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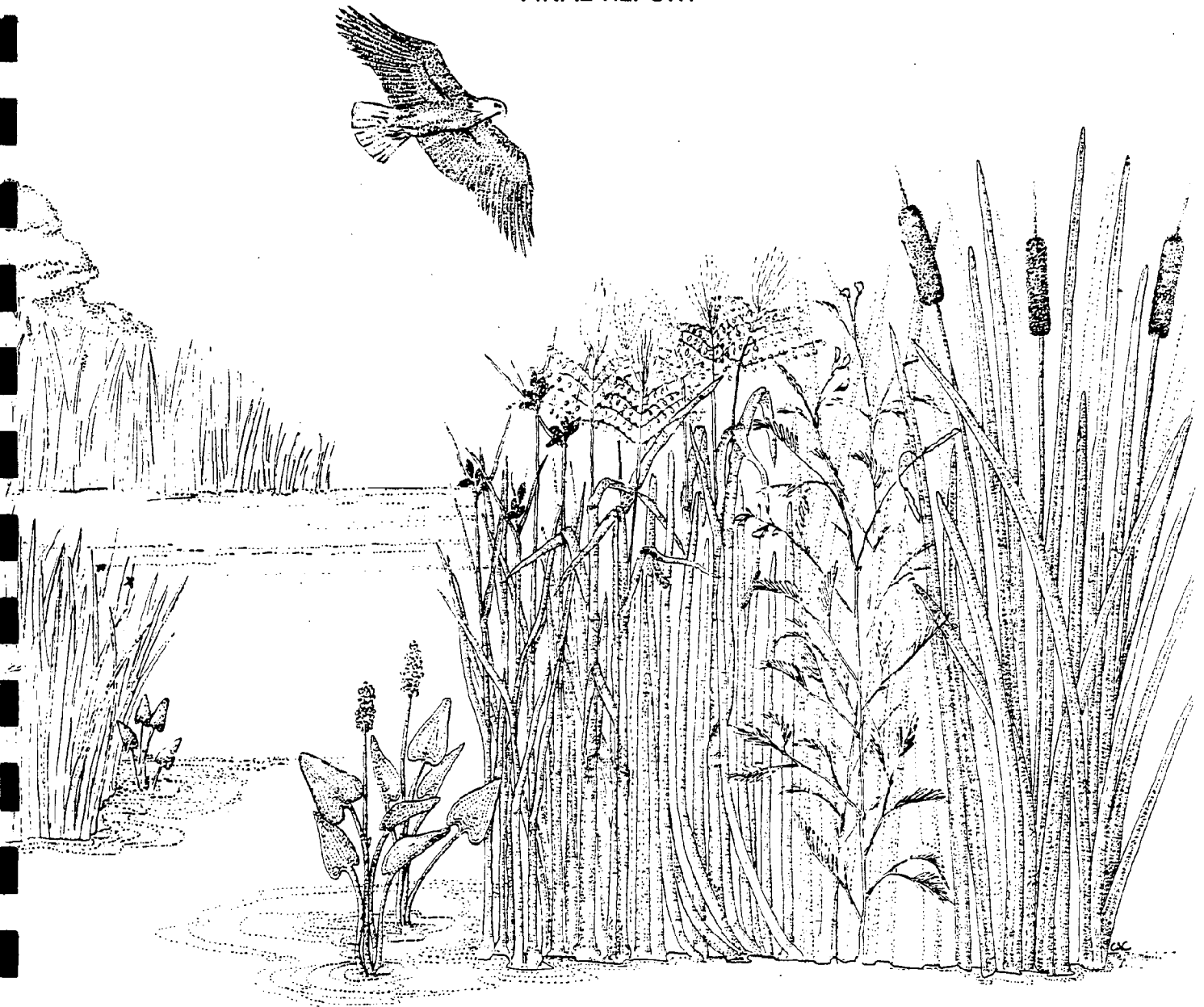
VA Coastal Resources Mgt. Program

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CONSERVATION PLANNING FOR THE NATURAL AREAS

OF THE LOWER PENINSULA OF VIRGINIA

FINAL REPORT



**VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION
DIVISION OF NATURAL HERITAGE**

**NATURAL HERITAGE TECHNICAL REPORT NUMBER 93-4
8 MARCH 1993**

CONSERVATION PLANNING
FOR THE NATURAL AREAS
OF THE LOWER PENINSULA
OF VIRGINIA
FINAL REPORT

Prepared by the
Virginia Department of Conservation and Recreation
Division of Natural Heritage
1500 East Main Street, Suite 312
Richmond, VA 23219

Project Manager
Lawrence R. Smith

Principle Investigator/Author
Kennedy H. Clark

Contributing Authors
Christopher A. Clampitt
Shepard Moon
Janit L. Potter

Prepared for
James City County
York County
City of Williamsburg



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Cover illustration: the cover illustration by Caren Caljouw depicts three natural heritage resources known to occur on the Lower Peninsula - bald eagle, sensitive joint-vetch, and tidal freshwater marsh.

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Staff of the
Virginia Department of Conservation and Recreation
Division of Natural Heritage

Thomas Smith - Division Director
Patricia Jarrell - Executive Secretary
Faye McKinney - Secretary/Receptionist
Leslie Trew - Natural Heritage Program Manager
Allen Belden - Field Botanist
Christopher Clampitt - Inventory Ecologist
Gary Flemming - Field Ecologist
Christopher Ludwig - Botanist
Sarah Maybe - Migratory Songbird Research Specialist
Thomas Rawinski - Vegetation Ecologist
Steve Roble - Zoologist
Phillip Stevenson - Zoology Research Specialist
Nancy Van Alstine - Botany Research Specialist
Steven Carter-Lovejoy - Information Manager
Sarah Holbrook - Conservation Intern
Timothy O'Connell - Environmental Review Coordinator
Tracy O'Connell - Conservation Intern
Megan Rollins - Data Specialist
Lawrence Smith - Natural Areas Program Manager
Caren Caljouw - Stewardship Coordinator
Kennedy Clark - Stewardship Biologist
Sandra Erdle - Preserve Design Research Assistant

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SUMMARY

The Virginia Natural Area Preserves Act defines **natural areas** as "any area of land, water, or both...which is important in preserving rare or vanishing flora, fauna, native ecological systems, geological, natural historical, scenic, or other similar feature...of the Commonwealth" (section 10.1-209, Code of Virginia). **Natural heritage resources** are defined as "the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest" (section 10.1-209, Code of Virginia). The Virginia Department of Conservation and Recreation administers the Virginia Natural Area Preserves Act through its Division of Natural Heritage.

In 1992, the Virginia Department of Conservation and Recreation received a grant from the Coastal Resources Management Program of the Virginia Council on the Environment to conduct conservation planning for the twenty-five natural areas identified in the natural areas inventory of James City County, City of Williamsburg, and York County, together known as the Lower Peninsula. The goal of the conservation planning project was to provide comprehensive and refined information to guide the conservation of the Lower Peninsula's natural areas.

Additional data regarding each site's natural heritage resources, threats, and ownership were collected. By combining the new data with existing knowledge from the inventory project, the following information was provided for each of the twenty-five natural areas through this project:

- primary and secondary ecological boundaries for each natural area,
- descriptions of the natural heritage resources of each site,
- information regarding the current status, use, ownership, and zoning of each natural area,
- considerations for the recreational, scenic, and educational value of the sites
- digitized ecological boundaries for use in geographic information systems, and
- guidelines on options that local governments can use to protect their natural areas.

The purpose of this information is to facilitate well-informed planning and wise land use decisions by the local governments. The information is also intended to help guide the localities in their own endeavors to actively protect the natural diversity of their jurisdictions. The report can be further utilized to increase awareness of local officials and residents of regional biodiversity issues, guide environmental review of projects which may affect the natural areas, and to assist local conservation organizations in their land protection and environmental education efforts.

INTRODUCTION

In 1989, the Virginia Department of Conservation and Recreation, through its Division of Natural Heritage, was contracted by the governments of James City County, the City of Williamsburg, and York County to conduct a three-year natural areas inventory. The project was supported financially through Coastal Zone Management Grants from the National Oceanic and Atmospheric Administration with matching funds provided by the local governments. The grants were administered by the Coastal Resources Management Program of the Virginia Council on the Environment. The goal of the inventory was to systematically identify the region's best remaining natural areas. The final report for the natural areas inventory was completed in early 1992.

In 1992, the Virginia Department of Conservation and Recreation received a grant from the Coastal Resources Management Program to conduct conservation planning for the natural areas identified in the inventory. Matching funds were provided by the Virginia Department of Conservation and Recreation. This report relates the methods, results, and conclusions of the Lower Peninsula conservation planning project.

OVERVIEW OF NATURAL HERITAGE DIVISION

The Virginia Natural Area Preserves Act of 1989 (section 10.1-209 et seq., Code of Virginia) directs the Virginia Department of Conservation and Recreation to "preserve the natural diversity of biological resources of the Commonwealth." The Act further establishes the Virginia Natural Heritage Program and requires the Department to develop a **natural heritage plan**, produce an **inventory of the Commonwealth's natural heritage resources**, maintain a **natural heritage data bank** of inventory data, and provide for the **protection and stewardship** of natural areas. The Department of Conservation and Recreation's Division of Natural Heritage fulfills this mandate. The Division of Natural Heritage is the Commonwealth's principal collector and manager of information on natural heritage resources and performs a variety of protection and stewardship tasks for priority natural heritage resources throughout the state. **Natural heritage resources** are defined as "the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest" (section 10.1-209, Code of Virginia). The Virginia Natural Area Preserves Act defines **natural area** as "any area of land, water, or both...which is important in preserving rare or vanishing flora, fauna, native ecological systems, geologic, natural historical, scenic, or similar features...of the Commonwealth" (section 10.1-209, Code of Virginia).

Each natural heritage resource is assigned a rank that indicates its relative rarity on a five-point scale (1 = extremely rare, 5 = common) or otherwise indicates the status of the species with letters (eg., X = apparently extirpated). Table 1 defines each

TABLE 1 - DEFINITION OF NATURAL HERITAGE RARITY RANKS

State rarity ranks are defined below; global rarity ranks are similar, but refer to a species rarity throughout its entire range. State and global ranks are denoted, respectively, with an "S" and a "G" followed by a character. Note that GA and GN are not used and GX means extinct. These ranks should not be interpreted as legal designations.

-
- S1 extremely rare; usually five or fewer occurrences in the state or may be a few remaining individuals; often especially vulnerable to extirpation
- S2 very rare; usually between five and twenty occurrences or with many individuals in fewer occurrences; often susceptible to becoming extirpated
- S3 rare to uncommon; usually between twenty and one hundred occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be vulnerable to large-scale disturbances
- S4 uncommon to common; usually more than one hundred occurrences, but may be fewer occurrences with many large populations; may be restricted to only a portion of the state; not usually vulnerable to immediate threats
- S5 very common; demonstrably secure under present conditions
- SA accidental in the state
- SH historically known from the state, but not verified for an extended period (usually fifteen or more years); this rank is used primarily when inventory has been attempted recently
- SN regularly occurring migrants, transients, or non-breeding seasonal residents; usually no specific site can be identified with its range in the state; note that congregation and staging areas are monitored separately
- SU status uncertain; often because of low search effort or cryptic nature of resource
- SX apparently extirpated from the state

rank in detail. Each natural heritage resource receives two ranks. One rank indicates the resource's rarity throughout its entire range (the global or "G" rank) and the other indicates the resource's rarity within Virginia (the state or "S" rank). For example, mountain camellia is ranked as G4/S2 indicating the species is uncommon throughout its range and very rare in Virginia.

The primary criterion for ranking natural heritage resources is the number of occurrences, that is the number of known distinct locations containing that resource. Also of great importance to the ranking process is the number of individuals at each location or, for highly mobile organisms, the total number of individuals. Other considerations include the condition of the occurrences, the number of protected occurrences, and threats. Although all species protected under state or federal endangered species laws are rare, not all rare species are listed as endangered or threatened. Natural heritage rarity ranks should not be interpreted as legal designations, but as indices of known biological rarity.

In addition to ranking each natural heritage resource in terms of rarity, Department of Conservation and Recreation scientists also rank each location or occurrence of natural heritage resources in Virginia on a four-point scale (A = excellent, D = poor), so that protection efforts can be aimed not only at the rarest natural heritage resources, but at the best examples of each. In the case of species, an occurrence of a natural heritage resource is ranked according to its **quality** (size and vigor of population, etc.), **condition** (naturalness of habitat, etc.), **viability** (the likelihood of long-term survival of resource), and **defensibility** (level of difficulty of protecting the resource). Given the intimate relationship between a natural community and its environment, occurrences of rare or exemplary natural communities are ranked in terms of their **quality** and **size**.

One of the many ways that the Division of Natural Heritage uses the ranks of natural heritage resources and their locations is to assess the overall biodiversity significance of a natural area, which may include only one natural heritage resource or may harbor many. Based upon the ranks, each site is assigned a biodiversity (or "B") rank on the following five-point scale:

- B1 outstanding significance, only known site for a natural heritage resource or an excellent occurrence of a G1 species;
- B2 very high significance, the best example of any natural community type, a good occurrence of a G1 species, or an excellent occurrence of a G2 or G3 species;
- B3 high significance, excellent example of any natural community type, a good occurrence of a G3 species;

- B4 moderate significance, a good example of a rare natural community type, a fair occurrence of a G3 species, an excellent or good occurrence of a S1 or S2 species;
- B5 general significance, fair to poor occurrence of a rare natural community, an S1 species, or S2 species, an excellent or good occurrence of a S3 species.

Natural areas which harbor many natural heritage resources may have their B rank upgraded to a level higher than that which would be indicated by the presence of any one of the resources. For example, a site containing good occurrences of four different G3 species would be ranked B2, rather than B3.

REVIEW OF NATURAL AREAS INVENTORY

The goal of the natural areas inventory conducted from 1989 to 1992 was to systematically identify the best remaining natural areas of the Lower Peninsula. The natural areas inventory was conducted in six steps:

- 1) review aerial photographs,
- 2) gather existing information,
- 3) conduct aerial reconnaissance of potential natural areas,
- 4) perform an initial ground survey,
- 5) complete a thorough biological survey of each potential natural area, and
- 6) compile the results and prepare a final report.

At the completion of the inventory, the Division of Natural Heritage had records of 7 rare vertebrate species, 10 rare invertebrate species, and 45 rare plant species from the three localities. Eleven natural communities of statewide significance were also identified.

