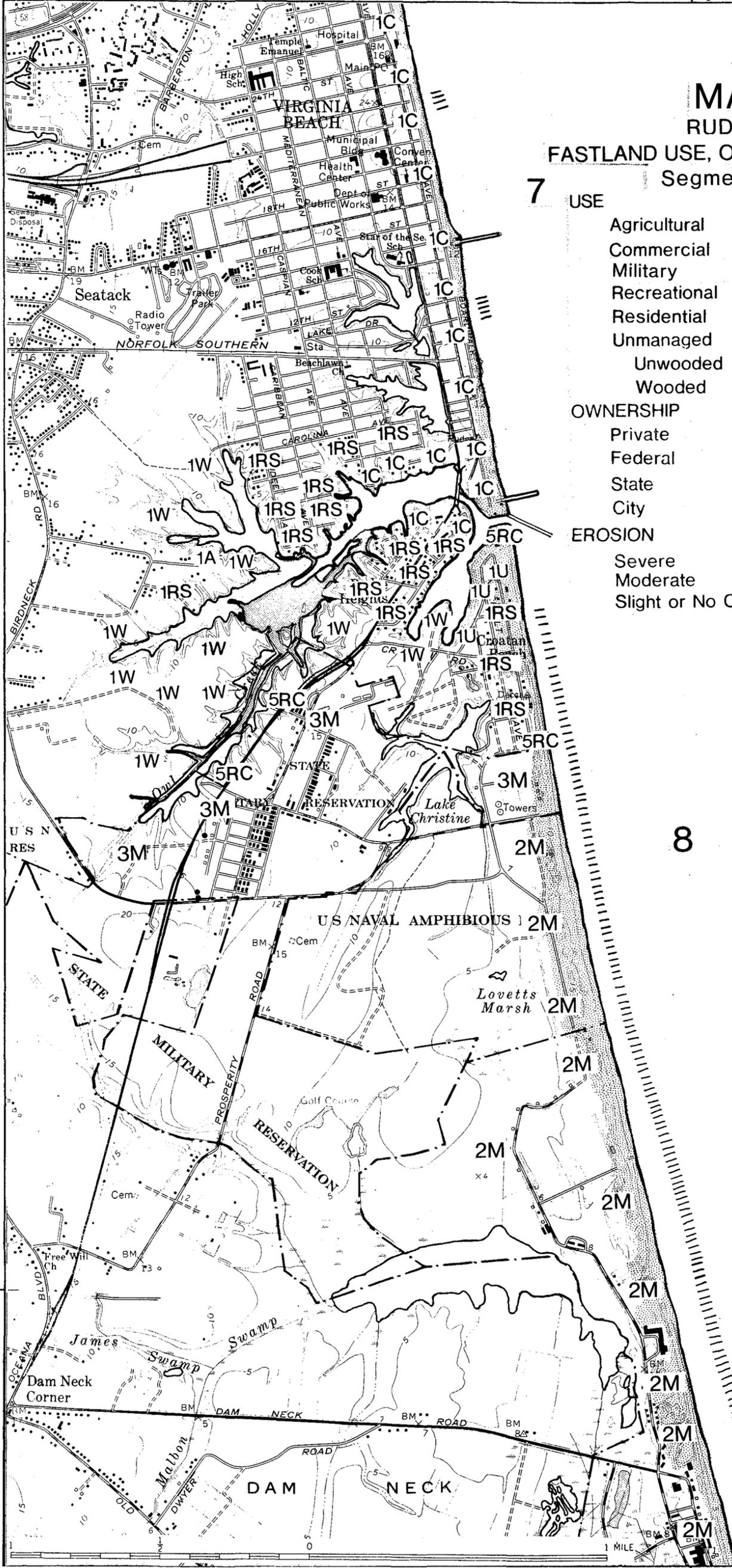


36° 47' 30"

36° 47' 30"

75° 57' 30"

75° 57' 30"



MAP 7C

RUDEE INLET

FASTLAND USE, OWNERSHIP, EROSION

Segments 7 and 8

7 USE

- Agricultural A
- Commercial C
- Military M
- Recreational RC
- Residential RS
- Unmanaged Unwooded U
- Wooded W

OWNERSHIP

- Private 1
- Federal 2
- State 3
- City 5

EROSION

- Severe
- Moderate
- Slight or No Change

8

70

36° 47' 30"

36° 47' 30"

75° 57' 30"

75° 57' 30"

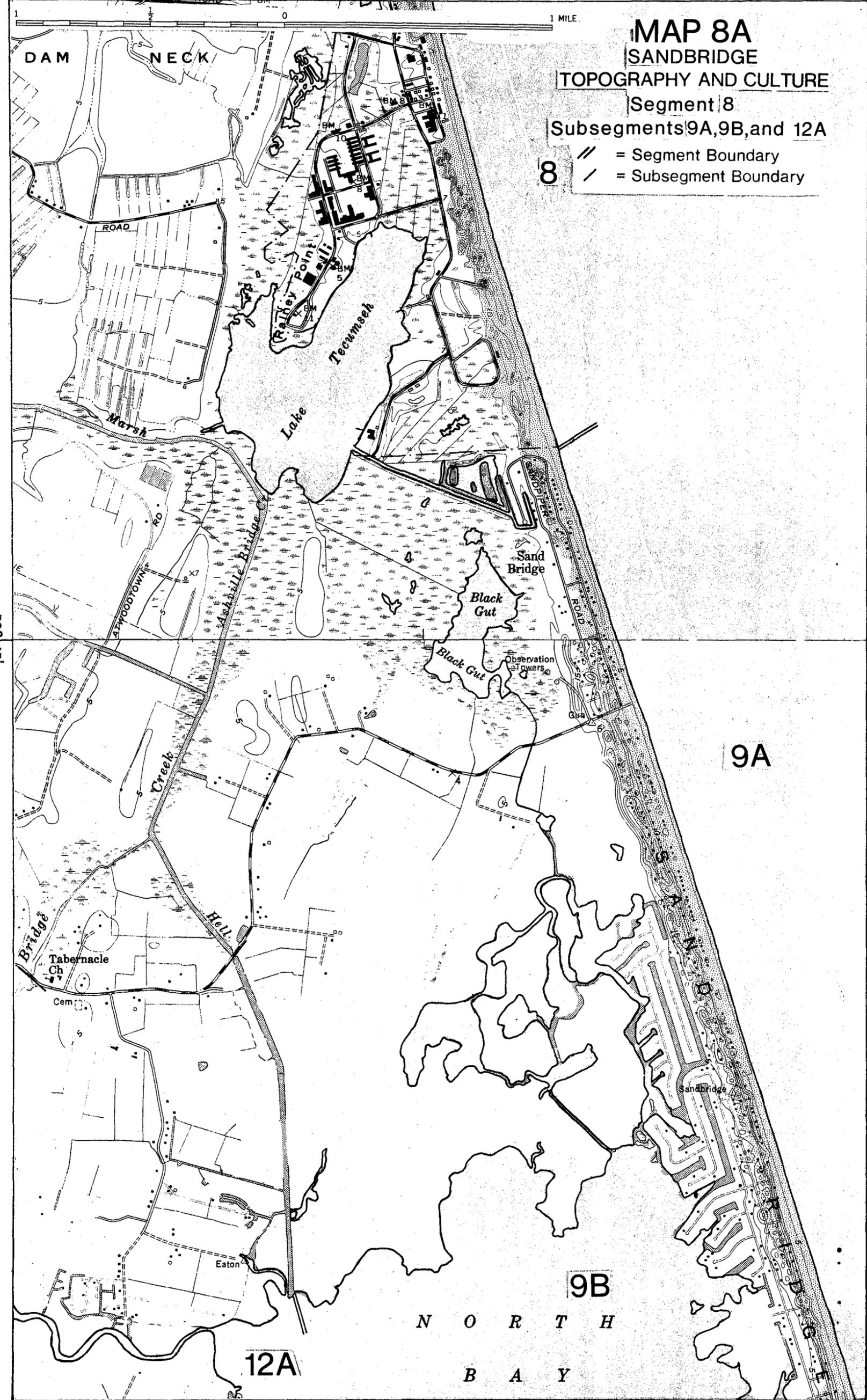
1 MILE

MAP 8A SANDBRIDGE TOPOGRAPHY AND CULTURE

Segment 8

Subsegments 9A, 9B, and 12A

-  = Segment Boundary
-  = Subsegment Boundary



9A

9B

12A

N O R T H
B A Y

75° 57' 30"

36° 45'

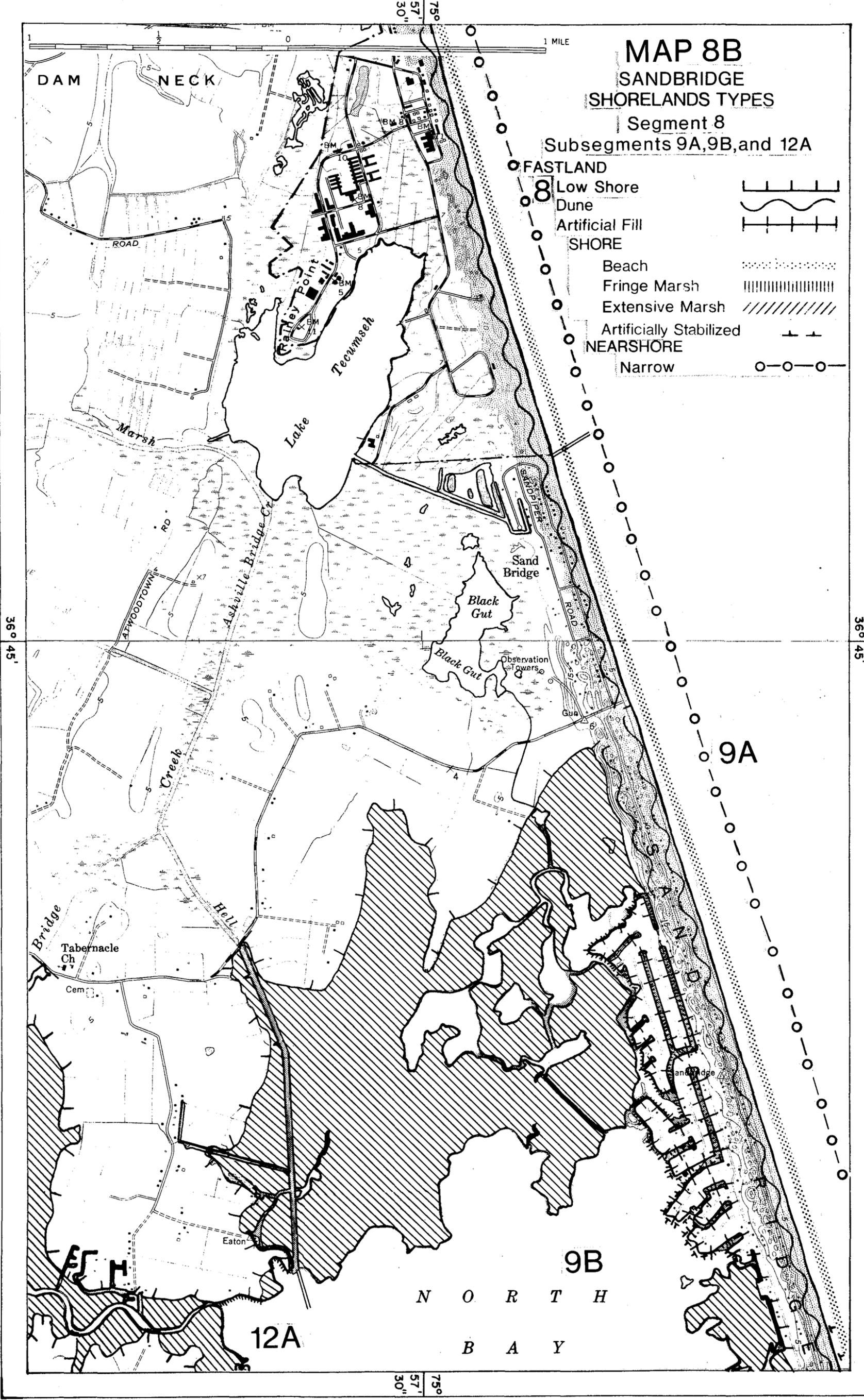
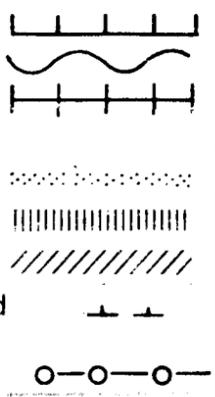
36° 45'

MAP 8B

SANDBRIDGE SHORELANDS TYPES

Segment 8
Subsegments 9A, 9B, and 12A

- FASTLAND
- 8 Low Shore Dune
- Artificial Fill SHORE
- Beach
- Fringe Marsh
- Extensive Marsh
- Artificially Stabilized NEARSHORE
- Narrow



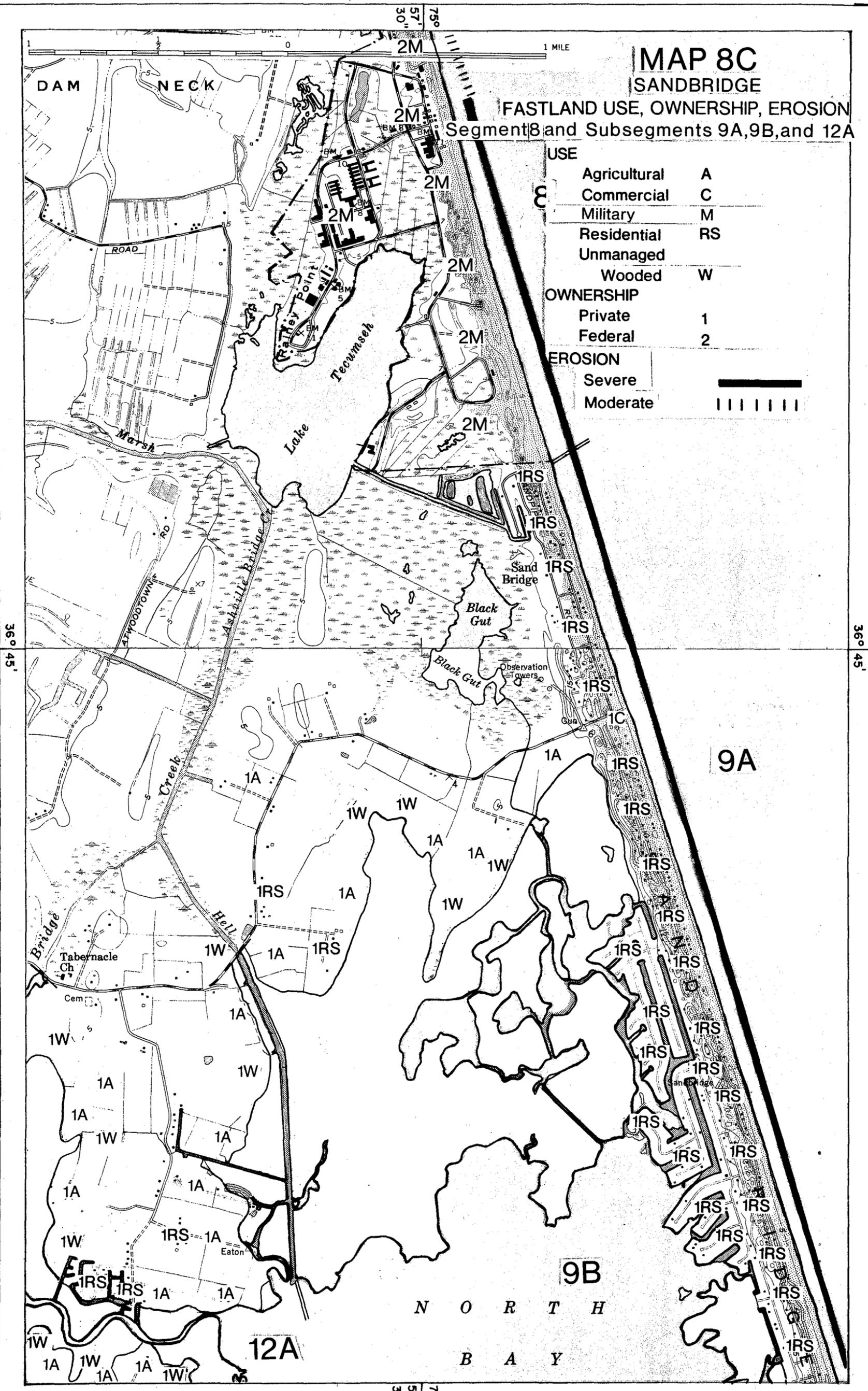
N O R T H
B A Y

MAP 8C

SANDBRIDGE

FASTLAND USE, OWNERSHIP, EROSION
Segment 8 and Subsegments 9A, 9B, and 12A

USE	
Agricultural	A
Commercial	C
Military	M
Residential	RS
Unmanaged	
Wooded	W
OWNERSHIP	
Private	1
Federal	2
EROSION	
Severe	
Moderate	



N O R T H
B A Y

75° 55'

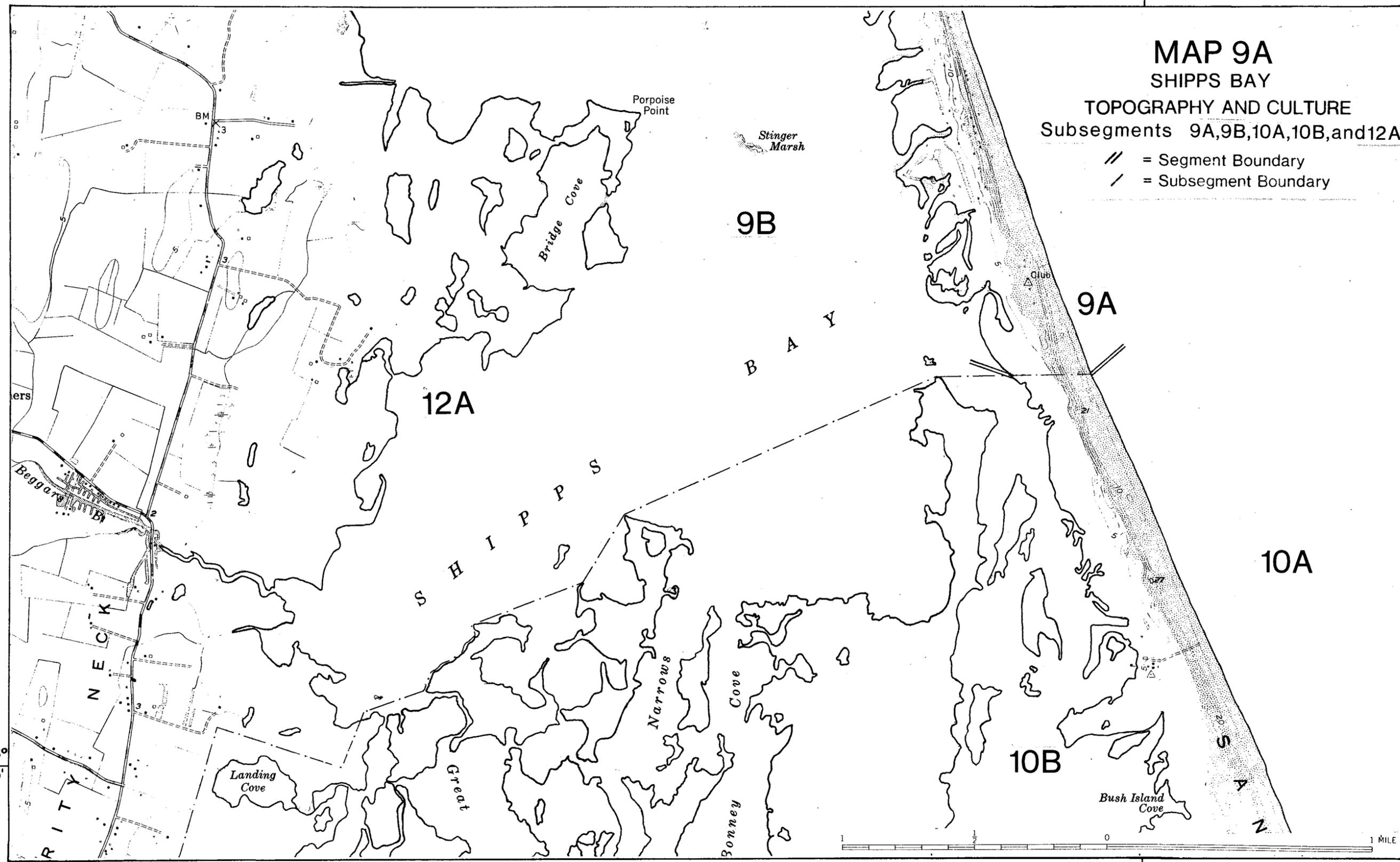
MAP 9A

SHIPPS BAY

TOPOGRAPHY AND CULTURE

Subsegments 9A,9B,10A,10B,and12A

- // = Segment Boundary
- / = Subsegment Boundary



75° 55'