Ninety-five potential natural areas were identified during the inventory. Of these, thirty-three were found to support natural heritage resources. In reviewing the results of the inventory, several of the potential natural areas were merged to form twenty-five natural areas, which ranged in size from 70 acres to over 5000 acres. Seventeen of the twenty-five natural areas are of statewide significance (i.e., ranked B4 or higher). During this inventory, Department of Conservation and Recreation scientists developed preliminary conservation planning boundaries for these seventeen sites. In developing these boundaries, the scientists considered a number of factors, including habitat for rare species, protection of water quality, and buffers from adjacent land uses.

The preliminary conservation planning boundaries were intended to be used to support wise planning and decision-making for the conservation of the natural areas. In the final report on the inventory project, the Department of Conservation and Recreation encouraged the localities to take appropriate actions to protect these sites.

Further information regarding the inventory project can be found in Natural Areas Inventory of the Lower Peninsula of Virginia (Natural Heritage Technical Report #92-1).

CONSERVATION PLANNING PROJECT

The goal of the Lower Peninsula conservation planning project is to provide more comprehensive and refined information to guide the conservation of the twenty-five natural areas identified in the inventory project. Conservation planning for the natural areas of the Lower Peninsula is the logical next step after the natural areas inventory. Additional data regarding each site's natural heritage resources, threats, and ownership was collected. By combining the new data with existing knowledge from the inventory project, the following information is provided through this project:

- refined conservation planning boundaries and biodiversity ranks for the seventeen state-significant sites;
- conservation boundaries for the eight regionally significant natural areas;
- more detailed descriptions for the natural heritage resources and ecological significance of each site
- expanded protection and stewardship recommendations for each natural area;
- further information on the current status and use of each site;
- basic information regarding ownership and zoning of each natural area;
- considerations for the recreational, scenic, and educational value of each site;
- digitized conservation planning boundaries for use by local governments in their geographic information systems; and
- information regarding options local governments can utilize to protect their natural areas.

The purpose of the information provided in this report is to facilitate well-informed planning and wise land use decisions by the local governments. The information is also intended to help guide the Williamsburg, York County, and James City County governments in their own endeavors to actively protect the natural diversity of their jurisdictions. The report can also be used to increase the awareness by local officials and residents of regional biodiversity issues and to assist local conservation organizations in their land protection and environmental education efforts.

The conservation planning boundaries and recommendations for protection and stewardship furnished in this document should not be interpreted as acquisition boundaries, proclamation boundaries, or regulatory land-use zones. Instead, the conservation planning boundaries and recommendations should be considered as tools to help steer wise land use planning on the

complex economic, social, and ecological landscape at all levels of government and the private sector.

The involvement of the Virginia Department of Conservation and Recreation in the conservation of these natural areas does not end with the submission of this final report. The Department is committed to providing assistance and support to local governments, developers, consultants, conservation organizations, businesses, and private citizens concerned with the preservation of biodiversity in the remaining natural areas of the Lower Peninsula. The Department of Conservation and Recreation will also continue to use the information in this report to guide its environmental review activities on the Lower Peninsula.

METHODS

COLLECTION OF INFORMATION

Working with the local governments in the project area and the Virginia Council on the Environment, staff of the Virginia Department of Conservation and Recreation gathered a substantial amount of information to aid in the effort of expanding and refining the conservation recommendations for the twenty-five natural areas of the Lower Peninsula.

Existing knowledge regarding the natural areas and topics pertinent to their conservation were studied. Recent aerial photographs, soil surveys, field notes from the inventory project, scientific publications, and conservation literature were included in this review. Another aerial reconnaissance survey was conducted over the project area. Additionally, several scientific and conservation experts outside of the Division of Natural Heritage were consulted for their specialized information or skills relating to conservation of the natural areas.

Property ownership and zoning was established for each natural area from county or city records. Basic ownership and zoning information is provided in the account for each site presented in the results and recommendations section.

Each natural area was visited at least once during the data collection phase of this project. During the visits, efforts were made to find the natural heritage resources originally documented by the inventory project, locate additional resources associated with the sites, assess the condition of the the resources, determine threats to the resources, and establish what protection and stewardship measures are necessary to insure the long-term survival of the resources.

CONSERVATION PLANNING PRINCIPLES

Standard natural heritage conservation planning guidelines were used for this project. Basically, conservation planning involves the design of ecological boundaries, complete site information (e.g., natural heritage resources present, threats, ownership, zoning, existing protection), a protection strategy, and an assessment of stewardship needs. A detailed account of these guidelines can be found in the Preserve Selection and Design Manual by The Nature Conservancy. Because this publication is not readily accessible to the general public, a brief summary of conservation planning principles is discussed in the sections below.

ECOLOGICAL BOUNDARIES

The principle components for the conservation planning of any natural area are the conservation planning, or ecological, boundaries. Preliminary conservation boundaries, such as those established in the Lower Peninsula natural areas inventory, are carefully refined into two ecological boundaries: primary and secondary. The primary ecological boundary encompasses the natural heritage resources of the site and the secondary boundary includes all areas intended to mitigate threats to the natural heritage resources. The area within the primary boundary is normally restricted from disturbance on any kind while some environmentally sensitive land uses are usually compatible with the area between the primary and secondary boundaries.

The primary ecological boundary simply includes all known occurrences of natural heritage resources at a site. Because "natural heritage" resource is defined (in part) as the habitat of rare species, the primary ecological boundary encompasses the locations where rare species have been documented as well as the surrounding habitats in which they are likely to be found. The designer should be intimately familiar with the habitat requirements of the species in question and the habitats available in the natural area. Primary ecological boundaries around rare or exemplary natural communities delineate the extent of the communities. This requires the designer to be knowledgeable regarding the ecological parameters defining the natural community type. The primary ecological boundary **does not** include any "buffer" to separate the natural heritage resources from the effects of adjacent land (or water) uses. Primary ecological boundaries may also include species movement corridors connecting two or more stations of natural heritage resources of the same type within a single natural area. Corridors are only included in the primary ecological boundary where they are determined to be essential habitat for the survival of the resources within the natural area.

The secondary ecological boundary includes all lands and water intended to mitigate natural and human threats to the natural heritage resources of the site and lands related to special management needs. The secondary ecological boundary is often

used to indicate an area within which certain land (or water) uses may affect the viability of the natural heritage resources. Occasionally, secondary ecological boundaries are also used to designate areas for some types of ecological management or scientific research, such as areas for fire breaks for prescribed burning or wildfire control. Secondary ecological boundaries may also include species movement corridors. Unlike corridors within primary ecological boundaries, corridors designated by secondary ecological boundaries normally connect two or more natural areas containing similar resources, not similar habitats within a single natural area.

The most common purpose of secondary ecological boundaries is to provide a buffer zone to the primary, or core, area. Buffer zones are areas of transition between natural heritage resources and surrounding land uses designed to protect the resources within the primary boundary from damage or degradation. Even the strongest and most complete protection of the core area containing natural heritage resources would be useless if surrounding land uses incompatible with the existence of the natural heritage resources were not attenuated. Buffer zones are generally the most effective and convenient way to protect natural heritage resources from surrounding incompatible land uses. The size and composition of a buffer zone varies depending upon the biology of the natural heritage resource and the disturbances to which it may be subjected. A buffer zone may be designed to protect the core area by maintaining surface and ground water quality and quantity, preventing alterations of ambient light, temperature, humidity, or wind conditions, or screening sensitive organisms from human activities and noise. Buffer zones can also be designed to minimize soil erosion and to prevent the invasion of aggressive or "weedy" species.

Effective secondary ecological boundaries require that the designer be familiar with the biology and threats of the natural heritage resource. An understanding of the structure, function, and uses of the landscape and movement patterns of species upon the landscape is also essential. For these reasons, site visits to targeted natural areas are mandatory before accurate ecological boundaries can be designed.

The best and most current information is always used to guide the conservation planning decisions. As the knowledge of the biological, geological, hydrological, social, and economic aspects of the natural area increases or changes, alterations or revisions in the ecological boundaries may be necessary to reflect the updated information. In some cases, complete information is not available. For example, the biology of some species is not well-understood due to a lack of scientific research or sometimes abiotic (non-living) environmental factors, such as ground water flow patterns or soil composition, have not been determined for an area. In these cases, conservation planning decisions are based upon the available information on and knowledge extrapolated from similar species, natural communities, and ecosystems.

The determination of compatible activities and uses within the primary and secondary ecological boundaries is dependent upon the biology of the natural heritage resources of the site and the ecology of the natural area. Land use standards are specific to each site and may vary even among sites that support similar natural heritage resources if other environmental factors are different.

Secondary ecological boundaries are not designed to protect the natural heritage resources from large scale environmental catastrophes such as global warming or acidic precipitation. Solutions to these broad problems must be addressed in similarly broad environmental education, policies, and regulations.

Primary and secondary ecological boundaries should not be interpreted as regulatory zones or acquisition boundaries, but as conservation tools to help guide the protection and stewardship of natural heritage resources.

Ecological boundaries for each natural area are presented in the site accounts in the results and recommendations section.

GEOGRAPHIC INFORMATION SYSTEMS

A geographic information system is a computer system which integrates traditional electronic databases with layered digitized graphic information about landscapes. Geographic information systems allow the merging, analysis, and manipulation of the graphic and text data in concert. Local governments often use geographic information systems to relate their mapped information, such as property tracts, zoning, and utility and road corridors, to the corresponding text data, such as property owners, land use, and utility service information. James City County and York County have geographic information systems on-line and the City of Williamsburg is considering purchasing and installing a geographic information system.

With the assistance of the Environmental Conditions Mapping, Analysis, and Planning System of the Virginia Council on the Environment, the Department of Conservation and Recreation has provided digitized primary and secondary ecological boundaries for each natural area to the local governments. The local governments can now incorporate the electronic natural area data into their geographic information systems. This will allow planning staff to examine the ecological boundaries integrated with other mapped information already in their geographic information systems.

PROTECTION OF NATURAL AREAS

Many protection tools are available to local governments, conservation organizations, and private citizens. Examples include acquisition, easements, natural area registry, and conservation zoning. Figure 1 depicts a conceptual model of land protection tools used by the Department of Conservation and

Recreation. The three localities, through cooperation with the Department, have all of these protection tools available to them plus several protection options unique to local governments. The Virginia Council on the Environment has composed a document to guide local governments in their efforts to secure protection of the natural areas within their jurisdictions. A copy of this document appears in Appendix A. Basic protection recommendations are given for each natural area in the site accounts found in the results and recommendations sections.

STEWARDSHIP GUIDELINES

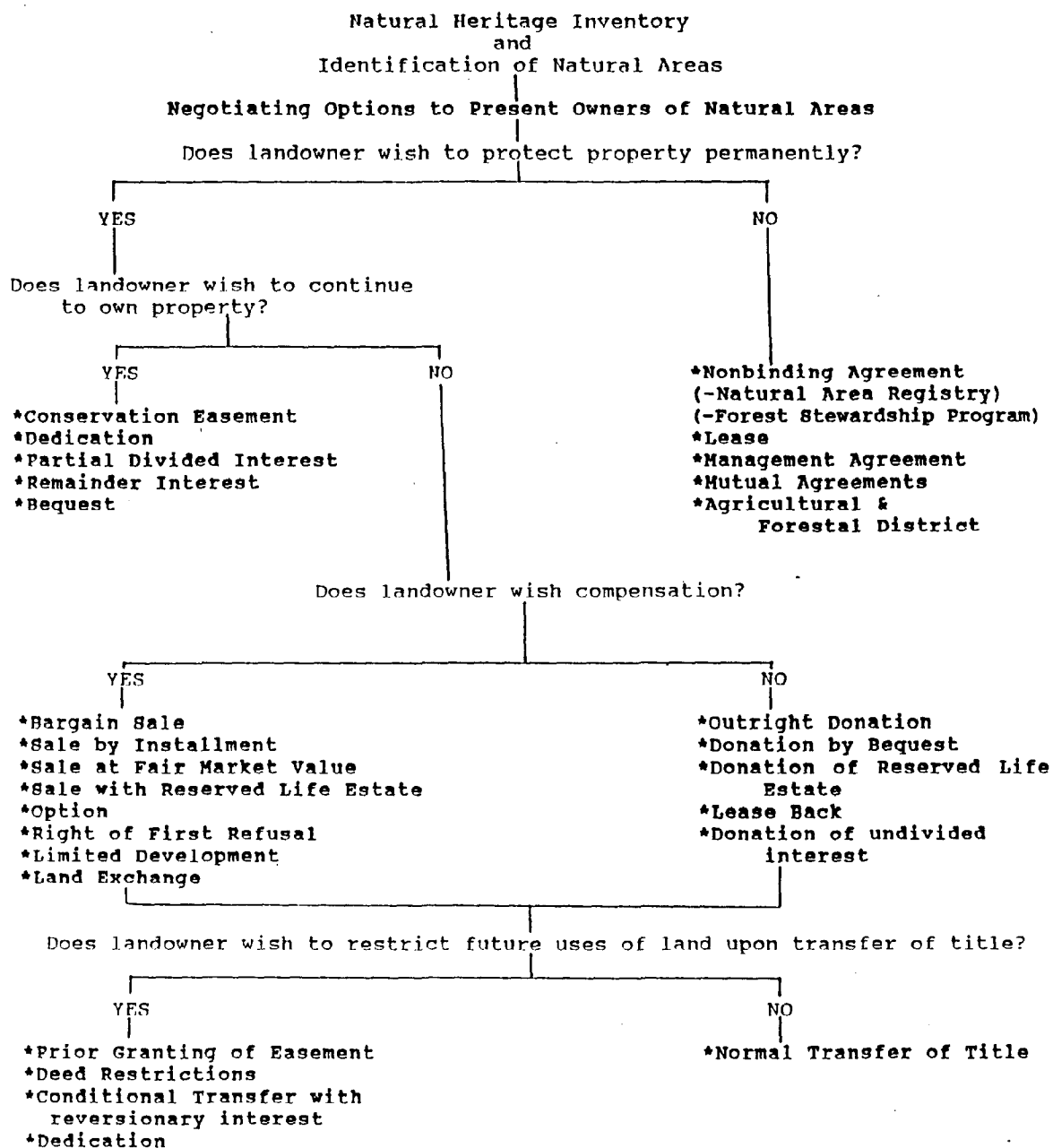
Natural areas stewardship involves the administration and management of a natural area after it is protected to assure the long-term survival of the natural heritage resources it supports. Basic stewardship recommendations are given for each natural area in the results and recommendations section. The higher priority sites (B2-B4) deserve comprehensive stewardship plans.