MAP 9B

SHIPPS BAY

SHORELANDS TYPES

Subsegments 9A, 9B, 10A, 10B, and 12A

FASTLAND

Low Shore

Dune

Artificial Fill

SHORE

Beach

Fringe Marsh

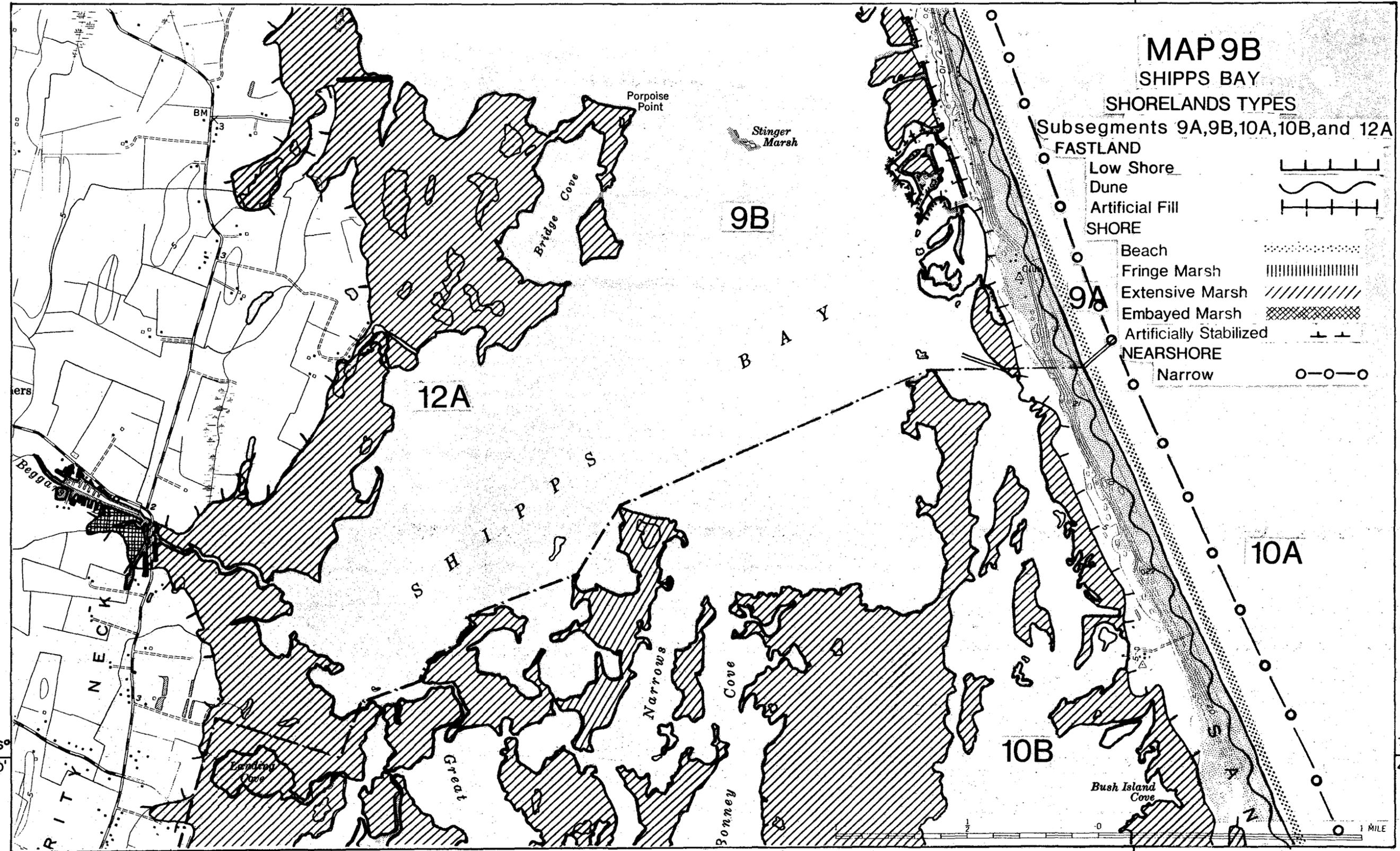
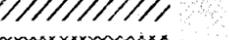
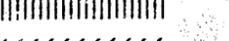
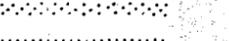
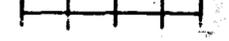
Extensive Marsh