The most important aspect of stewardship is determining compatible and incompatible land (and water) uses within the natural area. Which land uses are harmonious with the resources will depend upon the type of natural heritage resource, the ecosystem, and the type of land use being considered. Allowable land uses will therefore vary from site to site. Certain forms of some land uses may be incompatible, while more environmentally sensitive methods of the same general land use type may be compatible. For example, clearcutting of timber within a buffer zone delineated by the secondary ecological boundary of a given natural area may produce unacceptable effects to the natural heritage resources of the site, but selective cutting with strict environmental performance standards may be compatible. For some natural heritage resources, land uses may be only seasonally restricted. For example, timber harvest may not be compatible in the vicinity of a bird nesting colony during the nesting season, but can be conducted in the vicinity of the colony when nesting birds are not present.

Ecological management is another important component of natural areas stewardship. Ecological management includes all activities on a natural area specifically intended to benefit, save, or maintain natural heritage resources. Examples of ecological management include prescribed burning, wildfire suppression, removal or planting of vegetation for habitat restoration, installation of off-road vehicle barriers, and problem species control. Some natural heritage resources require intensive active management, while most require no or little active management.

Probably the most common form of ecological management that will need to occur on the Lower Peninsula's natural areas is problem species control. Problem species are plants or animals which directly or indirectly threaten the viability of natural heritage resources or have the potential to do so. Most problem species

FIGURE 1 - FLOWCHART OF NATURAL AREA PROTECTION TOOLS



are exotics. Exotic species are those whose natural range does not include the Lower Peninsula, but which were intentionally or unintentionally introduced to the region by humans. Often these exotic problem species become particularly invasive in disturbed areas. Examples of exotic problem species include millet grass, Japanese honeysuckle, and the Asiatic clam. Some native species can also threaten natural heritage resources, especially in urbanizing areas where nature's delicate balance has been disrupted. Beaver, white-tailed deer, and common reedgrass are examples of native species which can adversely affect natural heritage resources.

Stewardship also includes biological monitoring activities. Biological monitoring involves the periodic quantitative study of natural heritage resources and their environment. The purpose of biological monitoring is to furnish long term scientific data, to provide warnings as to any declines or damage to natural heritage resources, and to determine possible causes of such events. Additionally, biological monitoring may document increases in rare species populations and recovery of disturbed ecosystems. Monitoring visits usually also include some analysis of the status of problem species and environmental conditions. Whether or not and how often a natural heritage resource is monitored is determined by its priority, sensitivity, and threats.

Another part of stewardship is addressing the need for additional biological inventory or scientific research. In many natural areas, the true status of the natural heritage resources is poorly known and the potential for additional natural heritage resources to be found has not been thoroughly examined. Additional biological inventory may be recommended for these situations. Some species, habitats, and natural communities are not well understood due to a lack of scientific research. Natural areas provide an excellent setting for field research which may not only increase the general knowledge of the natural heritage resources and sensitive ecosystems, but may also provide information directly pertinent to the site's conservation.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS

Natural areas have uses other than the preservation of biodiversity. Depending upon the size and situation of the site and the sensitivity of the natural heritage resources it contains, a natural area may also furnish recreational, visual, and educational resources. Local governments can integrate natural areas into their comprehensive plans to improve the quality of life for residents and attract visitors.

The natural areas identified in the Lower Peninsula may offer a variety of recreational opportunities. Public access to some of these areas could encourage the awareness of the natural resources and promote their protection. Recreational opportunities may include nature observation, boating, canoeing, hiking, biking, and horseback riding. The natural areas may also contribute to greenspace either as designated greenways or open

space. Existing recreational facilities could be identified along with the natural areas to form an extensive greenways system in the Lower Peninsula. The concept of incorporating the natural areas into local comprehensive, open space, and parks and recreation plans should be encouraged to provide various levels of recognition and protection for the valuable natural and biological resources.

Natural areas often contribute to the scenic resources of an area. A preliminary visual assessment for each of the natural areas of the Lower Peninsula should be conducted for the conservation and enhancement of scenic resources. The Lower Peninsula's natural areas have a significant visual character which is typical of the environment early European settlers encountered upon arriving on the continent. The preservation of scenic resources is important to capture these historical perspectives of the early colonists as well as enhance the present perceptions of the environment.

The educational opportunities which the natural areas could offer are numerous. The focus of environmental education on the Lower Peninsula's natural areas could include levels ranging from public awareness to scientific research. There may be additional opportunities to form linkages for educational and interpretive facilities which would create an entire system of natural area educational opportunities within the Lower Peninsula. A coalition of public education representatives as well as educators and research scientists from surrounding institutions could facilitate such a system of educational opportunities in the area.

Preliminary recommendations regarding the recreational, scenic, and educational possibilities of each natural area are included in the site accounts. This information was provided by Janit Potter of the Department of Conservation and Recreation's Division of Planning and Recreation Resources.

RESULTS AND RECOMMENDATIONS

Information collection and site visits began in March of 1992 and were completed in early October of 1992. Ecological boundaries and conservation planning recommendations were formulated for each of the natural areas in October, November, and December of 1992.

A map of the project area which shows the general locations of all twenty-five natural areas can be found in Figure 2. Table 2 summarizes some of the information regarding each site.

The twenty-five sites presented in this report comprise the best remaining natural areas within York County, James City County, and the City of Williamsburg. The Virginia Department of Conservation and Recreation strongly urges the local governments

to vigorously utilize all the conservation tools at their disposal to secure protection for their natural areas and provide for the long-term stewardship of the sites. The Department of Conservation and Recreation's commitment to natural areas conservation on the Lower Peninsula does not end with the conclusion of this project. Project staff will continue to offer support to the local governments, developers, consultants, conservation organizations, and private citizens in the forms of environmental review, refined conservation planning, and active technical assistance with planning, protection, and stewardship of natural areas.

NATURAL HERITAGE RESOURCES

Since the publication of the inventory report, three additional occurrences of natural heritage resources have been added to the natural areas of the Lower Peninsula: slender marsh pink at Grafton Ponds, blueflag at Yarmouth Creek, and bald eagle at Powhatan Creek. A substantial amount of additional information was collected on known natural heritage resources. The information has been used to update the Department of Conservation and Recreation's Biological and Conservation Datasystem. A summary of natural heritage resources known from the Lower Peninsula and their global and state rarity ranks can be found in Table 3.

BIODIVERSITY RANK UPDATES

The biodiversity significance rank for each site was reconsidered in light of any new information discovered during this project. The B ranks of three of the twenty-five natural areas changed as a result of this reevaluation: Grove Creek Natural Area (B4 to B3), Goodwin Islands Natural Area (B4 to B5), and Queen Creek Natural Area (B4 to B5). The new ranks for these natural areas are presented in the site accounts below.

CHANGES IN NATURAL AREA SIZES

Of the seventeen natural areas for which preliminary conservation planning boundaries were delineated in the inventory report (boundaries were not designated for the eight B5 sites in the inventory report), three increased in size, nine decreased in size, and five had no significant change in size (significant was defined as a change of greater than ten percent of the preliminary area). Table 4 compares each natural area's size from the inventory report with its size as determined during this project. It is important to note that surface area was measured by a hand-operated planimeter in both projects and there may be a considerable margin for error. The digitized maps in geographic information systems should be consulted for precise area measurements.

Primary and secondary ecological boundaries should not be interpreted as regulatory zones or acquisition boundaries, but as

conservation tools to help guide the protection and stewardship of natural heritage resources.

SITE ACCOUNTS

Each natural area has an account below that furnishes information on the size, biodiversity rank, location, natural heritage resources, and ownership and zoning. Each site account includes a map indicating the primary and secondary ecological boundaries and text providing justification on each of these boundaries. Further, a general description of each natural area, protection and stewardship recommendations, recreational, scenic, and educational comments can be found in the accounts.

Primary and secondary ecological boundaries should not be interpreted as regulatory zones or acquisition boundaries, but as conservation tools to help guide the protection and stewardship of natural heritage resources.

Table 5 shows the format for the site accounts and explains the what data is presented in each field of information. Several symbols are used on the maps accompanying the site accounts. A legend for these symbols is provided in Figure 3. Table 6 is an index to the page numbers upon which each site account begins.

FIGURE 2 - LOCATIONS OF LOWER PENINSULA NATURAL AREAS

Map Number	Natural Area
1	Beaverdam Creek
2	Big Marsh Point
3	College Woods
4	Crab Neck Marshes
5	Deer Lake
6	Diascund Creek
7	Goodwin Islands
8	Gordon Creek
9	Grafton Ponds
10	Graylin Woods
11	Grice's Run
12	Grove Creek
13	Hog Neck Creek
14	Kentucky Farms
15	Lackey Ponds
16	Mount Pleasant Church
17	New Bethel Church
18	Powhatan Creek
19	Queen Creek
20	Shield's Point
21	Skiffe's Creek
22	Taskinas Creek
23	Upper Crab Neck
24	Ware Creek
25	Yarmouth Creek

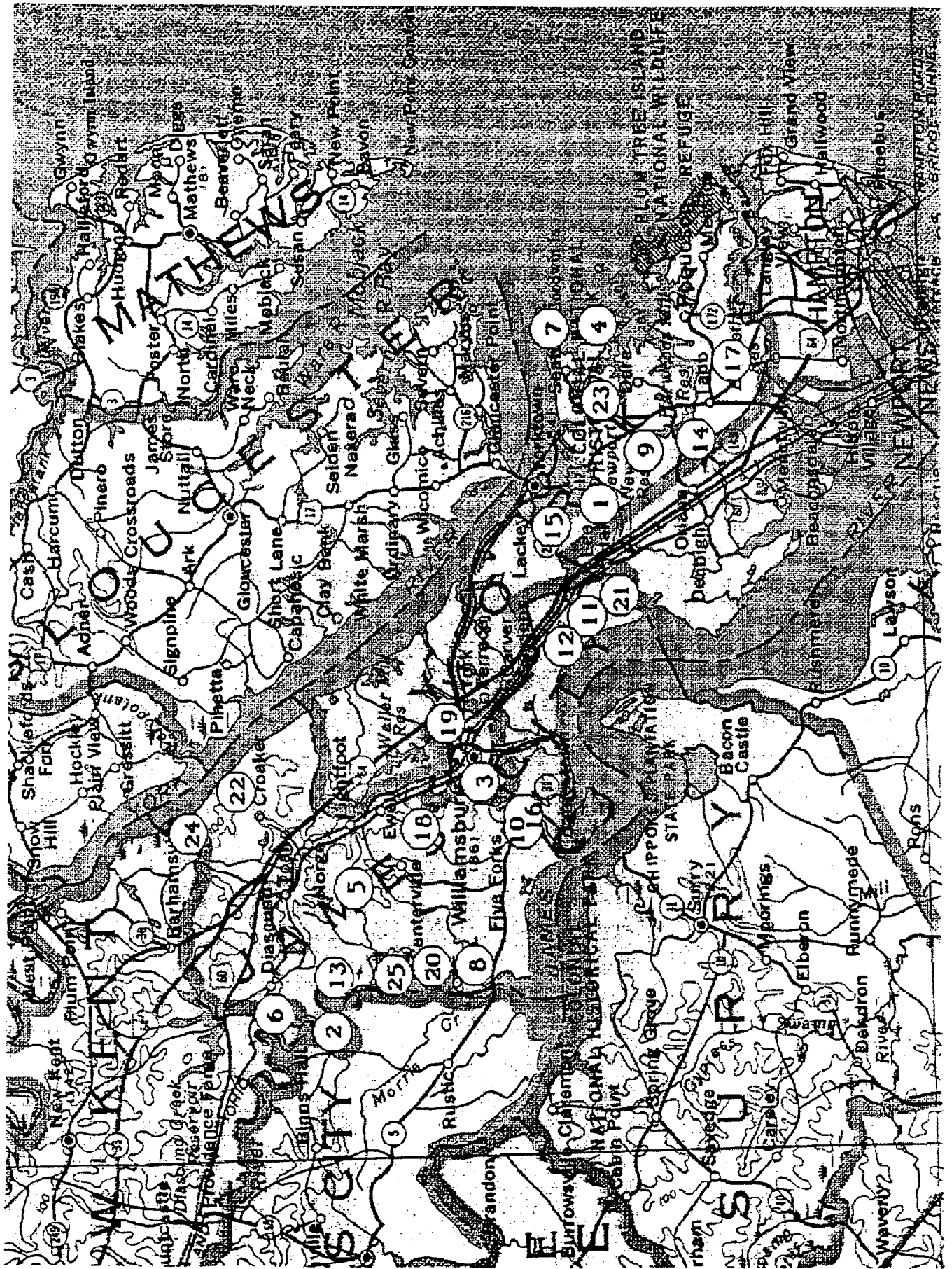


TABLE 2 - SUMMARY OF LOWER PENINSULA NATURAL AREAS

The table on the following three pages contains basic information on each of the twenty-five natural areas of the Lower Peninsula. The information fields and the symbols used within them are explained below. More detailed information can be found in the site accounts.

SITENAME the name of the natural area

B-RANK the biodiversity significance rank assigned to the natural area

SIZE the total size of the natural area in acres; acreage given on this table has been approximated using a hand-operated planimeter; geographic information systems should be consulted for more accurate area figures

LOCATION indication of which locality or localities in which the natural area occurs; JCC = James City County, YC = York County, CoW = City of Williamsburg, NKC = New Kent County, and CoNN = city of Newport News

PRIM the area contained within the primary ecological boundary in acres

SECOND the area contained between the primary and secondary ecological boundaries in acres

NATURAL HERITAGE RESOURCES listing of natural heritage resources known to occur in the natural area

TABLE 2 - SUMMARY OF LOWER PENINSULA NATURAL AREAS

<u>SITENAME</u>	<u>B-RANK</u>	<u>SIZE</u>	<u>LOCATION</u>	<u>PRIM</u>	<u>SECOND</u>	<u>NATURAL HERITAGE RESOURCES</u>
Powhatan Creek	B2	5510	JCC	2570	2940	small whorled pogonia Virginia least trillium false hop sedge bald eagle heron nesting colony
College Woods	B3	600	JCC,CoW	480	120	southern mixed hardwood forest small whorled pogonia hoary skullcap Florida adder's-mouth sweet pine sap
Diascund Creek	B3	3580	JCC,NKC	540	3040	tidal freshwater marsh Parker's pipewort yellow cowlily glossy crayfish snake
Gordon Creek	B3	2720	JCC	1760	960	tidal freshwater marsh
Grafton Ponds	B3	2640	YC,CoNN	2370	270	coastal plain sinkhole pond complex Harper's fimbriistylis Cuthbert's turtlehead Mabee's salamander barking treefrog slender marsh pink southern twayblade Collins' sedge star-nosed mole
Grove Creek	B3	890	JCC	550	340	bald eagle marl ravine forest sweet pine-sap mountain camellia hoary skullcap Shumard's oak

TABLE 2 - SUMMARY OF LOWER PENINSULA NATURAL AREAS (CONTINUED)

<u>SITENAME</u>	<u>B-RANK</u>	<u>SIZE</u>	<u>LOCATION</u>	<u>PRIM</u>	<u>SECOND</u>	<u>NATURAL HERITAGE RESOURCES</u>
Mount Pleasant Church	B3	80	JCC	25	55	New Jersey rush Virginia least trillium
Taskinas Creek	B3	400	JCC	100	300	Florida adder's-mouth mountain camellia
Yarmouth Creek	B3	3800	JCC	2530	1270	tidal freshwater marsh sensitive joint vetch yellow cowlily blueflag bald eagle eastern pondmussel
Beaverdam Creek	B4	600	YC	100	500	Florida adder's-mouth northern spring sideswimmer Spanish moss heron nesting colony
Big Marsh Point	B4	310	JCC	290	20	tidal freshwater marsh yellow cowlily
Deer Lake	B4	80	JCC	20	60	Florida adder's-mouth
Shield's Point	B4	320	JCC	130	190	tidal freshwater marsh
Skiffe's Creek	B4	30	JCC	5	25	Florida adder's-mouth
Ware Creek	B4	2830	JCC,NKC	650	2180	tidal brackish marsh tidal freshwater marsh sand post oak heron nesting colony
Crab Neck Marshes	B5	650	YC	580	70	tidal saltmarsh

TABLE 2 - SUMMARY OF LOWER PENINSULA NATURAL AREAS (CONTINUED)

<u>SITENAME</u>	<u>B-RANK</u>	<u>SIZE</u>	<u>LOCATION</u>	<u>PRIM</u>	<u>SECOND</u>	<u>NATURAL HERITAGE RESOURCES</u>
Goodwin Islands	B5	770	YC	480	290	least bittern heron nesting colony
Graylin Woods	B5	20	JCC	7	13	hoary skullcap
Grice's Run	B5	160	JCC	60	100	southern mixed hardwood forest
Hog Neck Creek	B5	630	JCC	310	320	tidal freshwater marsh yellow cowlily
Kentucky Farms	B5	130	YC	30	100	coastal plain sinkhole pond complex
Lackey Ponds	B5	80	YC	30	50	Mabee's salamander
New Bethel Church	B5	230	YC	230	0	Shumard's oak
Queen Creek	B5	2360	YC, CoW	1700	660	tidal freshwater marsh tidal brackish marsh southern mixed hardwood forest
Upper Crab Neck	B5	840	YC	840	0	southern mixed hardwood forest Carolina boltonia

TABLE 3 - NATURAL HERITAGE RESOURCES OF THE LOWER PENINSULA'S
NATURAL AREAS

(see Table 1 for definitions of rarity ranks)

<u>RESOURCE NAME</u>	<u>GLOBAL RARITY RANK</u>	<u>STATE RARITY RANK</u>
PLANTS		
blueflag	G5	S2
Carolina boltonia	G2Q	S1
Collins' sedge	G4	S3
Cuthbert's turtlehead	G3	S2
false hop sedge	G3G4Q	S1
Florida adder's-mouth	G3G4	S2
Harper's fimbristylis	G2	S1
hoary skullcap	G5	S1
mountain camellia	G4	S2
New Jersey rush	G2	S2
Parker's pipewort	G3	S3
sand post oak	G5	S2
sensitive joint-vetch	G2	S2
Shumard's oak	G5	S2
slender marsh pink	G5	S2
small whorled pogonia	G2	S2
Spanish moss	G5	S2
southern twayblade	G4	S2S3
sweet pine sap	G3	S2S3
Virginia least trillium	G3T2	S2
yellow cowlily	G5T3	S1
ANIMALS		
bald eagle	G3	S2S3
barking treefrog	G5	S1
eastern pondmussel	G4	S3
glossy crayfish snake	G5	S1
great blue heron (nesting colony)	G5	S3
great egret (nesting colony)	G5	S2
least bittern	G5	S2
Mabee's salamander	G4	S1
northern spring sideswimmer	G5	S1
star-nosed mole	G5	S3
NATURAL COMMUNITIES		
coastal plain sinkhole	N/A	S1S2
pond complex		
marl ravine forest	N/A	S1S2
southern mixed hardwood forest	N/A	S3
tidal brackish marsh	N/A	S5
tidal freshwater marsh	N/A	S3
tidal saltmarsh	N/A	S5

TABLE 4 - COMPARISON OF NATURAL AREA SIZES

This table shows the estimated area in acres of each natural area as reported in the inventory report (INVEN.) and in the conservation planning report (CONS.). The final column indicates whether the natural area's size increased (inc.), decreased (dec.), or did not change significantly (none) from the inventory report to the conservation planning report. Preliminary conservation planning boundaries were not delineated for the B5 sites in the inventory report, therefore those natural areas have no acreage information in the inventory report column (N/A). Areas were estimated using a hand-operated planimeter; geographic information systems should be consulted for exact areas.

<u>SITENAME</u>	<u>INVEN. ACRES</u>	<u>CONS. ACRES</u>	<u>SIZE CHANGE</u>
Powhatan Creek	5380	5510	none
College Woods	980	600	dec.
Diascund Creek	2330	3580	inc.
Gordon Creek	2765	2720	none
Grafton Ponds	2480	2640	none
Grove Creek	1330	890	dec.
Mount Pleasant Church	85	80	none
Taskinas Creek	2470	400	dec.
Yarmouth Creek	3330	3800	inc.
Beaverdam Creek	1050	600	dec.
Big Marsh Point	590	310	dec.
Deer Lake	70	80	inc.
Shield's Point	1420	320	dec.
Skiffe's Creek	220	30	dec.
Ware Creek	3260	2830	dec.
Crab Neck Marshes	N/A	650	-
Goodwin Islands	820	770	none
Graylin Woods	N/A	20	-
Grice's Run	N/A	160	-
Hog Neck Creek	N/A	630	-
Kentucky Farms	N/A	130	-
Lackey Ponds	N/A	80	-
New Bethel Church	N/A	230	-
Queens's Creek	2730	2360	dec.
Upper Crab Neck	N/A	840	-

TABLE 5 - KEY TO SITE ACCOUNT FORMAT

The site account for each natural area is presented in a standard format which is outlined and explained below.

SIZE: the total size of the natural area in acres. Acreage given in the site accounts has been approximated using a hand-operated planimeter; geographic information systems should be consulted for more accurate area figures.

BIODIVERSITY RANK: the overall (global) significance of the natural area in terms of the rarity of the natural heritage resources and the quality of their occurrences. These ranks are explained in detail in the introduction to this report.

LOCATION: the city or county and USGS 7.5' quadrangle in which the natural area occurs.

GENERAL DESCRIPTION: a brief narrative picture of the natural area. This section usually includes information on topography, general vegetation, wetlands and watercourses, soils, historic and existing land uses within the natural area, and land use surrounding the natural area.

NATURAL HERITAGE RESOURCES: a synopsis of the natural heritage resources found in the natural area. Information given usually includes common and scientific names, taxonomic affiliation, global and state ranks, global and state range, a brief physical description, habitat requirements, threats and vulnerabilities, and occurrence data. For the protection of the resources, precise locations are not provided. Normally, natural communities are discussed first, then each species is discussed in order of decreasing rarity.

PRIMARY ECOLOGICAL BOUNDARY: description and justification of the primary ecological boundary.

SECONDARY ECOLOGICAL BOUNDARY: description and justification of the secondary ecological boundary.

OWNERSHIP AND ZONING: general information regarding property ownership within the natural area and its current zoning. Information provided includes numbers of tracts involved, tract size patterns, whether in public and private ownership, and portion of tract occupied by natural area in some cases. When tracts are in public ownership, the owner is listed, but names of private owners are not given for their protection and privacy.

PRIMARY ACREAGE: area within the primary ecological boundary in acres.

SECONDARY ACREAGE: area between the primary and secondary ecological boundaries in acres.

TABLE 5 (CONTINUED) - KEY TO SITE ACCOUNT FORMAT

PROTECTION RECOMMENDATIONS: existing and proposed protection of the natural area. Information furnished includes existing regulations that protect the natural area, existing legal protection to the land, and suggestions for protection tools appropriate for the natural area. Because of the delicacy of the situation, detailed protection strategies with private landholders are omitted.

STEWARDSHIP RECOMMENDATIONS: Recommendations include compatible and incompatible land uses, need for further inventory or scientific research, ecological management needs, and biological monitoring needs.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: existing and potential recreational opportunities; preliminary assessment of scenic value; suggestions for appropriate educational activities. These comments were provided by Janit Potter of the Department of Conservation and Recreation's Division of Planning and Recreation Resources.

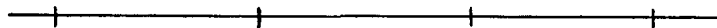
MAP: A map of each natural area showing the primary and secondary ecological boundaries can be found at the back of each site account. U.S. Geologic Survey 7.5 minute topographic maps are used as base maps with the ecological boundaries superimposed upon them. The scale is 1:24,000 (1 inch = 2000 feet). A legend for the ecological boundary symbols used on the maps is presented in found in Figure 3. Although the most current revisions available are used for base maps, many of the most recent developments are not depicted upon them. Because of the missing information on many of the base maps and their relatively large scale, a small margin for error may exist with many of the ecological boundaries. Fine tuning of the boundaries can be accomplished through field survey as necessary.

Primary and secondary ecological boundaries should not be interpreted as regulatory zones or acquisition boundaries, but as conservation tools to help guide the protection and stewardship of natural heritage resources.

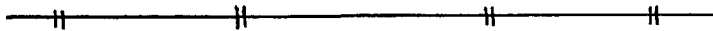
FIGURE 3 - MAP SYMBOLS

The following symbols are used on the maps accompanying the site accounts:

PRIMARY ECOLOGICAL BOUNDARY:



SECONDARY ECOLOGICAL BOUNDARY:



PRIMARY AND SECONDARY BOUNDARY MERGED:



RARE PLANT HABITAT OCCURRING WITHIN A DIFFERENT PRIMARY BOUNDARY:



HABITAT CORRIDOR CONNECTING TWO NATURAL AREAS:



NOTE: Primary and secondary ecological boundaries should not be interpreted as regulatory zones or acquisition boundaries, but as conservation tools to help guide the protection and stewardship of natural heritage resources.

TABLE 6 - INDEX TO SITE ACCOUNTS

<u>SITENAME</u>	<u>PAGE NUMBER</u>
Powhatan Creek.....	29
College Woods.....	40
Diascund Creek.....	48
Gordon Creek.....	55
Grafton Ponds.....	60
Grove Creek.....	70
Mount Pleasant Church.....	77
Taskinas Creek.....	82
Yarmouth Creek.....	87
Beaverdam Creek.....	96
Big Marsh Point.....	103
Deer Lake.....	108
Shield's Point.....	112
Skiffe's Creek.....	117
Ware Creek.....	121
Crab Neck Marshes.....	127
Goodwin Islands.....	130
Graylin Woods.....	134
Grice's Run.....	138
Hog Neck Creek.....	142
Kentucky Farms.....	147
Lackey Ponds.....	150
New Bethel Church.....	153
Queen's Creek.....	156
Upper Crab Neck.....	160

POWHATAN CREEK

SIZE: 5510 acres

BIODIVERSITY RANK: B2

LOCATION: James City County
Norge, Surry, and Williamsburg quadrangles

GENERAL DESCRIPTION: Powhatan Creek is the largest and most biologically significant natural area of the Lower Peninsula. This natural area includes a large part of the watershed of Powhatan Creek. Several perennial tributaries, the largest of which are Long Hill Swamp and Chisel Run, as well as a multitude of groundwater seeps and small intermittent streams, flow into Powhatan Creek. Most of the uplands in the natural area have been or will soon be subjected to intense residential development, major highway construction, and utility line construction.

Swampy bottomlands hug the major streams of the natural area which have been dammed by beaver in several places. Uplands in the natural area not currently farmed or developed are composed of a variety of forest types ranging from planted pine to maturing hardwoods. Typical canopy species include bald cypress, red maple, green ash, black gum, loblolly pine, tuliptree, and white oak. American holly, flowering dogwood, and spicebush are well-represented in the understory. Powhatan Creek, Long Hill Swamp, and Chisel Run are crossed by major roads in five places and by many small utility corridors within the natural area boundaries. Major highway construction is planned that will cross Chisel Run at yet another location and directly affect some of the natural heritage resources of the site.

Historically, the natural area was subjected to moderate to heavy forestry and agriculture; these practices continue to some degree in parts of the watershed. The most intense residential development in the Powhatan Creek Natural Area occurs in its northern half, but major developments also are planned or under construction for parts of the southern half.

Soils in the natural area are generally of the Peawick-Emporia-Levy or Emporia-Craven-Uchee associations. Bottomland soils consist almost exclusively of Johnston complex, which is a poorly drained, frequently flooded, and normally acidic silt loam or clay loam. Soils on slopes bordering the creek bottoms belong to the Emporia complex, a series of deep, well-drained, highly erodible fine sandy loams. Soils of the Emporia complex have formed over ancient shell deposits which greatly influence the soil chemistry. A variety of soil types occur on the uplands of the natural area, most of which are deep, well-drained, fine sandy loams or silt loams with moderate to low erodibility.

This natural area harbors three rare plant species, a rare bird species, and a bird nesting colony.

NATURAL HERITAGE RESOURCES: Four stations of the small whorled pogonia, a globally rare orchid, are found on the slopes of Chisel Run. Small whorled pogonias grow up to ten inches in height, have a single whorl of five leaves, and bear one or rarely two yellowish-green flowers in the spring. The small whorled pogonia is very rare throughout its range, the stronghold of which is in New England. The species is known from only six jurisdictions in Virginia. This orchid species is listed as endangered at the federal and state levels. Small whorled pogonia grows in a variety of woodland habitats in Virginia, but tends to favor mid-aged woodland habitats on gentle north or northeast facing slopes often within small draws. It is quite natural for plants of this species to remain dormant in the soil for long periods of time, up to four years or possibly longer, confounding botanical searches and biological monitoring. Plants often do not flower, sending up only vegetative stems in some years. Direct destruction as well as habitat loss and alteration are principle reasons for the species' decline.