Embayed Marsh

Artificially Stabilized

NEARSHORE

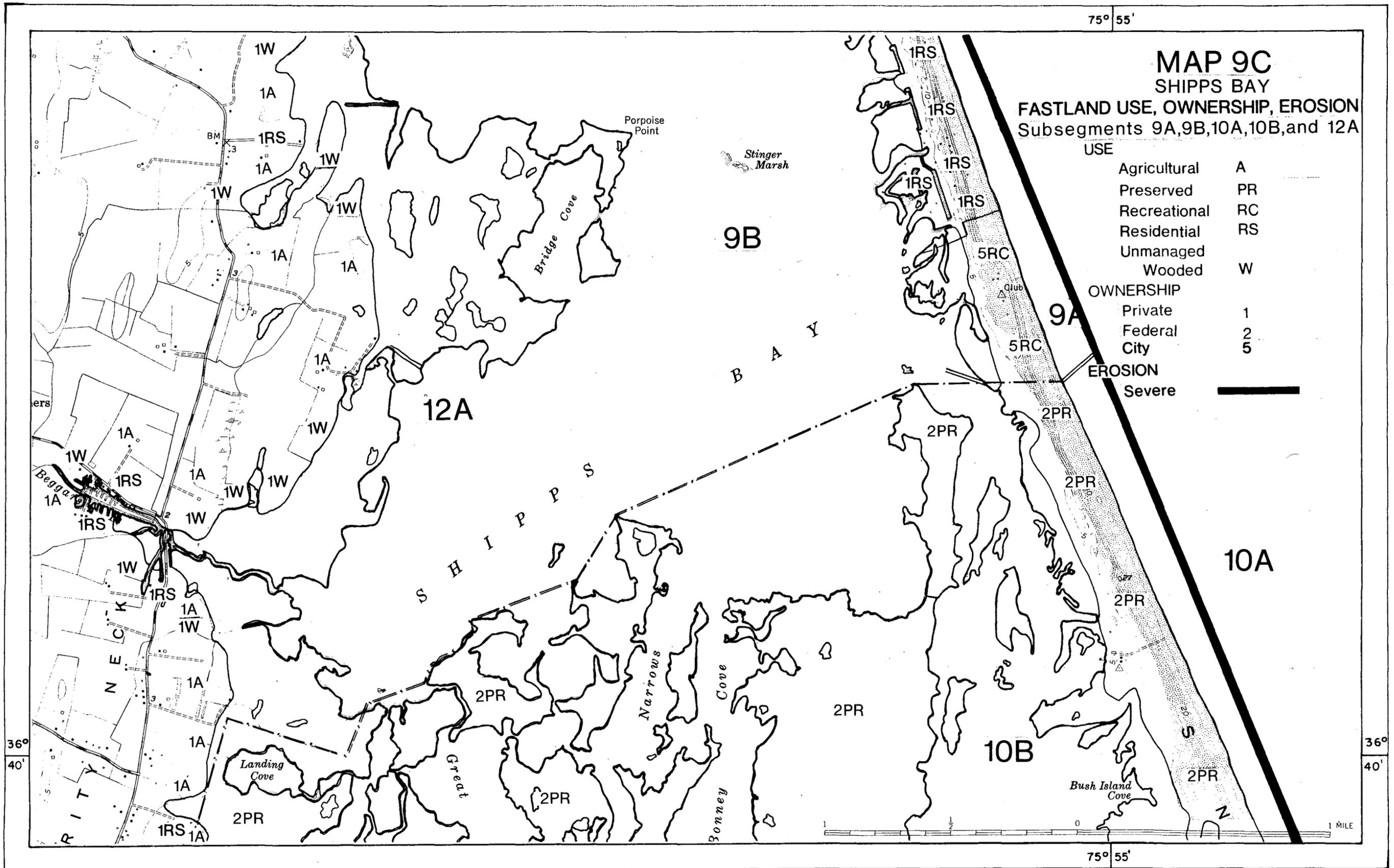
Narrow

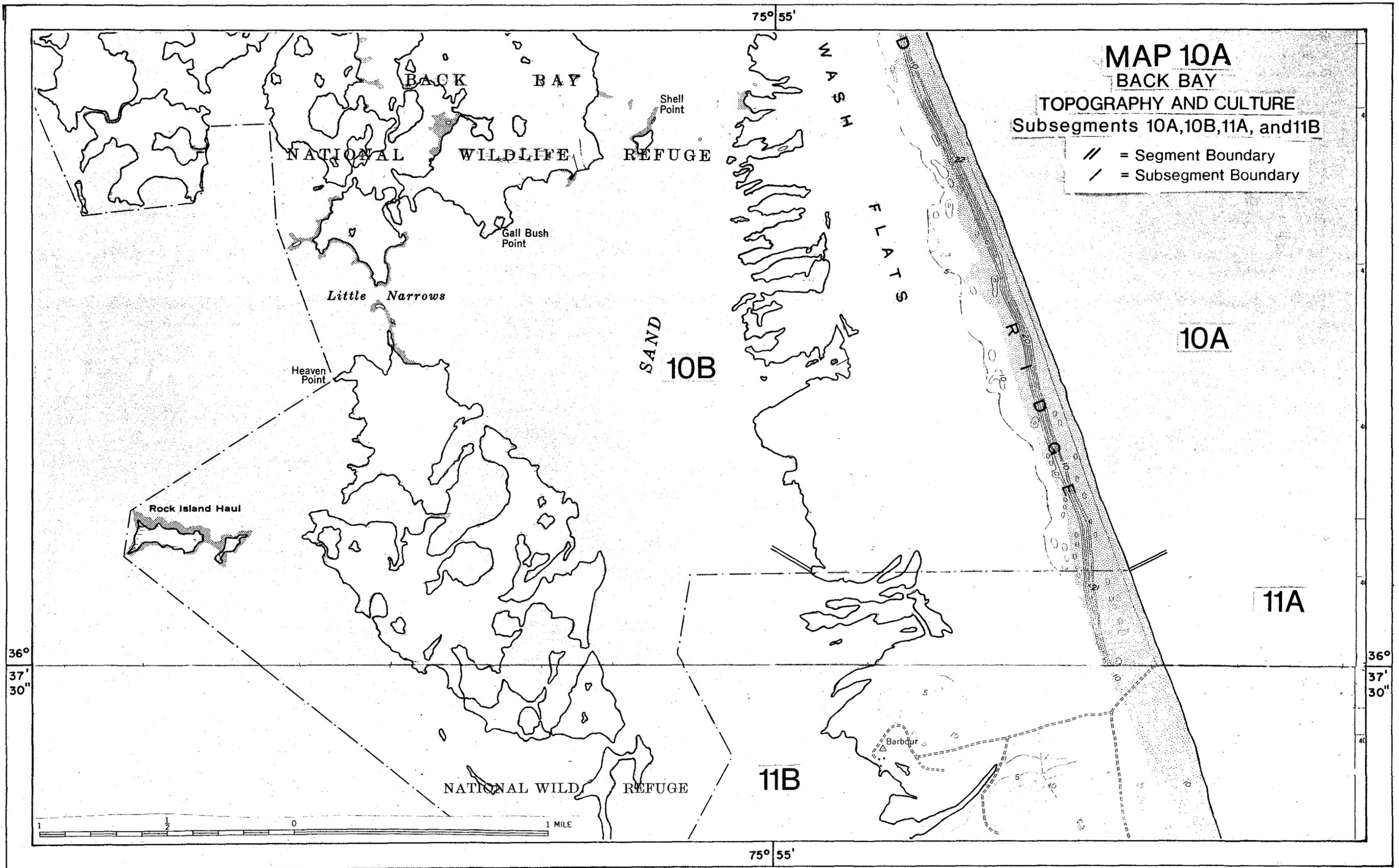


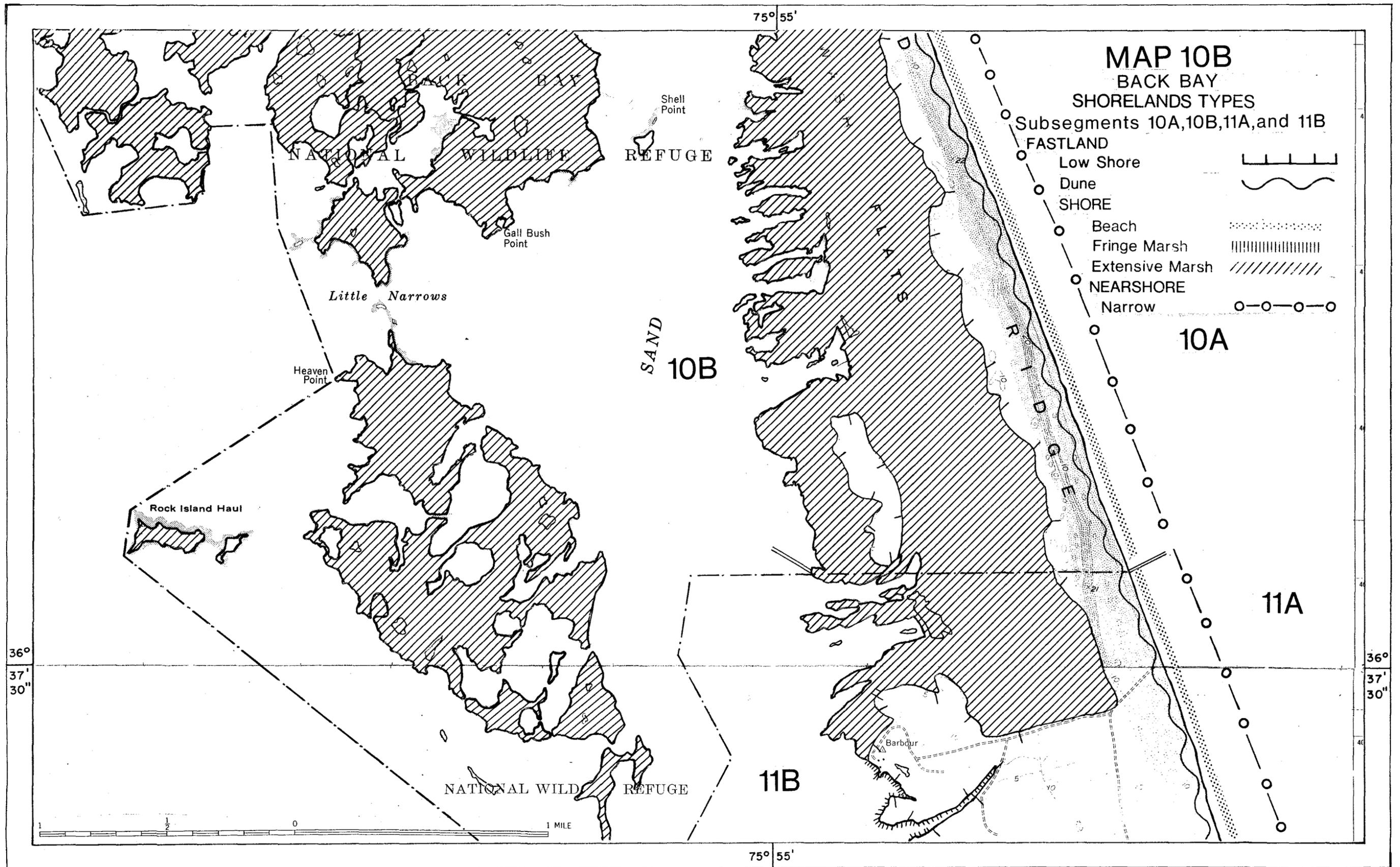
75° 55'

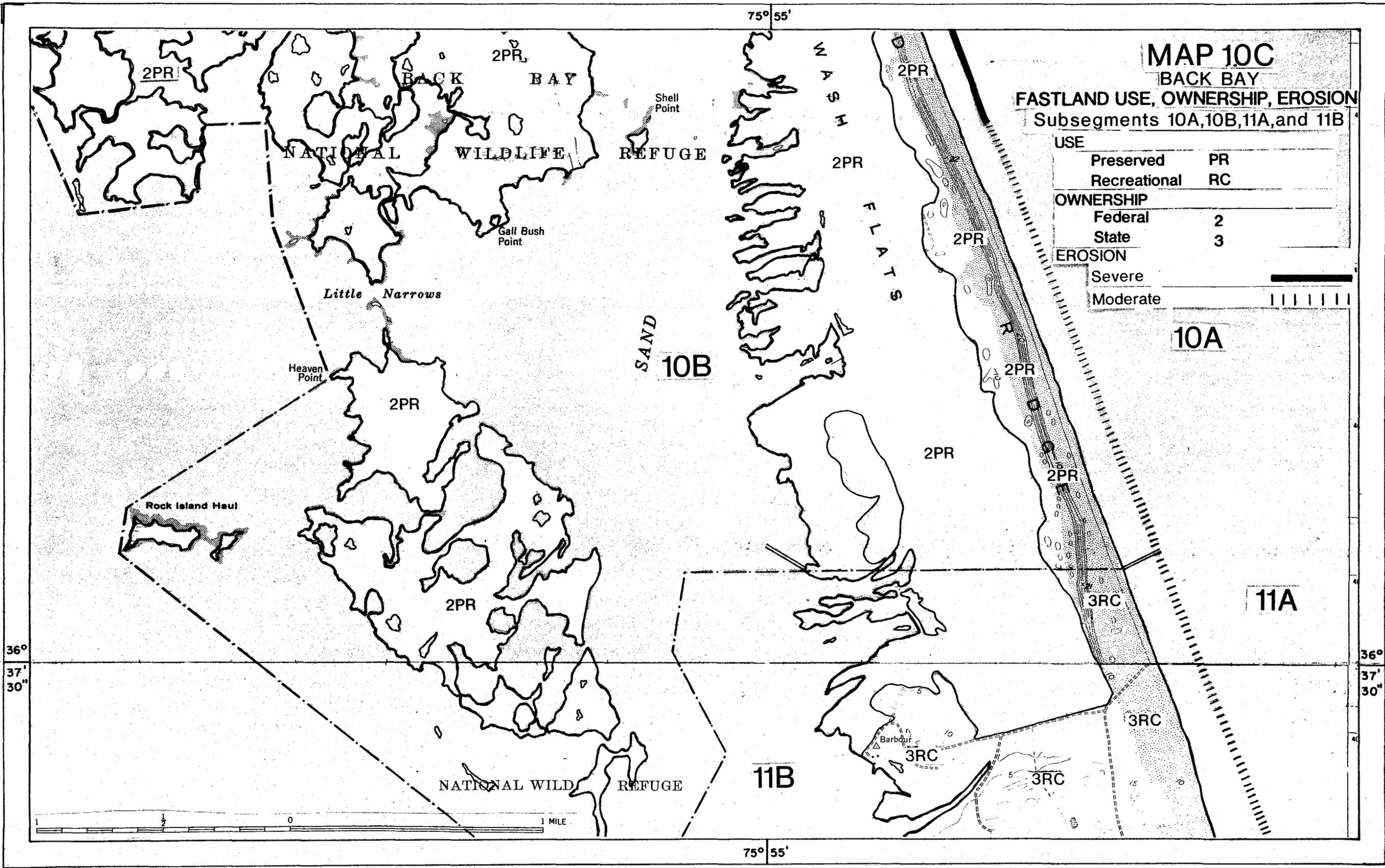
36°
40'

36°
40'









MAP 11B
FALSE CAPE
SHORELANDS TYPES
 Subsegments 11A, 11B and 12C

FASTLAND

- Low Shore
- Dune

SHORE

- Beach
- Fringe Marsh
- Extensive Marsh
- Artificially Stabilized

NEARSHORE

- Narrow
- Intermediate



36° 35'

12C

11B

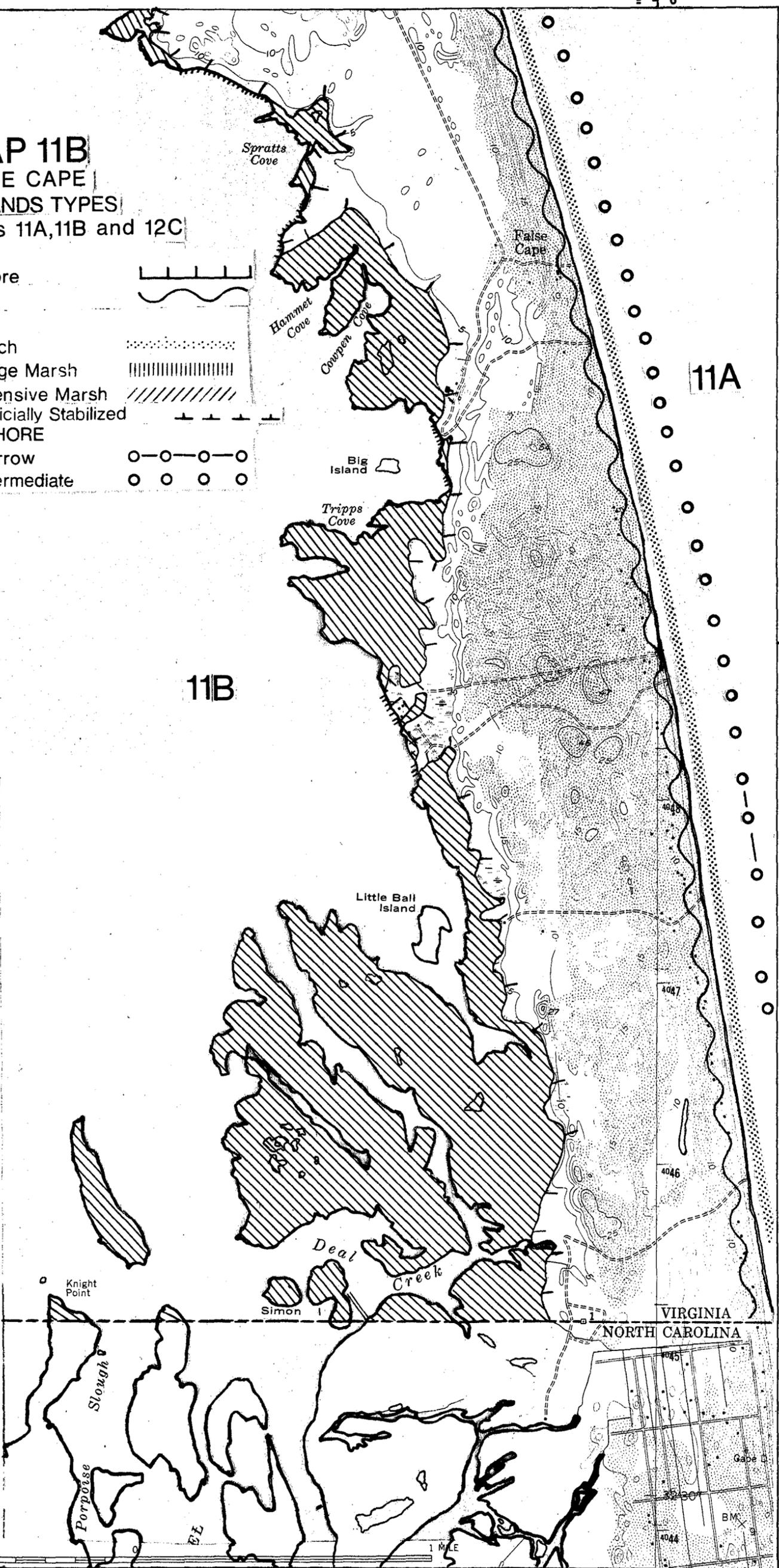
11A

75° 52' 30"

36° 35'

VIRGINIA
 NORTH CAROLINA

75° 52' 30"



MAP 11C

FALSE CAPE

FASTLAND USE, OWNERSHIP, EROSION
Subsegments 11A, 11B and 12C

USE

Agricultural A
Recreational RC
Unmanaged
Wooded W

OWNERSHIP

Private 1
State 3

EROSION

Moderate
Slight or No Change
Accretional

|||||
No Symbol
+++++



12C

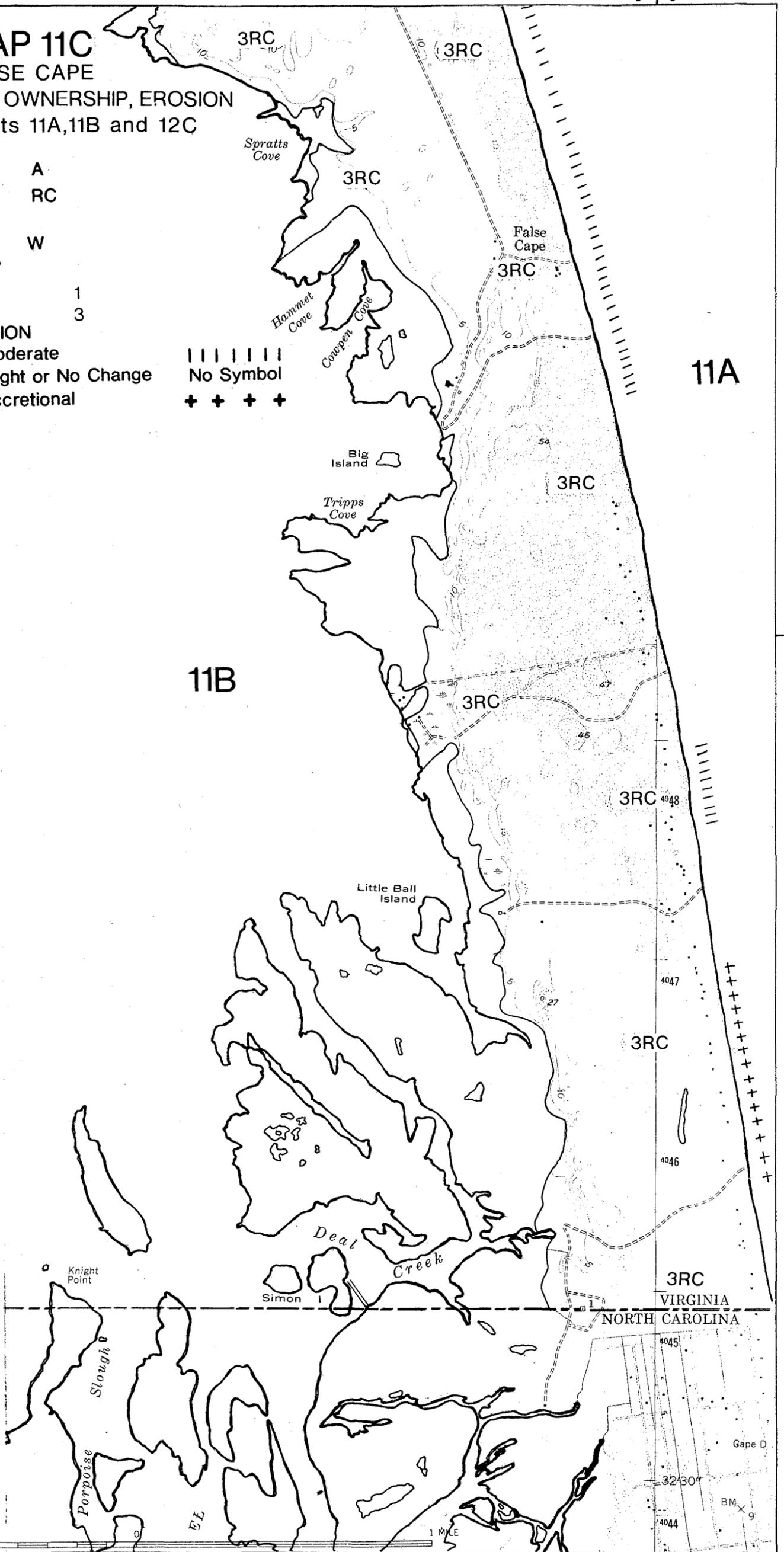


36° 35'

36° 35'

11B

11A



75° 30'

75° 30'

76° 00'

MAP 12A

MACKAY ISLAND NATIONAL WILDLIFE REFUGE TOPOGRAPHY AND CULTURE Subsegments 12B and 12C

- // = Segment Boundary
- / = Subsegment Boundary

**VIRGINIA TROJAN
WATERFOWL MANAGEMENT AREA**

12B

Public Landing

**POCAHONTAS
WATERFOWL MANAGEMENT AREA**

Sedge Island Point

12C

Simpson Island

**MACKAY ISLAND
NATIONAL WILDLIFE REFUGE**

VIRGINIA
NORTH CAROLINA

VIRGINIA BEACH CITY
CURRITUCK CO

Creek

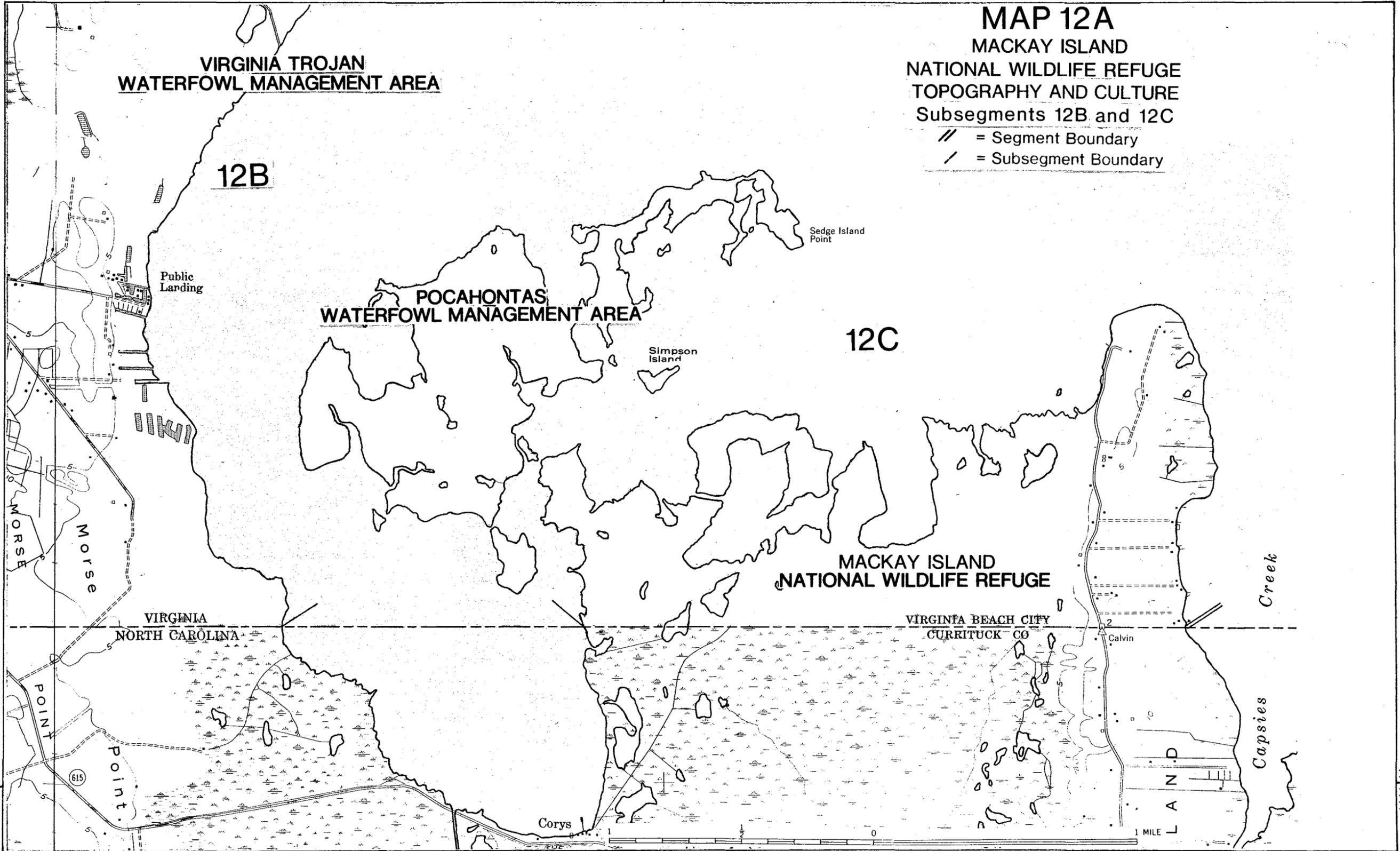
Calvin

Capsies

36°
32'
30"

36°
32'
30"

76° 00'



76° 00'