Although the surrounding habitats in the natural area have been thoroughly searched, more subpopulations of the pogonia may be found if dormant plants emerge. Conditions of each of the subpopulations range from excellent to fair, the two northernmost stations being the most stressed from recent development. Numbers of individuals at each station have been fluctuating or declining over the past several years. Two of the stations have been severely affected by the construction of a subdivision: one site is in the "backyard" of a soon to be developed lot and the other is in a small ravine in a "greenway" surrounded by buildable lots. At least one other subpopulation will be directly affected by the construction of a proposed major highway (Route 199) through the natural area. Some of the pogonia colonies are suffering damage from deer browse.

A globally rare plant in the lily family, **Virginia least trillium**, occurs at thirteen sites within the Powhatan Creek Natural Area along Powhatan Creek, Long Hill Swamp, and Chisel Run. The thirteen sites together represent one of the best populations of least trillium in the Commonwealth. Most of the subpopulations are in good to fair condition. The stations near recent development and timber clearcuts are the most stressed. The largest colony was reported at 700 flowering plants and thousands more of vegetative plants in 1987. These numbers are typical for the species.

The small three-leaved plants bear white to pink flowers (color depends on flower's age) in the early spring and are typically found in acidic soils. Not all of the habitat suitable for the species in the natural area has been exhaustively searched, so there is potential for more stations of the species to be found.

Virginia least trillium (sometimes also called Virginia dwarf trillium or least wake-robin) is rare throughout its range and is very rare in Virginia, occurring in only eight counties. The plant is a candidate for listing under the Federal Endangered

Species Act. Least trillium grows primarily in moist soils, although it does not occur in standing water habitats. The species is, in fact, very fastidious as to its hydrologic requirements. Any alteration in hydrology of trillium habitat that makes the soil either wetter or dryer will result in decline or extirpation of the colony. Most of the least trillium in the Powhatan Creek Natural Area occurs in one of three situations: on the margins of or high spots within the bottomland swamps, in groundwater seepage areas along the slopes of the streams, or in small feeder ravines that support intermittent streams.

The third rare plant species found in Powhatan Creek Natural Area is the **false hop sedge**. The species is known from the extreme southern edge of the natural area. False hop sedge is a densely tufted, perennial sedge, rising in clumps or "tussocks" from a short, thick rootstalk. The species is rare to uncommon throughout its range which includes most of the eastern United States. Seven sites are known for the false hop sedge in Virginia, thus it is considered very to extremely rare in the state. False hop sedge is a wetland or even aquatic plant, often found growing in permanently, semi-permanently, or seasonally flooded areas, especially where the canopy is broken or absent. Since the species is aquatic, it is very sensitive to water quality degradation and disturbance of the hydrologic regime. The Powhatan Creek population is in fair condition. About 150 vigorous plants grow at the site, but a residential development under construction upslope of the plants may be affecting the water quality and hydrology.

Powhatan Creek Natural Area contains a **bald eagle** nest site. Nesting bald eagles were first discovered at the site in 1992. The pair did not successfully produce young that year, however, apparently because of disturbance human activity in the vicinity. Nesting activity was noted this nesting season (1993), but it is too early at the time of this writing to know if they will successfully fledge young. An older, abandoned nest was also discovered a short distance from the active nest. Although the eagles may utilize some of the wider, more open parts of lower Powhatan Creek for foraging, it is likely that the birds forage outside the limits of this natural area to at least some degree.

Although bald eagles normally mate for life and usually nest in the same area each year, mated pairs may use two or more alternate nest sites in the same area from year to year. Since the two nests at Powhatan Creek have not been active during the same years, the nests probably represent alternate nest sites for a single mated pair. Bald eagles are the largest species of raptor (birds-of-prey) found in Virginia and require large areas of habitat because of their size. In addition to extensive forested areas for nesting and roosting habitat, bald eagles also require substantial stretches of wooded shoreline for foraging habitat. Although different pairs of eagles show different degrees of sensitivity to human activity, all bald eagles are vulnerable to human disturbance, especially if normal human activity patterns to which eagles have habituated are suddenly

changed or increased. Visual screening from human activity is essential to bald eagle reproductive success.

Bald eagles are rare throughout most of their range, including Virginia. The species is listed as endangered by both the Federal and Virginia Endangered Species Acts. Although bald eagle populations have made a substantial recovery since the ban on the use of certain persistent pesticides in the United States, the species is now even more threatened by habitat loss and human disturbance.

A nesting colony of great blue herons, the largest wading bird found in Virginia, occurs in the northernmost corner of Powhatan Creek Natural Area on Long Hill Swamp. The colony first occupied this site in 1988 after another, larger colony on Powhatan Creek was displaced by development. This heron nesting site has been characterized by slow, but consistent, growth since it was founded; there were at least 20 active nests in 1991 and at least 25 active nests in 1992. Most of the nests are built in snags (standing dead trees) in a shallow impoundment. The herons appear to forage in lakes and ponds in the vicinity of the natural area and possibly in the James, York, and Chickahominy rivers.

Like most colonial nesting birds, great blue herons put "all their eggs into one basket" by packing large numbers of reproductive birds into a few, small areas. This makes entire populations vulnerable to a single disturbance. Great blue herons are very sensitive to activity around their nesting sites, especially during the courtship and nestbuilding stages. Disturbance of the heron colony by such activities as construction, off-road vehicles, or even pedestrians can cause nesting failure and desertion of the colony. Although, great blue herons are not particularly rare, the colonial breeding behavior of the species and the decline of the wetland habitats used for nesting make the species biologically significant and sensitive.

In addition to the trees currently used for nests, great blue heron colonies require additional habitat around the nest sites for resting perches and colony expansion. The area in which the heron colony resides is subject to agricultural and forestry activities which do not seem to be completely incompatible with the nesting herons. The tract containing the heron colony is scheduled for future residential development. Most of the snags supporting nests will fall within the next fifteen years. When the snags fall, the herons may move to other trees in the vicinity or they may abandon the colony.

PRIMARY ECOLOGICAL BOUNDARY: The small whorled pogonia's primary boundaries encompass all known populations plus adjacent suitable habitat consisting of north or northeast facing slopes from the height-of-land (drainage divide) to the bottom of the slope. A small part of a subdivision was included in the primary boundary because two stations of the small whorled pogonia occur on or

near some of the lots in the southeastern edge of the subdivision. Some of these lots already have houses built upon them or are currently being built upon.

Because the known colonies of least trillium are scattered about the natural area, the least trillium primary boundary is extensive. The boundary encompasses all trillium habitat in the watershed, occupied or unoccupied. Most of the known trillium stations occur below the fifty foot contour, therefore the fifty foot contour line is generally used as a guide for the primary boundary. The primary boundary runs below the fifty foot contour when existing development would make it impossible for least trillium to persist there and may exceed the fifty foot contour to encompass existing trillium colonies or high potential habitat that lay above that elevation. It is essential that small feeder ravines, groundwater seeps, and intermittent streams in addition to the bottomland swamps are included in the primary boundary for trillium.

The primary boundary around the least trillium habitat also provides a continuous corridor of habitat among the existing subpopulations. Such corridors facilitate seed dispersal. Unlike some plant species whose seeds are dispersed by wind or vertebrates, trillium seeds are carried by ants and the species is dispersed slowly in short steps. Trillium seeds are normally moved only through suitable habitats and are not transported across barriers as wind, mammal, or bird carried seeds may be. Maintenance of habitat corridors for seed dispersal is essential to the genetic health of the trillium subpopulations in situations such as Powhatan Creek where development has fragmented the landscape.

The primary boundary around the false hop sedge includes the rare plants themselves and all the contiguous wetland habitat suitable for supporting the species.

The primary boundary designed around the Virginia Least trillium habitat also furnishes nesting and roosting habitat for the bald eagles.

The primary boundary around the great blue heron nesting colony encompasses all of the known nest trees as well as additional habitat for resting perches or expansion of the colony. The colony's primary boundary is connected to the nearest rare plant primary boundary to provide a continuous corridor of natural area habitat and a limited amount of foraging habitat for the herons.

SECONDARY ECOLOGICAL BOUNDARIES: The small whorled pogonia is vulnerable to contamination of surface water runoff. Accordingly, the secondary boundary for this species is set at the height-of-land, except where existing development makes this unrealistic.

The least trillium often occurs in ground water seepage areas making the plant dependant upon groundwater quality and quantity.

The secondary boundary around the trillium's primary boundary is designed to encompass probable groundwater recharge areas where possible, as well as enough land to assure that ditching, road construction, or well-digging does not alter the hydrology of the trillium habitat. Where existing development makes encompassing all probable groundwater recharge areas unrealistic, the secondary boundary is set up to the edge of development. A groundwater regime study to determine actual recharge and discharge areas is needed to more accurately determine the extent of land that should fall within the secondary boundary.

The secondary boundary around the false hop sedge is designed to protect the water quality and hydrologic regime of the rare plant habitat and also to help buffer the wetland community in which the plant is found from other effects of surrounding development such as invasive problem species. The secondary boundary is set nearly at the height-of-land except where existing development makes that guideline unrealistic.

Substantial research has been conducted regarding the appropriate width of buffer zones intended to shelter eagles from human activity. Various research projects have indicated from 330 feet up to 1/4 mile is necessary to adequately screen eagles from disturbance. The width of the buffer depends on the sensitivity of the eagle to human activity, the type of the activity, and whether the buffer zone is open or has dense, screening vegetation. Because vicinity around the bald eagle primary boundary is currently forested, a 330 foot wide buffer may be adequate to shield the birds from human activity. Given the planned clearing and development in the southern part of the natural area, however, a larger buffer zone may be required. Endangered species regulatory authorities (the Virginia Department of Game and Inland Fisheries and the United States Fish and Wildlife Service) should be consulted regarding a final determination on this issue. The secondary boundary around the least trillium habitat provides for the 330 foot minimum buffer zone around the bald eagle habitat as well.

The secondary boundary around the great blue heron colony follows the primary boundary 1000 feet distant. The principle purpose of the secondary boundary is to shelter the heron colony from visual and noise disturbance.

It is important to note that a large patch of residential development within the natural area has been excluded from the secondary boundary resulting in a "hole" in the ecological boundaries. Although the development in the "hole" will undoubtedly affect the water-quality, hydrology, and habitat continuity of the natural area, the exclusion was necessary to maintain realistic protection and management goals.

OWNERSHIP AND ZONING: Powhatan Creek Natural Area is predominantly in multiple private ownership. The natural area includes parts of 103 different property tracts. The site also includes part of or is adjacent to 9 existing residential

subdivisions. Large parts of the natural area are owned by several development companies. A small percentage of the site is in public ownership by the Eastern State Hospital, the National Park Service, and the James City County-Williamsburg school system.

Most of Powhatan Creek Natural Area is zoned for general agricultural use or for general, planned community, and multi-family residential development. A small portion of the natural area is zoned for limited industry.

PRIMARY ACREAGE: 2570 acres

SECONDARY ACREAGE: 2940 acres

PROTECTION RECOMMENDATIONS: Much of the land in the primary boundary is designated as Resource Protection Area by the James City County Chesapeake Bay Preservation Ordinance. The Bay Ordinance establishes a 100 foot minimum buffer zone around all wetlands and watercourses of the Bay; most forms of physical development are restricted from the buffer zone. The wetland habitats occupied by some of the least trillium subpopulations fall under the jurisdiction of the Federal Clean Water Act which regulates the alteration of wetlands. If least trillium becomes a federally listed species, the wetland habitats in which these plants live will receive additional consideration on projects which require Clean Water Act authorization. Because the small whorled pogonias occur on private land, their endangered species designation offers them little protection. The proposed highway construction through small whorled pogonia habitat will utilize federal funds, but negotiation regarding avoidance, minimization, and mitigation of environmental impact has been completed and the alignment selection finalized. The great blue heron nest trees, as well as the birds themselves, are protected by the Federal Migratory Bird Treaty Act making it illegal to harm the herons directly or to cut down nest trees at any time of year.

Private and public owners alike should be approached regarding assignment of some permanent protection, probably conservation easements, to the primary protection areas. For lands between the secondary and primary boundaries, less binding protection, such as a management agreement, would be more appropriate. In this way, owners will still have full use of their land, but would be encouraged to use best management practices for minimization of non-point source pollution and to maintain forested buffer strips along the primary boundaries.

Although there are too many lots in the surrounding subdivisions to make contacting each owner individually a realistic goal, a serious effort at public education and awareness should be made for those hundreds of property owners regarding the effects that construction and lawn management on their lots will have on the natural heritage resources neighboring them. Educational programs regarding rare species conservation, invasive species control, and non-point source pollution should encourage

environmentally sensitive development and lawn management on the subdivision lots. It may be wise to approach owners of particularly sensitive lots, such as those containing small whorled pogonia plants, to arrange for natural area registry of their property. A local conservation group would be an ideal organization to conduct this landowner education and contact work.

STEWARDSHIP RECOMMENDATIONS: Areas within the primary boundary should be restricted from land disturbing activities of any kind. Certain types of land use are compatible with the natural heritage resources of the site between the primary and secondary boundaries. Most of the secondary boundary is designed to protect the water quality and hydrologic regime of the rare plant sites. Agriculture and forestry are compatible uses in this boundary, but land managers should be encouraged to meet best management practices for minimization of non-point source pollution. Additionally, ditching, road construction, well-drilling, wastewater discharge, or other projects which may affect the hydrologic regime or water quality of the rare plant sites should be carefully considered before their implementation to insure the rare plant habitat is not affected. A 100 foot wide forested strip should be left between these compatible land uses in the secondary boundary and the edge of the primary boundary. The purpose of the 100 foot forested strip is to protect the core area from alterations in microclimate and reduce the likelihood of invasion by problem species. Ideally, dense housing, commercial, and road development should be restricted from within the secondary boundary. A research project investigating the groundwater flow patterns in and around the natural should be conducted. The secondary boundaries may be altered or refined based on the results of the study.