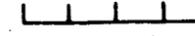
MAP 12B

MACKAY ISLAND NATIONAL WILDLIFE REFUGE SHORELANDS TYPES Subsegments 12B and 12C

FASTLAND

Low Shore

Artificial Fill

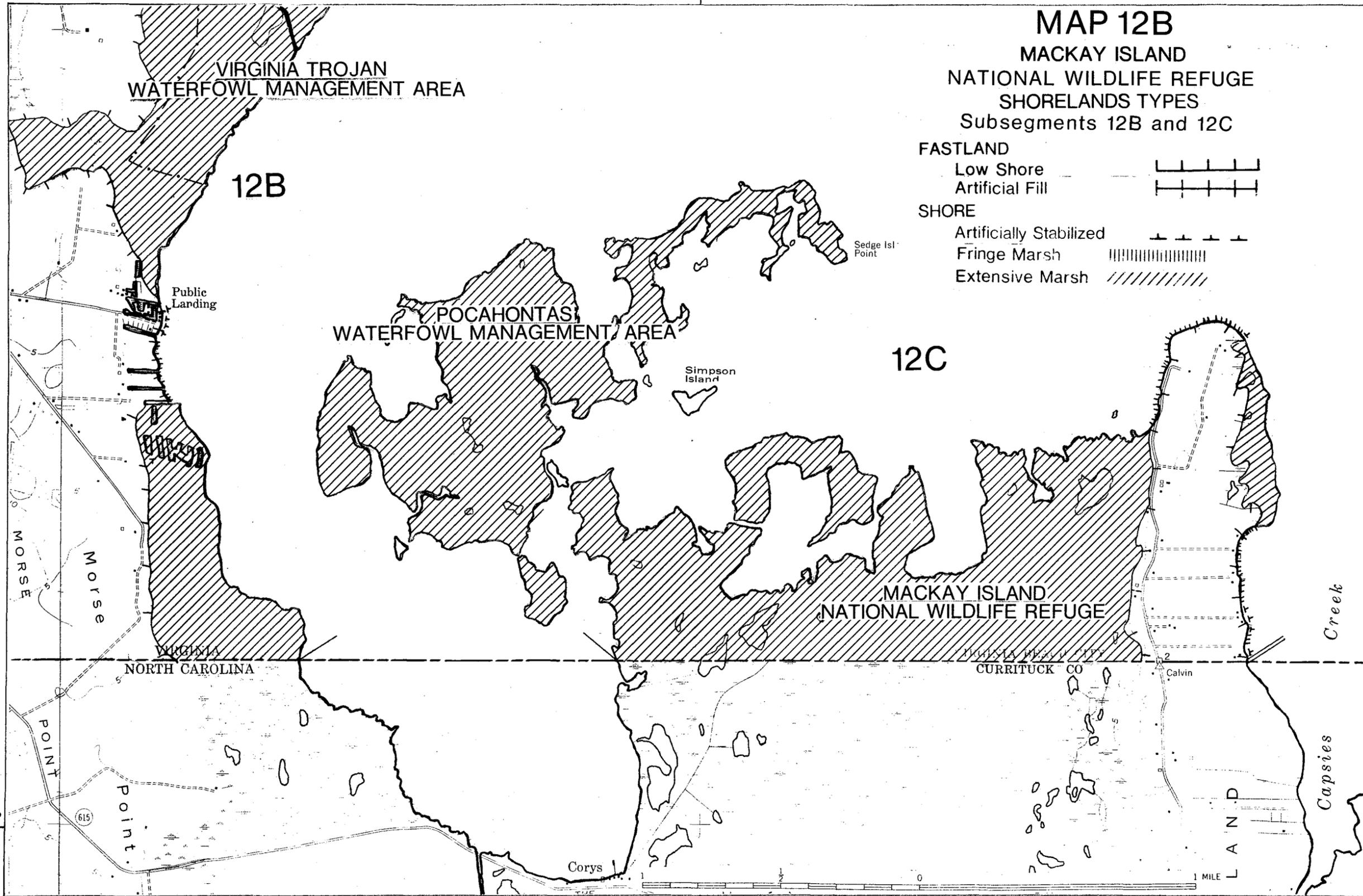
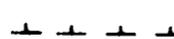


SHORE

Artificially Stabilized

Fringe Marsh

Extensive Marsh



VIRGINIA TROJAN
WATERFOWL MANAGEMENT AREA

12B

Public
Landing

POCAHONTAS
WATERFOWL MANAGEMENT AREA

Simpson
Island

12C

MACKAY ISLAND
NATIONAL WILDLIFE REFUGE

VIRGINIA
NORTH CAROLINA

VIRGINIA
CURRITUCK CO

Calvin

Creek

Capsies

Corys

1 MILE

36°
32'
30"

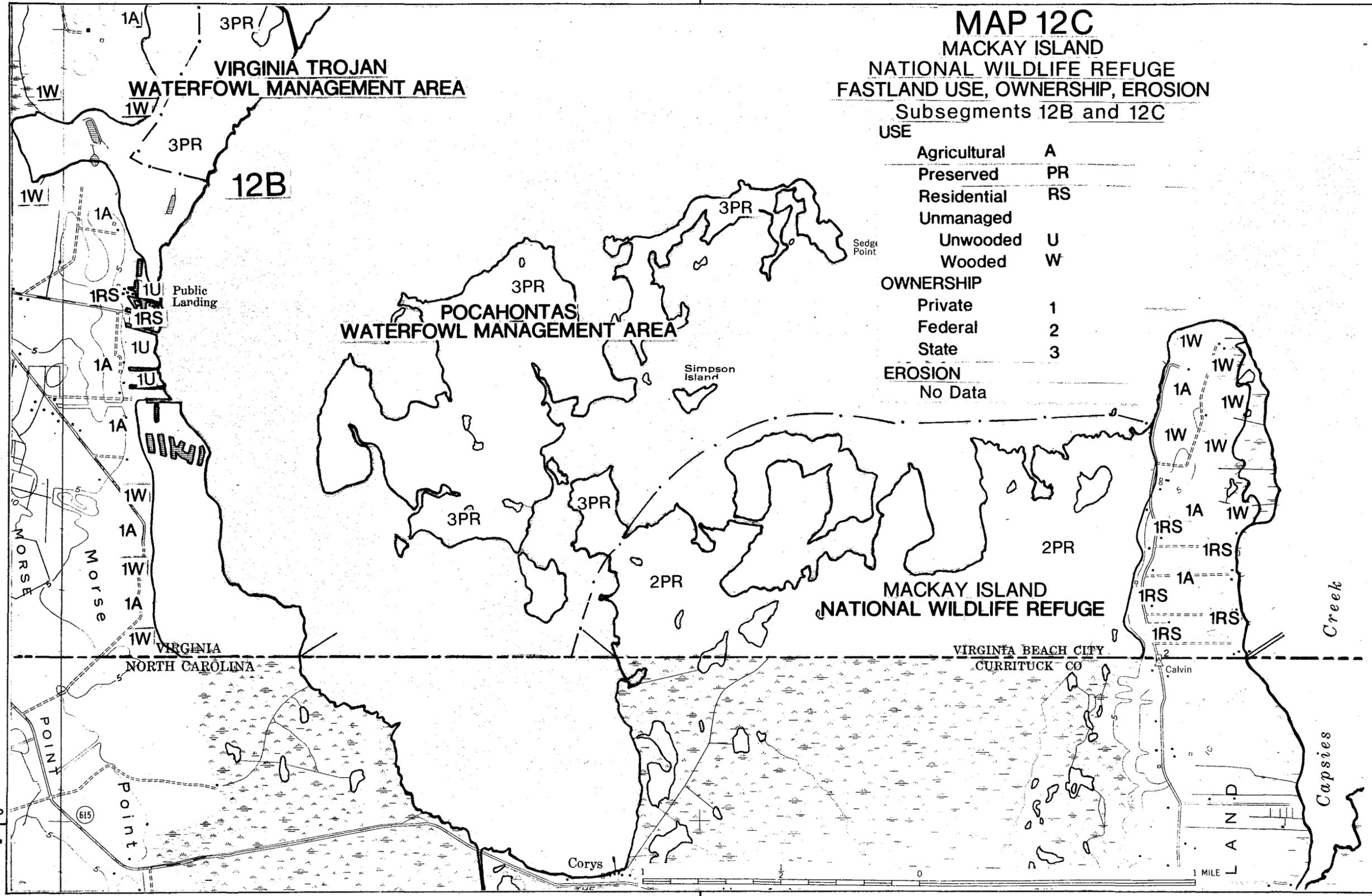
36°
32'
30"

76° 00'

76° 00'

MAP 12C
MACKAY ISLAND
NATIONAL WILDLIFE REFUGE
FASTLAND USE, OWNERSHIP, EROSION
 Subsegments 12B and 12C

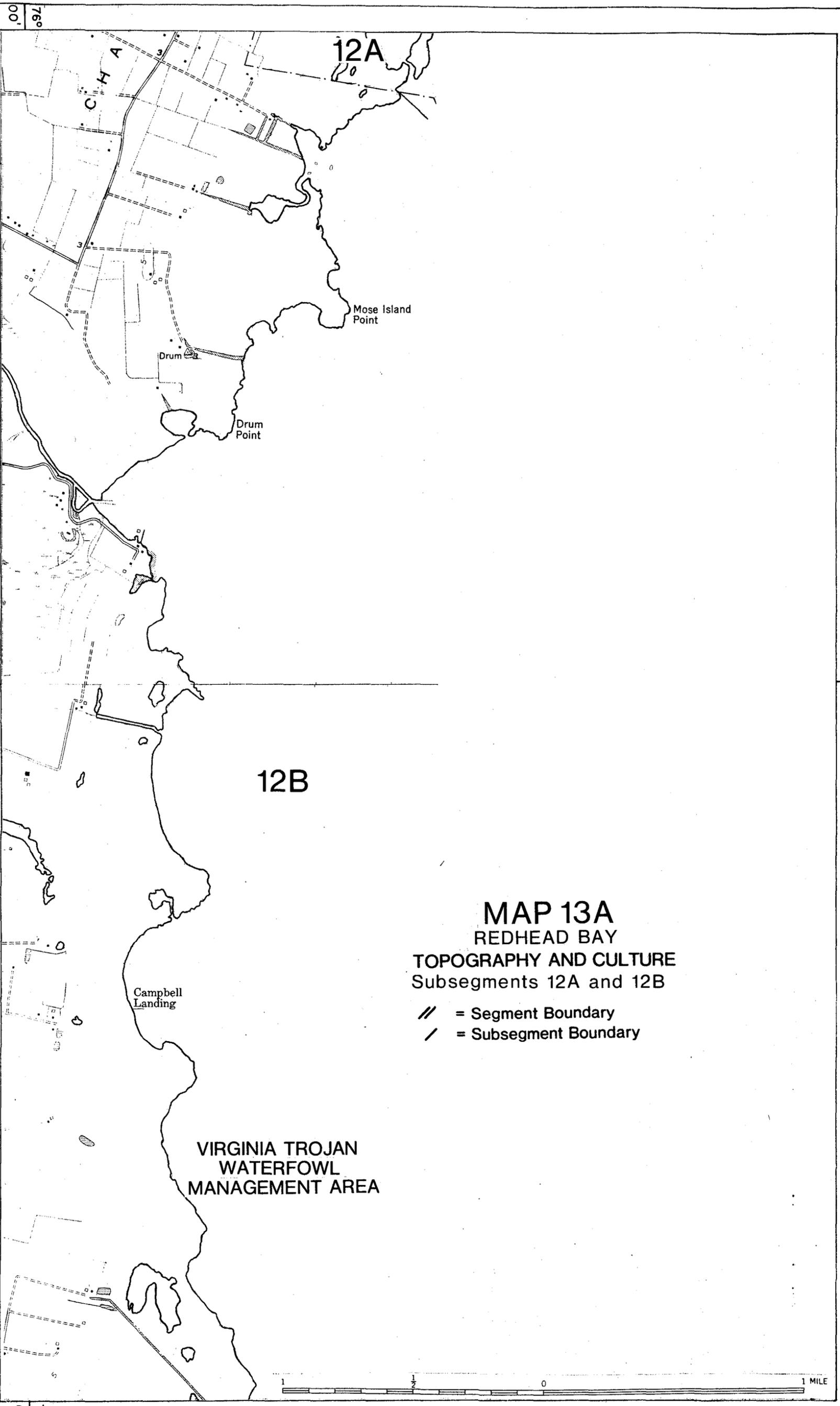
USE	
Agricultural	A
Preserved	PR
Residential	RS
Unmanaged	
Unwooded	U
Wooded	W
OWNERSHIP	
Private	1
Federal	2
State	3
EROSION	
No Data	



36°
32'
30"

36°
32'
30"

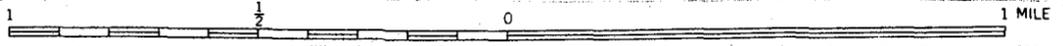
76° 00'