The rare plant occurrences require little active management, but the plant subpopulations should be monitored. To accurately determine reproductive status and population size of the rare plants, the stations should be visited at least twice during the growing season; the first visit documents all flowering plants, while the second documents all fruiting plants and late-emerging vegetative plants. Normally, known plant locations are marked with plastic stakes set a certain distance and direction from each plant. In large colonies where marking each plant is not practical, flagging is used to mark the extent of the colony for future reference. In such situations, detailed monitoring of a subset of each large rare plant colony can be used to assess the general status of the subpopulation. Staff of the William and Mary Biology Department have been monitoring the rare plants over the past several years and would probably be willing to continue their monitoring efforts.

Nesting activity and reproductive success of the bald eagle nest should be monitored annually. The Nongame and Endangered Species Program of the Virginia Department of Game and Inland Fisheries conducts aerial surveys of bald eagle nest sites in Virginia and normally include the Powhatan Creek nest in their surveys.

False hop sedge prefers open or semi-open canopy conditions. The openness of the false-hop sedge habitat at Powhatan Creek appears to be maintained by the hydrology of the site. Should the canopy cover over the habitat of this rare plant increase, active management in the form of manual clearing of vegetation may be required to maintain the viability of the population.

Problem species issues in the natural area should be addressed. Invasive plant species such as Japanese honeysuckle or millet grass may threaten the rare plant populations. Searches for invasive weeds around the rare plant stations should be conducted during the rare plant monitoring visits. If potentially invasive plants are discovered, they should be monitored for aggressiveness and threat to the rare plants. Invasive plants determined to be threatening the viability of the rare plant populations should be controlled using environmentally sensitive techniques. White-tailed deer browsed some of the small whorled pogonia colonies. Given the dense development surrounding parts of the natural area, controlling deer populations through hunting may not be safe or effective. Trapping and relocation of deer is generally not fiscally practical. Excluding deer from the pogonia colonies by fencing or caging the plants may provide a possible solution, but the implications of fencing should be carefully considered before implementation. Beaver may also become a problem species in the natural area if their engineering activities flood or alter least trillium habitat.

Motorized vehicles should be restricted from within at least 100 feet outside the primary boundary (except for on existing roads) of the rare plants to prevent damage to the rare plant habitats from soil erosion and sedimentation. Because collection can be a major threat to rare plants, their precise locations should be kept confidential.

Ideally, the area within the secondary boundary around the heron colony should be restricted from all human activities during the entire nesting season, February through August, every year the colony is active and for five years after it becomes inactive (to allow for the opportunity of re-establishment). Part of an active agricultural field is within the secondary boundary, however, and it is probably not necessary or realistic to discontinue its use. The vegetation and topography of the site screens the herons from the agricultural field. Additionally, herons may habituate to regular, non-threatening, low-level activities such as farming. If all farming activities are kept to the existing fields and access roads, there should be little conflict between the farming and the herons. The area has historically been subject to intensive forestry activities. Timbering of the land could be continued between the primary and secondary boundaries as long as all forestry activity is restricted during February through August. At sites where clearcutting is to occur, a minimum 100 foot buffer strip of forest should be left between the clearcut and the primary boundary. A residential development is planned for this tract. Careful community planning should be undertaken to minimize

destruction or disturbance of the heron colony during and after development of the tract.

The nesting colony should be monitored at least annually for numbers of individuals, numbers of active nests, and numbers of eggs and young. It is best to check the colony two or more times during the reproductive season to get the most accurate assessment of the colony's status and reproductive success. Because of limiting resources, however, more than one visit is not always possible. Great care should be taken to minimize disturbance to the nesting herons while conducting monitoring activities. The best monitoring technique for collecting the most accurate data while causing the least disturbance is through aerial survey. Researchers from the College of William and Mary and the Virginia Nongame and Endangered Species Program routinely monitor heron nesting colonies in Virginia. This colony has been and probably will be included in their aerial surveys, although lack of financial resources are ever a threat to the statewide monitoring program.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: Powhatan Creek is not a canoeable waterway; however, the portions of the creeks between Route 5 and Long Hill Road (Route 612) could provide a linear greenspace. Designation of this greenway would promote biodiversity and improve the gene pools for species within the natural area. Route 5 is a state Scenic Byway which may offer opportunities to develop interpretive displays which could become a part of an overall marketing plan for the byway. The National Park Service, the locality, and the state may want to work together to explore the option for use of the Greensprings Plantation Site (part of the Colonial National Historical Park) as a destination point and possible interpretive center for the Powhatan Creek natural area.

Route 5 is also a designated bike route. Plans to include a bike trail on News Road (Route 615) and on Long Hill Road (Route 612) could enhance the use of the area by bicyclists.

The Layfayette High School is within the Powhatan Creek natural area. Interpretive trails may be planned from this location to provide teaching laboratories.

Since the Powhatan Creek natural area is subject to intense development pressures, a public education program for existing and potential residents would aid in the retention of biodiversity within the area. The education efforts may focus on backyard conservation, awareness, and appreciation for the existing natural resources. The locality could require developers to participate in the designation of greenways and open space, development of interpretive facilities in areas appropriate for public access, and establishment of programs to encourage environmentally sensitive planning and construction practices.



COLLEGE WOODS

SIZE: 600 acres

BIODIVERSITY RANK: B3

LOCATION: City of Williamsburg and James City County
Williamsburg Quadrangle

GENERAL DESCRIPTION: This natural area has great regional significance because it is a relatively large tract of unbroken, natural vegetation situated in a rapidly urbanizing area. The forest is composed of stands of pine, mixed pines and hardwoods, and mixed hardwoods. Dominating the forest canopy are white oak, tulip-tree, loblolly pine, and American beech. Flowering dogwood is the major understory species.

The land is a dissected plain; a number of ravines drain into an adjacent lake. Soils on the ravine slopes belong to the Emporia complex, a series of deep, well-drained, highly erodible sandy loams. Soil types on the plain are fine sandy loams such as Emporia and Kempsville-Emporia. The underlying Yorktown formation derived from ancient shell deposits strongly influences the Emporia complex soil types found in the ravines. The varied landscape and environmental conditions of this natural area provide a diversity of microhabitats which support four rare plant species and harbors an unusually rich forest community.

Although much of the site was farmed or logged at one time, the College Woods has been allowed to remain in a relatively undisturbed state for many decades. The natural area is bordered by a university campus and residential development to the east and moderate to intense residential development to the north, west, and south. A large public school is on the western border of the natural area. The site is currently used for recreation, education, and ROTC training.

NATURAL HERITAGE RESOURCES: This natural area contains an exemplary occurrence of a southern mixed hardwood forest, reported to be one of the best examples of such a natural community in all of Virginia. Although the southern mixed hardwood forest is a common natural community type in Virginia, few examples approach the size, age, and quality of the College Woods. Old-growth qualities such as many large maturing trees, complex stratification, diverse species composition, and considerable downed wood and standing dead trees make this one of the most outstanding occurrences of this natural community type in the region, if not the entire state. The most significant features of the community are the diverse maturing hardwood composition dominated by a number of oak species growing over healthy and complex understory, shrub, and herbaceous layers. American beech is gradually entering the lower canopy. Steep-sided ravines and a number of seeps, streamheads, and ravine-bottom wetlands further contribute to the biological significance of the site. The richness, age, and size of the forest also

contribute to its importance as breeding habitat for neotropical migratory passerines (songbirds); such habitat is a commodity in increasingly low supply on the Lower Peninsula.

Two stations of a globally rare plant, the **small whorled pogonia**, occur in the College Woods Natural Area. This orchid species is listed as endangered at the federal and state levels. Small whorled pogonia is very rare throughout its range; it is found sporadically in sixteen states and provinces in eastern North America and known from only six jurisdictions in Virginia. The populations of small whorled pogonia on this natural area are in fair to poor condition. One station produced 2 stems in 1989, 3 stems in 1990, and none in 1992; the other site produced one stem in 1989, one in 1990, none in 1991, and one in 1992. In all cases, relatively few or no individuals flowered and produced seed. Although the populations may not appear to be of viable size or condition, small numbers of plants in a population is to be expected and often is typical for this species. In fact, it is natural for rootstock of this species to remain dormant in the soil for long periods of time, up to four years or more, causing results of short-term monitoring programs to be deceiving. Additionally, a substantial seedbank (viable dormant seeds in the soil) may exist. The College Woods stations represent important subpopulations of the Lower Peninsula population of the small whorled pogonia, especially considering the large amount and high quality of habitat suitable for the species at the College Woods. Because of these factors plus the legal status of the species, the plants warrant serious protection.

A small population of **sweet pine sap**, a herbaceous perennial of the indian-pipe family, was discovered in College Woods Natural Area in early 1989. Sweet pine sap derives its nutrients from other plants; it is not photosynthetic. The plants are small (no taller than four inches) and pale (due to the lack of chlorophyll). The reddish-purple flowers bloom in the early spring or in the autumn (but not both). The species is rare throughout its range which includes most of the southeastern states. Known from only fifteen Virginia counties, the plant is very rare in the state. Sweet pine sap is a very fragile plant; trampling, damage to the host plant, erosion, and sedimentation can quickly extirpate a population.

A small population (two individuals) of the **Florida adder's-mouth** was located in the southern part of the College Woods Natural Area in 1989. There are also historical records for the species at another location within the natural area. Florida adder's-mouth, an inconspicuous herbaceous plant in the orchid family, is very rare in Virginia occurring in only 6 counties on the coastal plain of the state. The species is rare to uncommon throughout its range: Virginia south to Florida.

The fragile Florida adder's-mouth grows two to eight inches tall and sprouts one or two oval leaves from a bulbous base. This perennial species bears a few to many small flowers with orange "lips" on a central stalk in middle to late summer. Florida

adder's-mouth is a plant of moist soils and is usually found along streambanks, swamp margins, or wet mossy areas in Virginia. The adder's-mouth is a shade species. In addition to direct habitat loss from conversion of land to other uses, clearing, erosion, sedimentation, and hydrologic disturbance may significantly degrade Florida adder's-mouth habitat.

A population of the **hoary skullcap** is found in the College Woods Natural Area. This plant in the mint family is extremely rare in Virginia. The hoary skullcap occurs only in a few sites on the piedmont and coastal plain in Virginia, but is much more common in other parts of its range: the northern Appalachians and adjacent regions. The hoary skullcap is, in fact, a mountain species which sometimes occurs in rigorous terrain outside of mountainous regions. The known population in the College Woods is small with only five stems documented in 1989, but all the stems were flowering or fruiting and a further search of adjacent suitable habitat may locate additional individuals.

PRIMARY ECOLOGICAL BOUNDARIES: The primary boundaries around the known rare plants, all of which occur on the slopes or edges of ravines or within or on the edges of swampy bottomlands, encompass occupied and contiguous unoccupied habitat for the species. The primary boundary around the natural community delineates the extent of the exemplary southern mixed hardwood forest. Because three of the rare plant occurrences' primary boundaries fall entirely within the the community's primary boundaries, these rare plant primary boundaries are presented with a different symbol as indicated on the map legend.

SECONDARY ECOLOGICAL BOUNDARY: The secondary boundary around the southern mixed hardwood community generally follows the primary boundary at a distance of 100 feet on level land. Maintaining a 100 foot woodland buffer around the exemplary southern mixed hardwood forest will help insure the continued integrity of this natural community. Among the benefits provided by the buffer to the exemplary natural community are the following: (1) preventing increased light beyond the edges of the forest, (2) reducing the likelihood for invasion of aggressive "weedy" species into the forest, (3) protecting soils within the forest from erosion, and (4) decreasing the possibility of wind-throw of trees within the forest. Maintaining a 100 foot woodland buffer may also help reduce the number of brown-headed cowbirds in the exemplary southern mixed hardwood forest. Brown-headed cowbirds are brood parasites on neotropical migratory passerines: the cowbirds do not build their own nests, but lay their eggs in the nests of other species who unknowingly raise the young cowbirds at the expense of their own young. Cowbirds will occupy many habitats, but they prefer edge habitat (areas where open and forested lands meet). Minimizing edge habitat and buffering the forest interior from edge effects may help reduce losses of neotropical migratory passerines to cowbird parasitism.

When slopes of more than 5% or 10% are involved, the 100 foot buffer becomes insufficient due not only to the severe

erodability hazard of the Emporia complex soils, but also to different light exposure angles. In cases where the community's primary boundary falls on slopes of 10% or greater, the secondary boundary is extended to 100 feet past the top of the slope. This extra woodland buffer is especially critical on slopes with a south or west aspect, due to higher exposure to the sun.

The secondary boundary is also designed to follow as smooth and straight a path as possible to further minimize perimeter size and thus minimize the amount of edge. One area of abandoned field behind the Berkley School was included in the secondary boundary even though it is not currently forested. The field does not appear to be used for school facilities and a portion of it should be allowed to return to a forested state to buffer the core forest community.

The secondary boundary around the rare plant occurrences represents a woodland buffer to the rare plant habitat. The secondary boundaries for the plants occurrences are not shown on the map because they all occur within the natural community boundary, but the plants' secondary boundaries are discussed in the text for ecological protection and management purposes.

Secondary boundaries are drawn at the drainage divides or "height-of-land" upslope of the rare plant occurrences. The Emporia complex soils found in the rare plant habitats are highly erodible. It is essential to keep nutrient loadings, chemical contaminants, and sediment out of the runoff to which these plants are subjected and prevent undue erosion of the soils within which they grow. Maintaining a healthy woodland buffer up to the height-of-land will help accomplish these water quality and erosion control goals.

Where rare plants occur on ravine slopes, the secondary boundary was designed to encompass land 100 feet past the top of the ravine on the opposite side of the plant occurrences. The ravine bottoms and ravine sides have different habitat characteristics than the level lands around them: the ravines are generally more shaded, more humid, have a steeper slope resulting in stronger runoff, and have a different soil type than the surrounding land. Maintaining a healthy woodland 100 feet past the top of the ravine edge opposite the plant occurrences will help maintain the microclimate in which the rare plants are found. Rare habitats occurring in or at the edge of bottomland swamps have a secondary boundary designed at the height-of-land on both sides where possible.

It was necessary, although not ideal, to exclude existing roads, lawns, and buildings from the secondary boundaries around the exemplary forest and rare plant habitats to facilitate realistic protection and management efforts.

OWNERSHIP AND ZONING: The majority of the College Woods Natural Area is owned by the College of William and Mary, a state-supported university, and a private foundation. The remainder of

the natural area is owned by the James City County-Williamsburg school system (part of one tract) and private individuals (parts of ten tracts). All of the land inside the primary boundaries is owned by the College.

The City of Williamsburg government does not regulate the land use on the College of William and Mary tract because it is state-owned property. The remaining tracts are zoned mostly for business, while some tracts are zoned for planned community developments.

PRIMARY ACREAGE: 480 acres

SECONDARY ACREAGE: 120 acres

PROTECTION RECOMMENDATIONS: Because small whorled pogonia is a federally and state listed species and because the rare plants occur on state property at the College Woods Natural Area, the Federal Endangered Species Act and the Virginia Endangered Plant and Insect Act provide a certain degree of regulatory protection for the species. Neither the other rare plants nor the southern mixed hardwood forest, however, enjoy any legal protection.

The College of William and Mary should be approached regarding permanent legal protection of the natural area. Given the relatively high significance of the site and the facts that the natural area is mostly in state ownership and is already managed for its natural resources to some degree, natural area dedication and inclusion of the tract into the Virginia Natural Area Preserves System is recommended. A precedent for dedication of state university properties has already been set by Old Dominion University which is currently pursuing natural area dedication of their Blackwater Ecological Preserve. The local school system and private landowners should be contacted to arrange voluntary or permanent protection of the appropriate part of their land through conservation easements, natural area registry, or management agreements.

STEWARDSHIP RECOMMENDATIONS: A great part of the significance of the College Woods Natural Area lies in the large size and continuous nature of the forest. Physical development, conversion of forested acres to other vegetation types, or construction of roads or utility rights-of-way within the natural area will cause the loss of forest habitat, increased forest fragmentation, and increased edge effect. Such land-disturbing activities should be restricted from within the natural area boundaries.

Although extensive survey for rare plant species has been conducted in the College Woods Natural Area, only a limited amount of inventory for rare animal species has taken place. Additional inventory for rare animals is recommended. Department of Conservation and Recreation staff scientists are available to conduct or coordinate such inventory efforts.

The natural heritage resources found in the College Woods require little ecological management, but should be monitored for status and condition. To accurately determine reproductive status and population size of the rare plants, the populations should be visited at least twice during the growing season; the first visit documents all flowering plants, while the second documents all fruiting plants and late-emerging vegetative plants. Normally, known plant locations are marked with plastic stakes set a certain distance and direction from each plant. Staff of the William and Mary Biology Department have been monitoring the rare plants over the past several years and would probably be willing to continue their monitoring indefinitely. Because collection can be a major threat to rare plants, the precise locations of the hoary skullcap and small whorled pogonia should be kept confidential.

The southern mixed hardwood forest should also be monitored. Several permanent sampling plots should be established in random locations in the forest. In each sampling plot, species composition and relative abundances should be measured for each forest stratum (canopy, understory, shrub layer, herbaceous layer). Additionally, soil composition factors and the age, size, and health of selected trees should also be recorded. Measurements should be taken at least once every five years late in the growing season at approximately the same date each year the community is monitored. Such a forest monitoring program will not only provide insight as to the development and function of an exemplary maturing forest, but also sound early warnings to adverse changes in the forest structure from such threats as invasive species. Department of Conservation and Recreation staff scientists can assist with the implementation of such a forest monitoring program.

The establishment of Breeding Bird Census plots in the exemplary forest of the College Woods Natural Area is recommended. Monitoring of breeding bird use in the natural area over time will give indications as to the effects of changes in land use and natural community structure on use of the site by songbirds. The Williamsburg Bird Club may be interested in taking responsibility for this project.

Additionally the recreational, educational, and training activities that occur in the College Woods should be monitored to assure that natural heritage resources are not affected. It may be advisable to restrict large scale human activities from the immediate vicinity of the rare plants, as the plants are highly susceptible to trampling. Many of the trails in the natural area are built on slopes and are eroding severely. It is recommended that erosion control devices, such as broad-based dips, be installed on these sloped trails. Motorized vehicles should be restricted from the College Woods to prevent destruction and disturbance of wildlife and minimize soil erosion in this sensitive area.

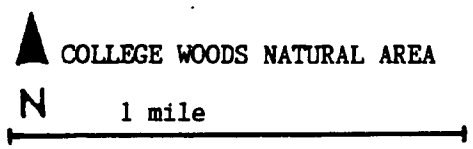
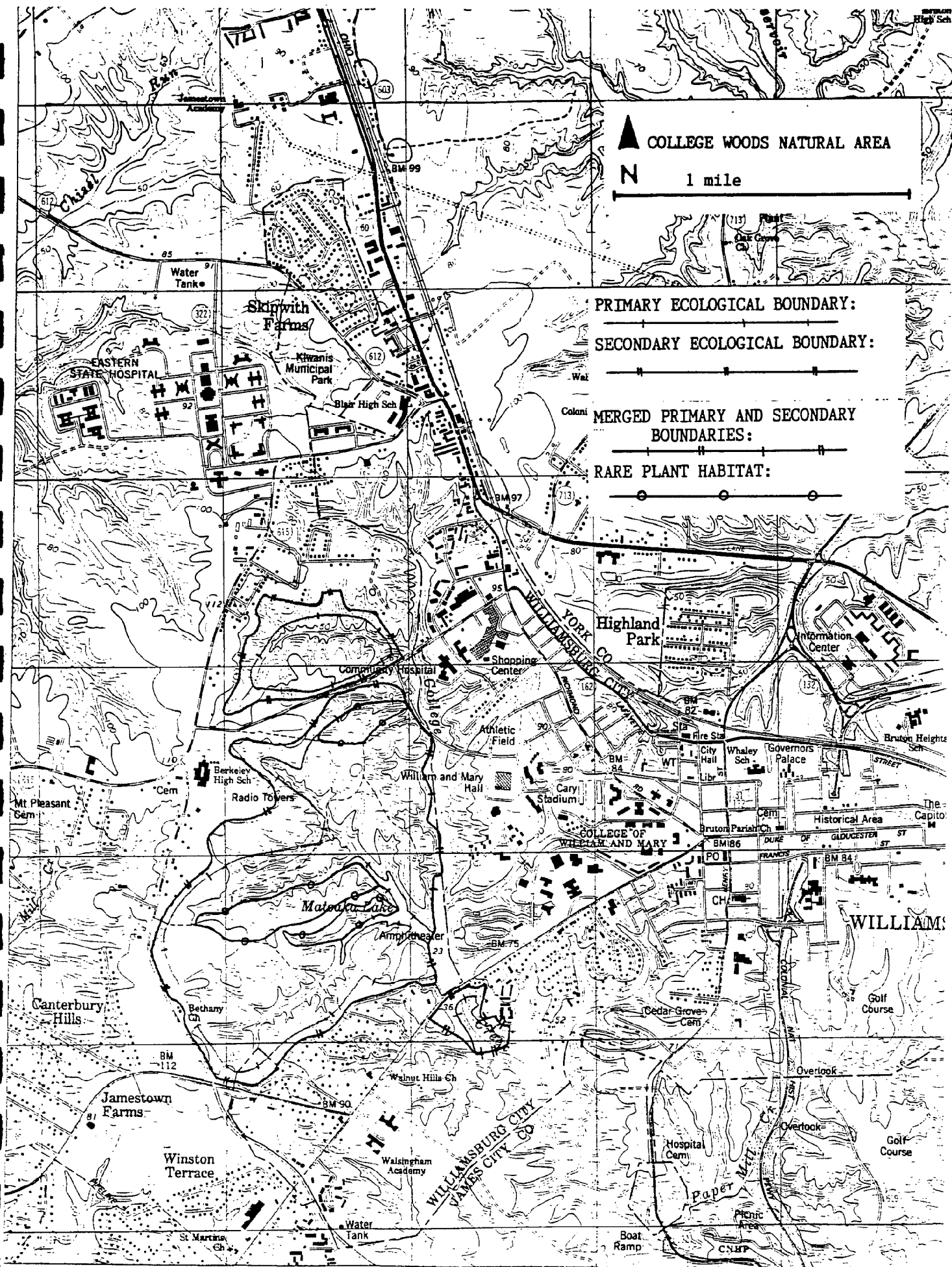
Invasive plant species such as Japanese honeysuckle could threaten the rare plant populations in the College Woods. Any aggressive weeds posing a threat to the rare plants would be identified during the annual monitoring activities. If invasive plant species are determined to be a threat to the rare plants, appropriate actions should be taken to control the weeds.

There is one invasive exotic species that may seriously threaten the composition, quality, and integrity of the College Woods Natural Area in the near future: the gypsy moth. The gypsy moth is an exotic species accidentally released in New England before the turn of the century. A destructive wave of the species has been moving south ever since. A large infestation of gypsy moths can defoliate a forest repeatedly causing significant tree mortality, changes in forest light and moisture regimes, and changes in forest composition and structure. Gypsy moth caterpillars will consume the leaves of many species of trees, but are especially fond of oaks. As the College Woods Natural Area is dominated by a number of maturing oak species, an uncontrolled gypsy moth invasion could so drastically alter the College Woods as to detract significantly from its value as a natural heritage resource.

Given the serious consequences to the resource, the College Woods should be monitored for the presence of gypsy moths. At the first sign of invasion, immediate action should be taken to control or suppress gypsy moths. These actions may include trapping and destruction of adult moths, removal and destruction of egg masses, interference with moth breeding behavior (through the use of artificial moth pheromones), or integrated pest management. Conservation-oriented student groups from the College of William and Mary may be a good source of volunteers for the more labor-intensive preventative measures.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: The College Woods Natural Area is already used for recreational and academic purposes by the College of William and Mary. Additional signage within the mixed hardwood forest trails could increase use of the area as an outdoor classroom. A trail management plan should be a priority. Such a plan may recommend the evaluation of existing trail alignments as well as incorporate techniques to prevent erosion and sedimentation.

Once the lake becomes approved for primary contact, it should be reopened for canoeing and non-motorized boating. The areas once used for canoe access could be reactivated and the lake could resume its function as an outdoor classroom.



PRIMARY ECOLOGICAL BOUNDARY:

SECONDARY ECOLOGICAL BOUNDARY:

MERGED PRIMARY AND SECONDARY BOUNDARIES:

RARE PLANT HABITAT:

DIASCUND CREEK

SIZE: 3580 acres

BIODIVERSITY RANK: B3

LOCATION: James City and New Kent Counties
Walkers and Toano quadrangles

GENERAL DESCRIPTION: Diascund Creek Natural Area straddles the border between New Kent and James City County just north of the Chickahominy River. Diascund Creek itself, which forms the border, is a medium-sized, freshwater, tidal creek that flows through swamps and marshes. Mill Creek, a smaller tributary, joins Diascund Creek near its mouth. The natural area supports a rare natural community, populations of two rare plant species, and a rare animal species.

The upper reaches of both streams are lined by swamps dominated by large bald-cypress with swamp tupelo, black gum, red maple, and green ash in the understory. The marshes along the lower reaches of the two creeks are dominated by wild rice over a dense layer of pickerelweed and arrow arum. Associated with the marsh are a large number of additional species such as cardinal flower, beggar's-ticks, and spatterdock. The forests in the upland portion of the site are composed of mixed pines and hardwoods. Loblolly pine dominates the drier ridges, with hardwoods dominating the slopes and bottomlands. Some of the uplands in and near the natural area have been logged recently.

Soils in the marshes consist of the poorly drained, regularly flooded Levy silty clay. Swamp soils are Johnston complex, a series of poorly drained silt loams. The soils of the slopes surrounding the creeks, marshes, and swamps include Emporia complex and Craven-Uchee complex, both a series of well-drained, highly erodible fine sandy loams. The uplands of the natural area include a number of silt loams and sandy loams such as Peawick silt loam, Bojac sandy loam, and Newflat silt loam.

Historic land use in the natural area has been agriculture and timber management along with hunting and fishing. In years past only a few rural residences occupied the natural area. Today, fishing, along with recreational boating, have become the major uses of the creeks. Hunting still occurs to some degree, but residential development has limited that pursuit over much of the natural area. The site has been heavily developed in recent years. Moderately dense residential communities have sprouted around the middle and lower sections of Diascund Creek. Many shoreline bulkheads and private piers are associated with the residential development. The scattered farmhouses have been augmented by strip residential development along the major roads in the natural area. One major road, a large powerline corridor, and a multi-track railroad pass through the natural area. Major roads also fringe the edges of the site. Current land use surrounding the natural area resembles that within its

boundaries. A large public water supply reservoir occurs one-half mile north of the natural area.

NATURAL HERITAGE RESOURCES: Diascund Creek Natural Area contains a good example of a **tidal freshwater marsh**, a rare natural community type. Freshwater tidal marshes occur in the narrow range where estuarine salinities are very low but the rivers and creeks are still tidal. Although characterized by low salinity levels, salt concentrations in freshwater tidal areas may vary daily due to changing wind, temperature, and precipitation conditions. Because of the fluctuating salinity levels, freshwater marshes are usually identified by their plant composition. Cattails, wild rice, rice cutgrass, arrow arum, pickerelweed, and broad-leaved arrow-head distinguish freshwater marshes in Virginia from more saline marshes. The streams and channels that meander through the marsh are also an essential part of the natural community. The creeks are ecologically linked to the marshes by a common medium, water, and may support important areas of submerged aquatic vegetation.

Healthy freshwater marshes and creeks furnish many ecological benefits. Marshes enhance water quality, help contain flood and storm waters, buffer against shoreline erosion, produce large amounts of nutrients and energy, and provide habitats for a vast array of vertebrates and invertebrates. Freshwater tidal creeks rich in submerged aquatic vegetation provide spawning and nursery areas for fish and other aquatic animals.

The marshes of Diascund Creek and Mill Creek are medium-sized and support a moderate amount of natural diversity, but the marshes may be threatened by surrounding land use.

Diascund Creek harbors a healthy population of **Parker's pipewort**. Parker's pipewort is a plant of the pipewort family which ranges from southern Quebec and Maine south to Virginia. The species is rare throughout its range and within Virginia. The plant is known from twenty-five sites in twelve Virginia Coastal Plain counties.

Parker's pipewort is an diminutive, inconspicuous, perennial herb with grass-like leaves. Its small, nearly spherical flowering heads are born singly on the ends of long stems. The species is most often found in shallow water, tidal flats, and muddy shores such as found at the edges of the marshes and swamps at Diascund Creek Natural Area. Because the species is semi-aquatic, it is very sensitive to water quality degradation and alteration of the hydrologic regime. Considering its small size and precarious habitat, Parker's pipewort is also extremely vulnerable to damage to its habitat from erosion, bulkheading, or trampling.