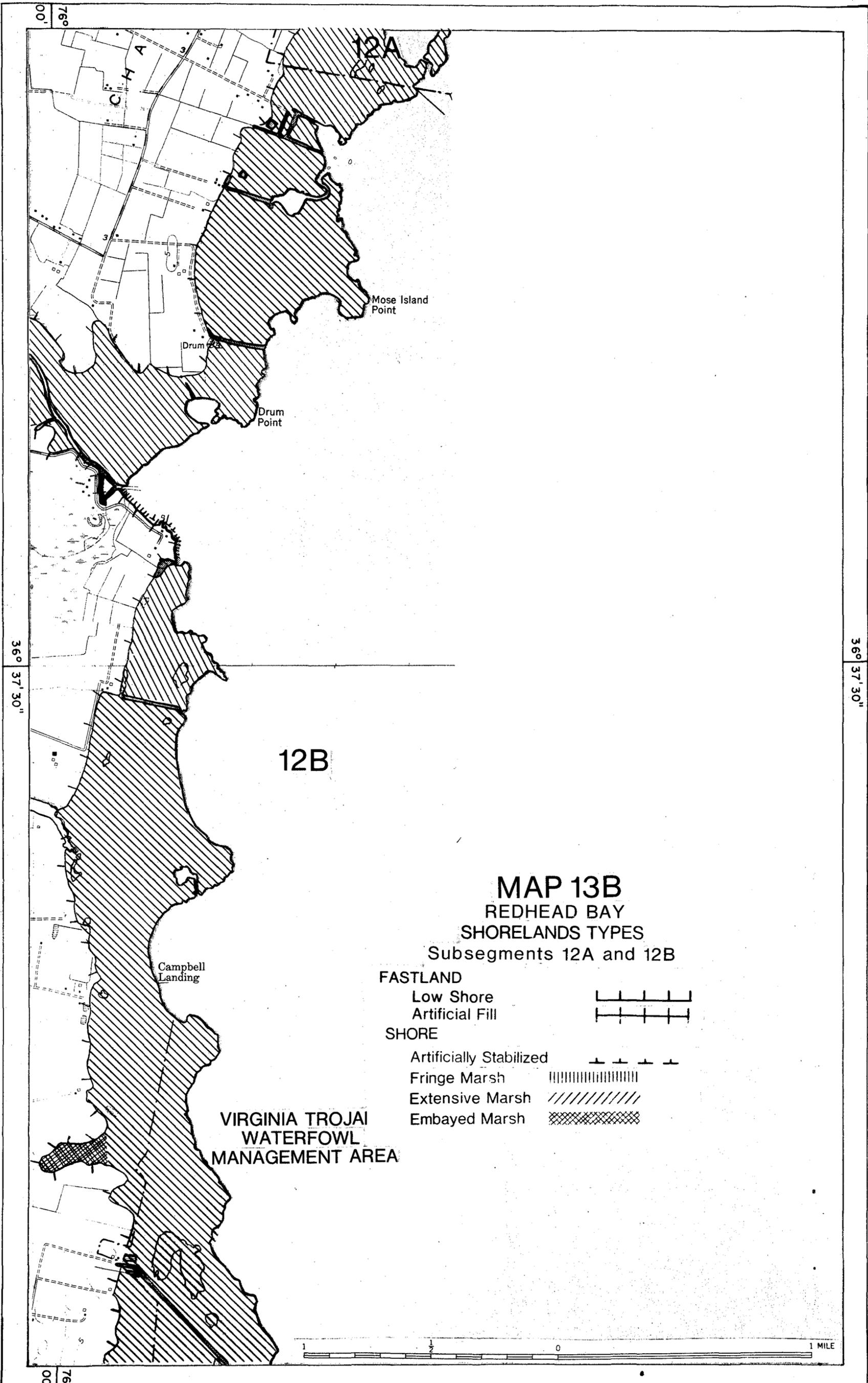


MAP 13A
REDHEAD BAY
TOPOGRAPHY AND CULTURE
Subsegments 12A and 12B

- // = Segment Boundary
- / = Subsegment Boundary

**VIRGINIA TROJAN
 WATERFOWL
 MANAGEMENT AREA**





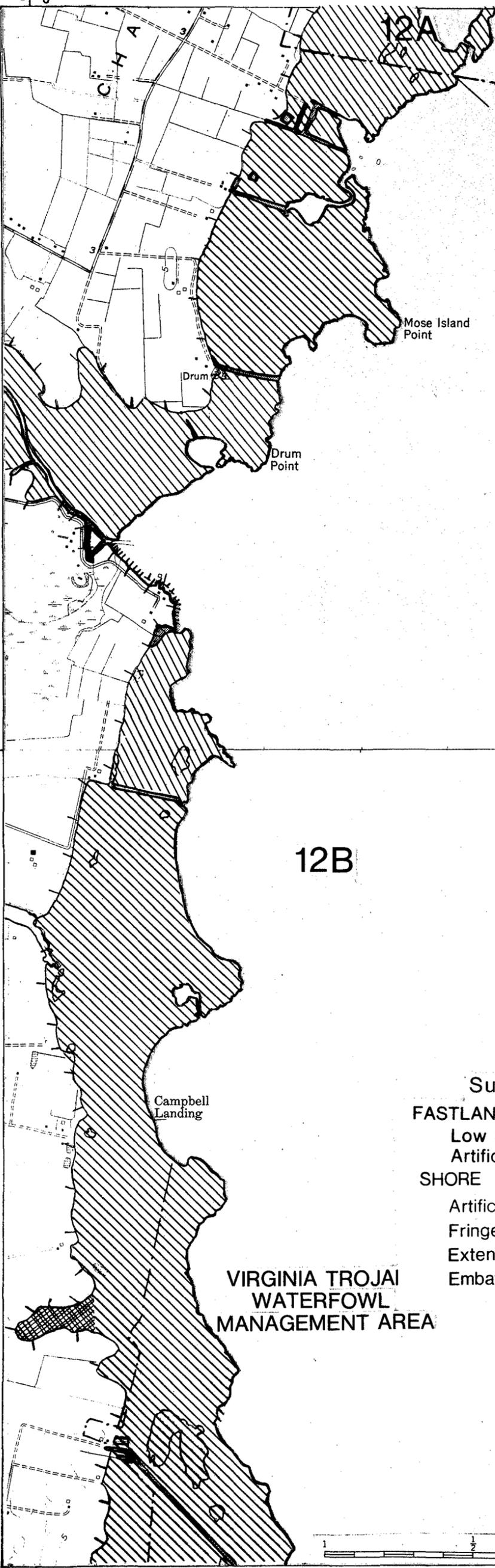
76° 00'

76° 00'

36° 37' 30"

36° 37' 30"

87

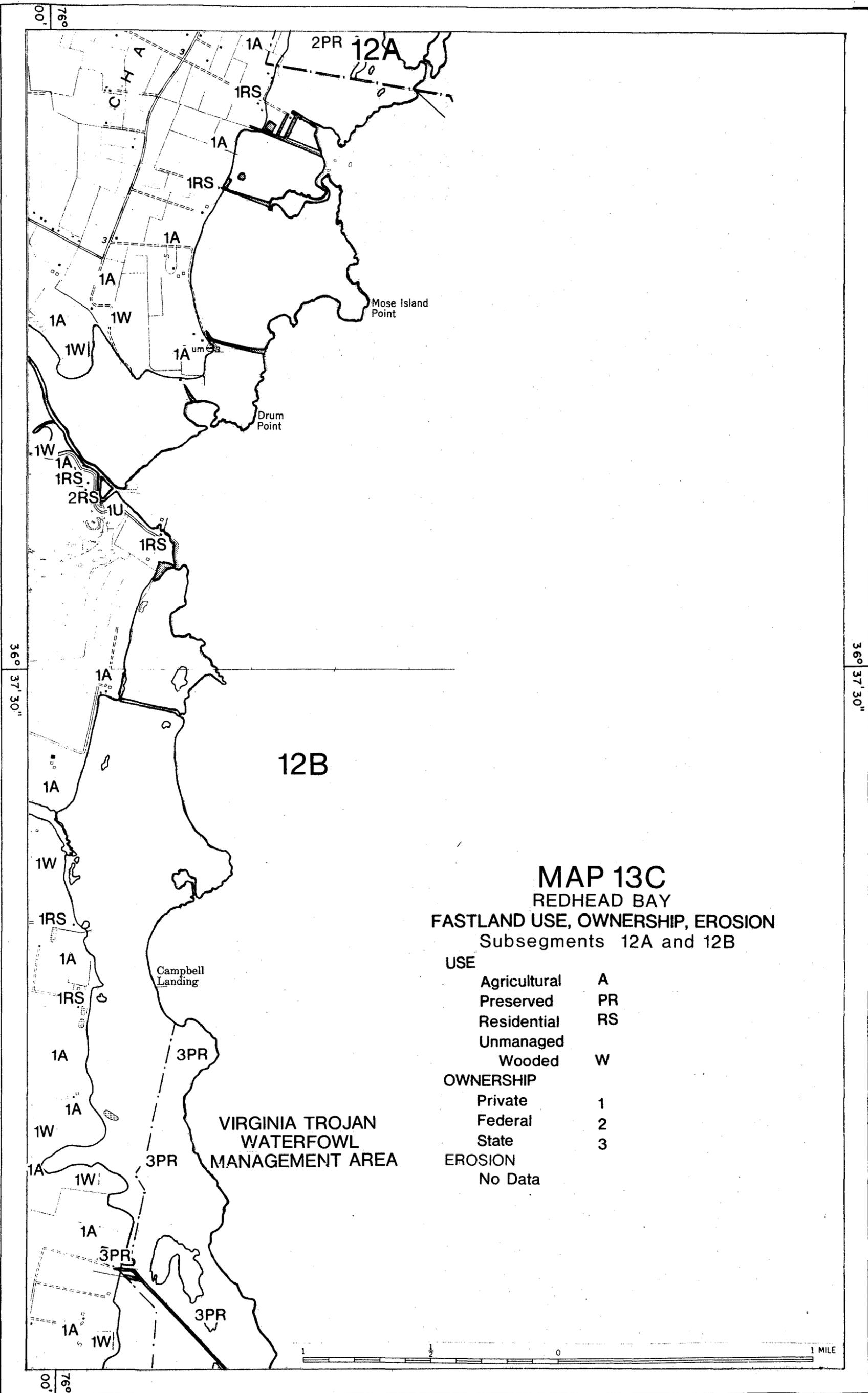


MAP 13B
REDHEAD BAY
SHORELANDS TYPES
 Subsegments 12A and 12B

- FASTLAND**
- Low Shore
 - Artificial Fill
- SHORE**
- Artificially Stabilized
 - Fringe Marsh
 - Extensive Marsh
 - Embayed Marsh

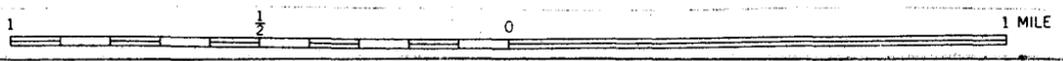
VIRGINIA TROJAI
WATERFOWL
MANAGEMENT AREA





MAP 13C
REDHEAD BAY
FASTLAND USE, OWNERSHIP, EROSION
 Subsegments 12A and 12B

USE	
Agricultural	A
Preserved	PR
Residential	RS
Unmanaged	
Wooded	W
OWNERSHIP	
Private	1
Federal	2
State	3
EROSION	
No Data	

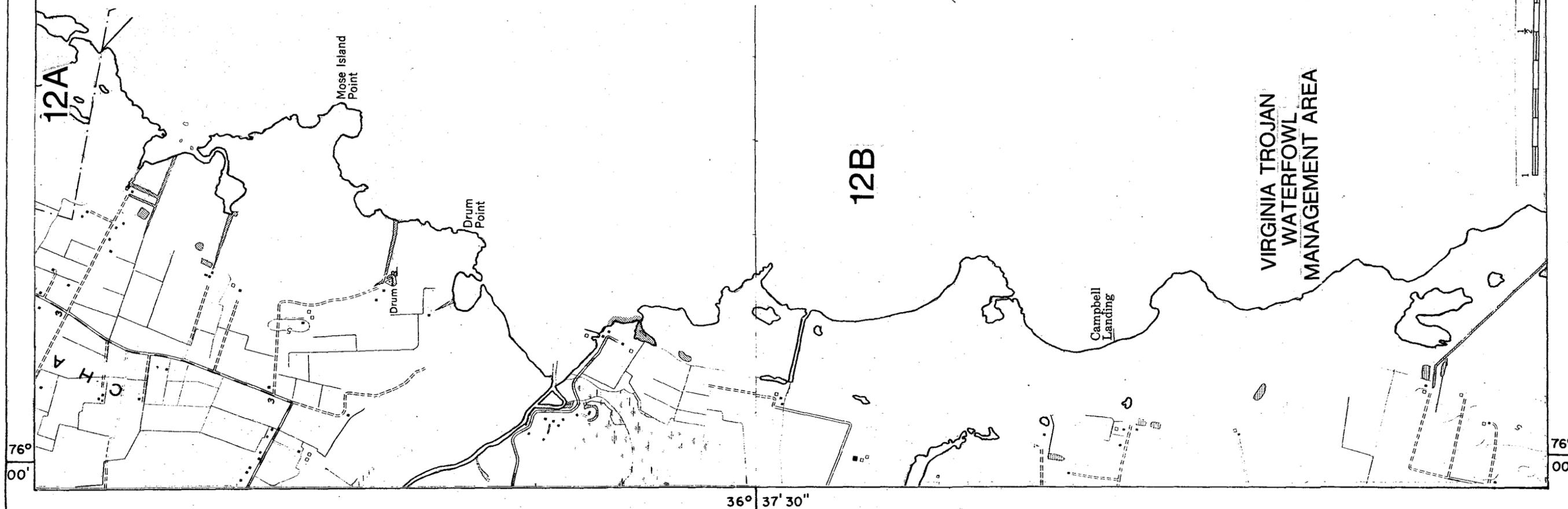


36° 37' 30"

MAP 14A

NORTH LANDING RIVER
TOPOGRAPHY AND CULTURE
Subsegments 13A and 13B

- // = Segment Boundary
- / = Subsegment Boundary



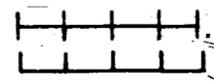
76° 02' 30"

MAP 14B

NORTH LANDING RIVER SHORELANDS TYPES Subsegments 13A and 13B

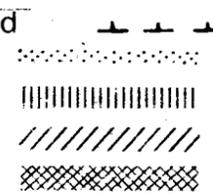
FASTLAND

- Artificial Fill
- Low Shore



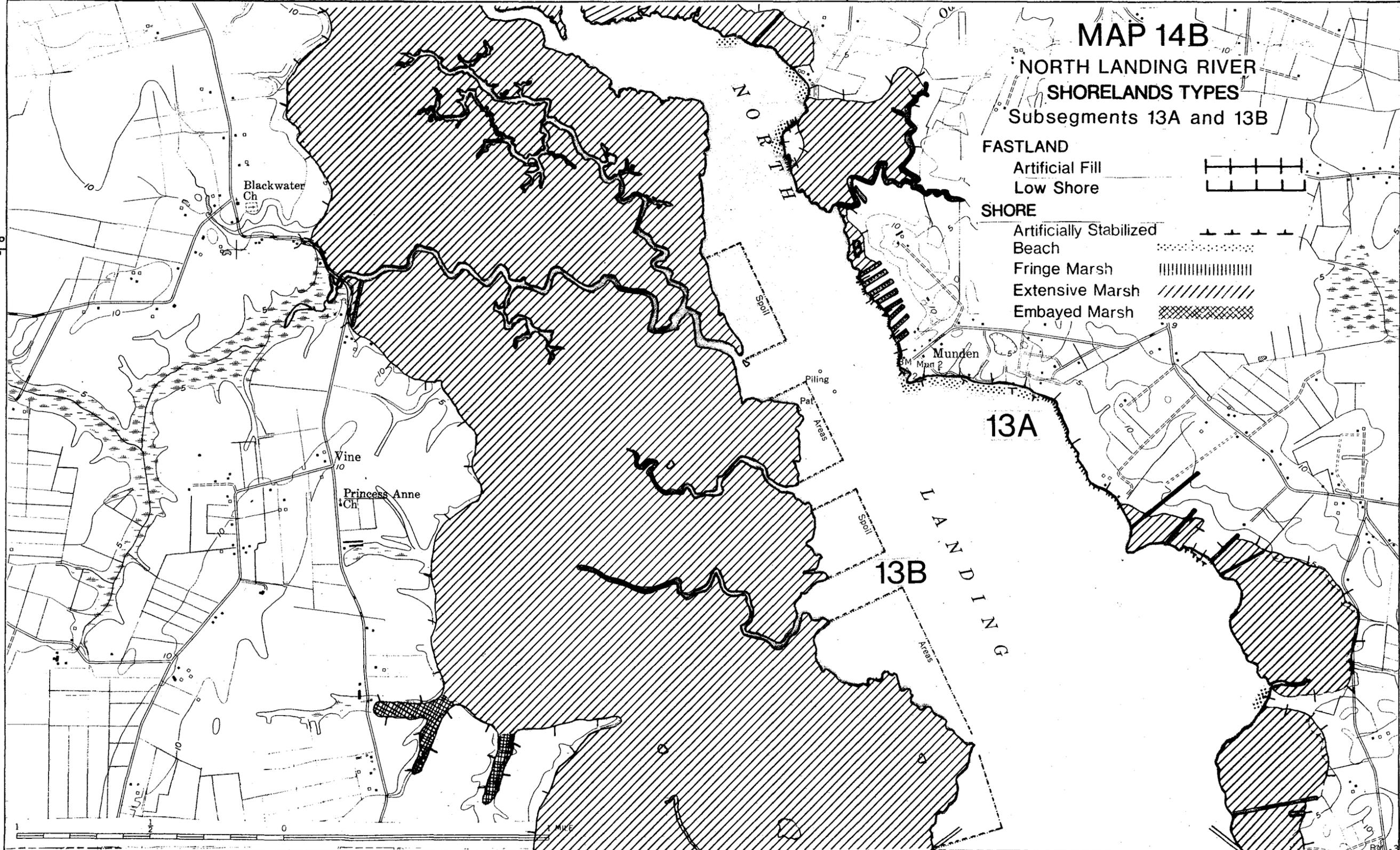
SHORE

- Artificially Stabilized Beach
- Fringe Marsh
- Extensive Marsh
- Embayed Marsh



36°
35'

36°
35'



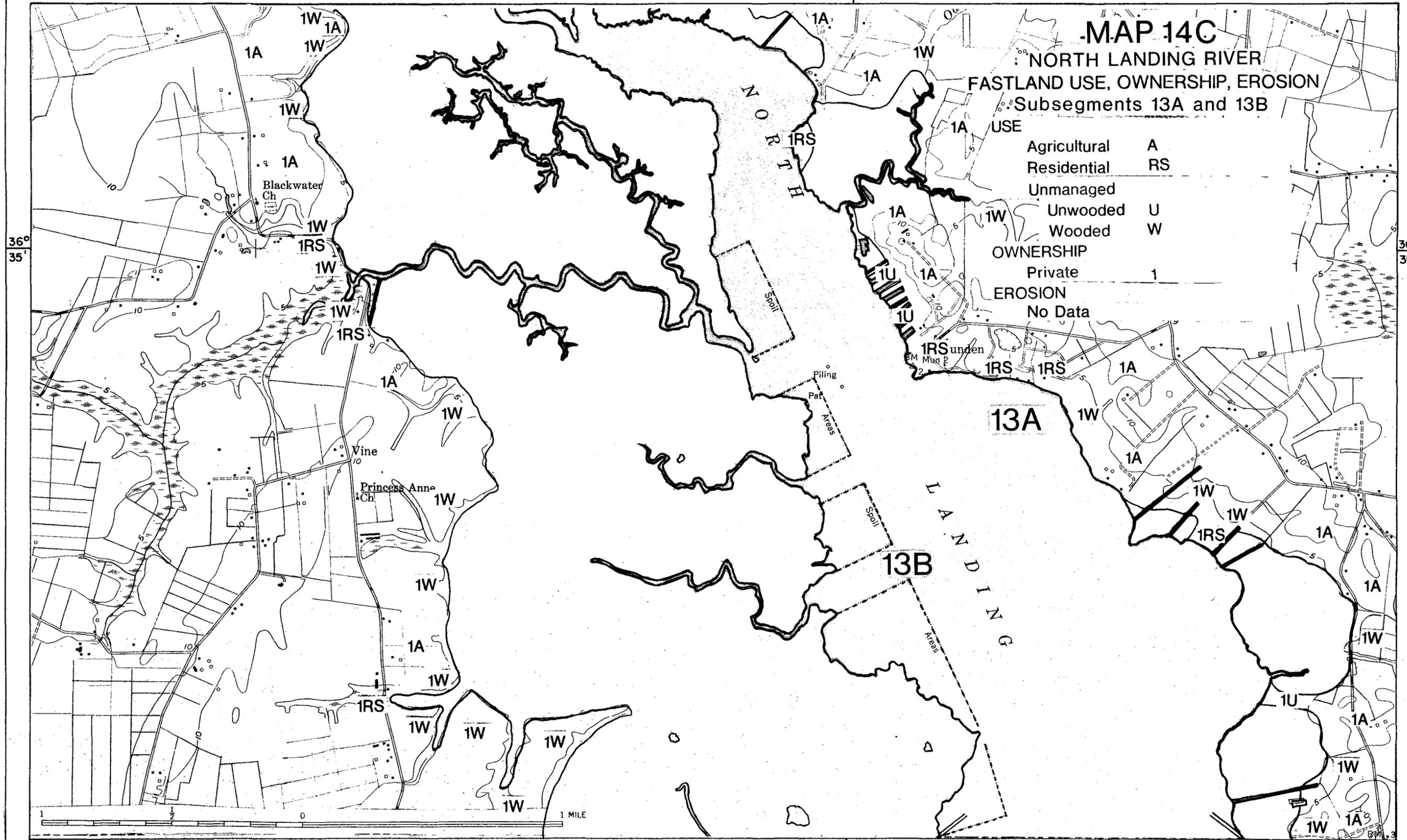
76° 02' 30"

76° 02' 30"

MAP 14C

NORTH LANDING RIVER FASTLAND USE, OWNERSHIP, EROSION Subsegments 13A and 13B

USE	
Agricultural	A
Residential	RS
Unmanaged	
Unwooded	U
Wooded	W
OWNERSHIP	
Private	1
EROSION	
No Data	



36° 35'

36° 35'

76° 02' 30"