Another rare aquatic plant known from Diascund Creek Natural Area is the **yellow cowlily**. Yellow cowlilys are rooted in creek and river bottoms and their elongated leaves float at the water's surface. The showy yellowish to green flowers bloom through the

spring and summer. Yellow cowlily often grows in deep, mid-channel waters. In addition to being sensitive to degradation of water quality and disturbance of the hydrologic regime, the plant's habit of growing in open water makes it very vulnerable to direct damage from boat traffic.

Yellow cowlily is rare throughout its range, the coastal regions of Virginia, North Carolina, and South Carolina, and extremely rare in Virginia. The plant occurs at only seven sites in the Commonwealth, all of which are in three counties along the tidal portion of the Chickahominy River and its tidal tributaries. The population at this natural area is spread throughout Diascund Creek and Mill Creek and is one of the largest populations in Virginia.

The glossy crayfish snake has been documented from Diascund Creek Natural Area through the capture of a single individual in 1991. That was the first time the species has been found in the Commonwealth since the 1940's, when it was captured in the same vicinity as the 1991 find. Because there is only one known population of the snake in Virginia, the species is considered extremely rare in the Commonwealth. Virginia is the northern edge of the species' range which includes the Atlantic Coastal Plain from Virginia south to Florida and west to Texas. The glossy crayfish snake is more common in the main part of its range.

Glossy crayfish snakes grow up to thirty inches long, are brown or greenish-brown, and sometimes have two thin stripes running their length. The species is not venomous. Glossy crayfish snakes are one of the most secretive snakes in Virginia. The species is most often found in swamps, marshes, or ponds, especially at the muddy interface of land and water. The principle prey includes crayfish, salamanders, frogs, and small fish. The main threat to this species is the destruction of its habitat.

PRIMARY ECOLOGICAL BOUNDARY: In addition to including the significant freshwater tidal marsh, the primary boundary also includes open water habitat which supports yellow cowlily and shoreline habitat which supports Parker's pipewort and the glossy crayfish snake.

SECONDARY ECOLOGICAL BOUNDARY: Ideally in this situation, the secondary boundary would form a buffer zone around the primary boundary and all tributaries leading into the core area. The purpose of the buffer zone would be to protect the shoreline from erosion and protect the natural area's water quality and quantity.

Unfortunately, existing residential development, roads, and utility corridors combined with the large size of the watershed, the great number of minor tributaries, and the meandering oxbows of Diascund Creek make the establishment of a distinct buffer zone difficult. Instead, the secondary boundary encompasses a

portion of the Diascund Creek watershed within which land uses will have the greatest effects on the ecological integrity of the core area. Major roads are generally used to define the secondary boundary because they readily delineate geographic units and often follow the height-of-land (drainage divides).

OWNERSHIP AND ZONING: Diascund Creek Natural Area is entirely within private ownership. On the James City County side alone, the natural area includes all or part of eighty-eight tracts and two subdivisions. Many of the tracts apparently are owned by members of about three or four families. Diascund Creek, Mill Creek, and the other "navigable waters" in the natural area are designated "waters of the state" and may thus be considered as publicly owned.

The entire natural area on the James City County side is zoned for general agriculture.

Ownership and zoning research was not conducted for the New Kent County side of the natural area for this project.

PRIMARY ACREAGE: 540 acres

SECONDARY ACREAGE: 3040 acres

PROTECTION RECOMMENDATIONS: Diascund Creek, its swamps, tidal freshwater marshes, some of its tributaries, and 100 feet of upland around these wetland features have been designated as a Resource Protection Area by the James City County Chesapeake Bay Preservation Ordinance. The Bay Ordinance restricts most types of physical development from within Resource Protection Areas. The wetlands of the natural area also receive protection from the Federal Clean Water Act and similar state and local tidal wetland laws which regulate the alteration of wetlands. The watercourses themselves may also benefit from some protection under the Clean Water Act and from regulatory actions of the State Water Control Board which determine allowable discharges into waters of the state.

It appears that a portion of the Diascund Creek marsh may be under a conservation or scenic easement, but research has not yet been able to determine the extent or status of the easement.

Protection of the Diascund Creek Natural Area presents a particular challenge due to its natural situation, diverse multiple ownership, and existing developments. Efforts should probably begin with a public awareness and education program for property owners within the natural area. Although many of the property owners may be appreciative of the natural beauty of the site, few probably understand its biological significance and function. Once an understanding and appreciation of the ecological value of the natural area by the property owners is established, many may be interested in having their property or the appropriate part of it placed on the Virginia Registry of Natural Areas. If the relationship with the landholders is

accommodating, negotiation of conservation tools, such as management agreements or conservation easements, which will protect the natural area from further incompatible land uses may be possible. James City County should also consider rezoning the lands within the natural area to a more conservation-oriented status.

Similar protection efforts should be instituted simultaneously on the New Kent County portion of the natural area.

STEWARDSHIP RECOMMENDATIONS: Except where existing development prevents it, a forested buffer zone 330 feet in width should be established around the primary boundary and around all tributaries and wetlands which feed into the primary area. The buffer zone should remain undisturbed. Best management practices for the minimization of non-point source pollution should be encouraged throughout the natural area. Additional physical development, including the construction of houses, bulkheads, piers, and roads, along the shores and wetland margins of the natural area should be discouraged. Hunting, fishing, canoeing, hiking, and nature observation are all activities compatible with the natural heritage resources of the site. New or increased wastewater discharge into Diascund Creek or its tributaries should not be permitted.

Additional inventory should be conducted for the glossy crayfish snake. Information as to the size and condition of the population of this elusive species at Diascund Creek is needed to guide well-informed conservation measures.

Diascund Creek and to a lesser extent Mill Creek are subject to a large amount of motorboat traffic. Studies in the Chesapeake Bay area of Maryland have indicated that operation of motorboats in tidal creeks can have adverse effects on marshes, shores, creek bottoms, and water quality. The disturbance and resuspension of bottom sediments through the turbulence produced by boat propellers, damage to marshes, shorelines, and submerged aquatic vegetation, and the release of sewage and toxic compounds are problems associated with motorboat traffic in these sensitive areas. Similar studies have not been conducted in the Lower Peninsula project area. Because of the large number of variables involved, such as amount and speed of boat traffic, hull sizes and shapes, creek widths and depths, and amount of natural (wind-generated) wave action, results documented from one specific site cannot be inferred to be the situation at another site. For this reason, the establishment of a research program to determine the effects, if any, of motorboat traffic in this and the other Chickahominy River natural areas is recommended. The Shoreline Erosion Advisory Service of the Virginia Department of Conservation and Recreation or the Virginia Institute of Marine Science may be willing to lead the research effort. Funding for such a study may be available from the Coastal Zone Management Program. Appropriate actions for the preservation of the tidal marsh and creek ecosystems should be instituted based on the results of the study.

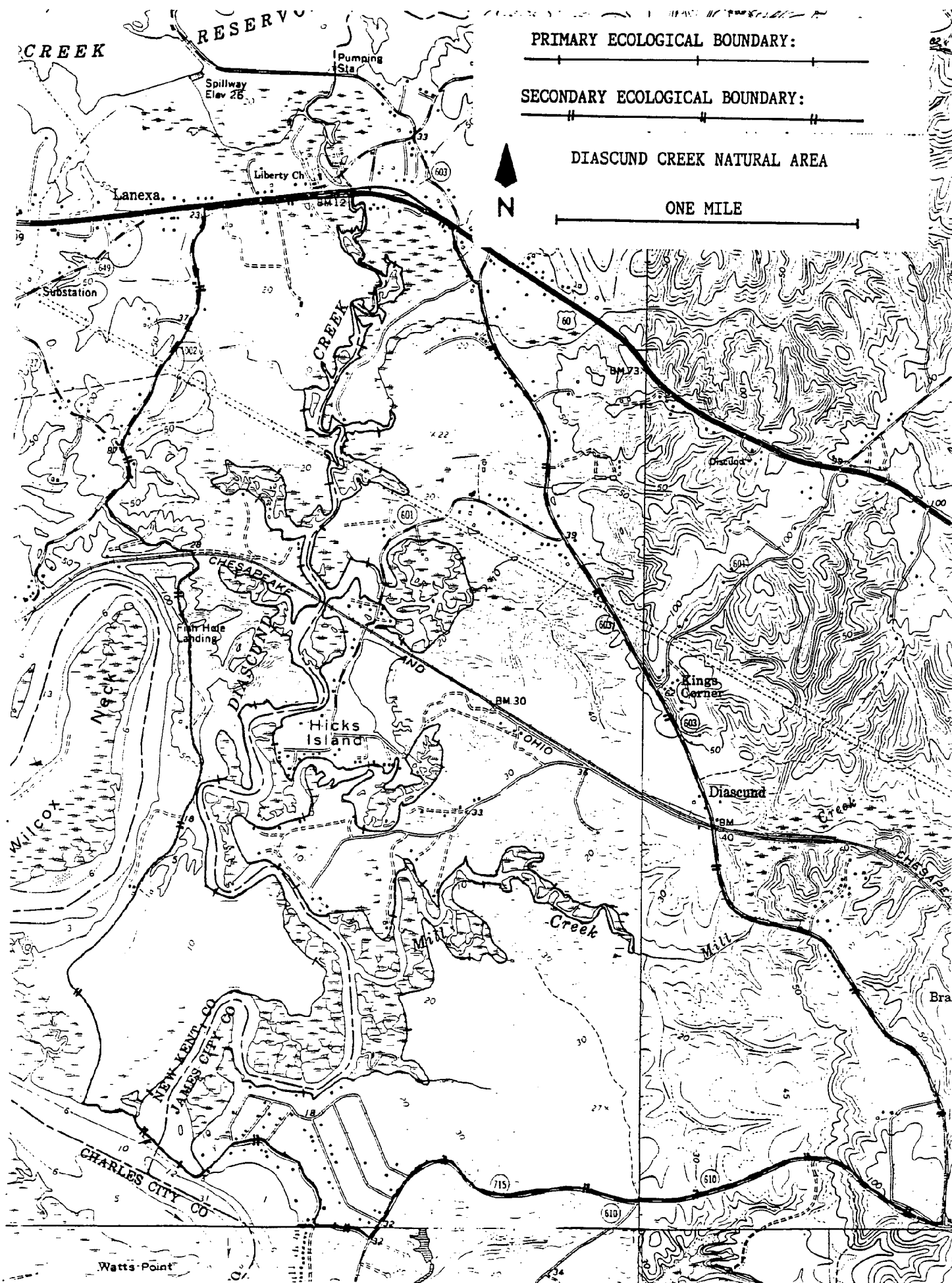
Yellow cowlily colonies in Diascund Creek and Mill Creek often show signs of damage from motorboats passing through them. Steps to help abate motorboat-caused damage to the yellow cowlily populations would greatly enhance their long-term viability. Preventative measures could include posting of educational signs at area marinas and possibly in or near yellow cowlily colonies themselves. The signs could provide a description of the plant, explain its sensitivity and significance, and request boaters to voluntarily avoid navigating through cowlily colonies.

The yellow cowlily and Parker's pipewort populations should be monitored annually for their size and condition. At least one visit to the site each year during the growing season should be conducted to record numbers and locations of plants as well as evidence of reproduction, disease, or damage. The marsh should be monitored as well. Several permanent sampling plots should be established at random locations within the marsh. In each sampling plot, plant species composition and relative abundances along with water quality and soil composition factors should be measured once every five years at approximately the same of year. Monitoring will facilitate early detection of threats such as sea-level rise, aggressive species invasion (especially common reedgrass), and erosion. Department of Conservation and Recreation staff are available to provide guidance with the design and implementation of the biological monitoring program.

Because collection can be a major threat to rare plants, the precise location of the Parker's pipewort should be kept confidential.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: Diascund Creek receives a considerable amount of recreational motorboating. The Virginia Department of Transportation records show an informal boat landing at Route 601 and Diascund Creek.

The planned development along this waterway should be encouraged to provided community piers and docks. A proliferation of private dock and pier facilities should be avoided. Developers of subdivisions could proffer community dock facilities and interpretive signage as part of an incentive program to improve environmental consciousness among residents.



GORDON CREEK

SIZE: 2720 acres

BIODIVERSITY RANK: B3

LOCATION: James City County, Brandon and Norge quadrangles

GENERAL DESCRIPTION: Gordon Creek Natural Area, located along the Chickahominy River in the westernmost part of James City County, consists of an extensive pristine freshwater tidal marsh, its waterways and channels, and the bordering upland forests. The dominant plant species in the marsh include wild rice, duck potato, big cordgrass, cattails, and a variety of other herbaceous species. Surrounded by the marsh are several islands of various sizes. The islands and the uplands bordering the marsh are forested with loblolly pine, Virginia pine, southern red oak, red maple, sweetgum, and other hardwoods.

Soils in the marsh are almost entirely Levy silty clay. As one would expect for marsh soils, Levy silty clay is deep, nearly level, poorly drained, and acidic. The soils of the uplands in the natural area are of the Peawick-Emporia-Levy association. The steeply sloping bluffs around the marsh consist principally of Emporia complex, while the more level uplands in the natural area are dominated by Peawick silty loam, Dragston fine sandy loam, and Altavista fine sandy loam. The Emporia complex soils found on the bluffs are highly erodible.

Historically, the uplands of the natural area were logged or farmed. These practices continue today to some degree. The marsh has traditionally been used for hunting and fishing, which, along with recreational boating, are the predominant uses of the marsh today. The surrounding land is still quite rural with a few agricultural fields, large forested tracts, and scattered houses. A large private campground is operated just south of the natural area. Construction of a large scale residential development has begun south of Gordon Creek and another such development has been proposed on land east of the natural area.

NATURAL HERITAGE RESOURCES: Gordon Creek Natural Area contains an outstanding example of a **tidal freshwater marsh**. This natural community type is rare to uncommon and the marsh at Gordon Creek may be one of the best remaining examples of this ecosystem in North America because of its great size and excellent quality.

Tidal freshwater marshes occur in the narrow range where estuarine salinities are very low but the rivers and creeks are still tidal. Although characterized by low salinity levels, salt concentrations in freshwater tidal areas may vary over time due to changing wind, temperature, and precipitation conditions. Because of the fluctuating salinity levels, freshwater marshes are usually identified by their plant composition. Cattails, sweet flag, wild rice, rice cutgrass, arrow arum, pickerelweed, and broad-leaved arrow-head distinguish freshwater marshes in

Virginia from more saline marshes. The streams and channels that meander through the marsh are also an essential part of the natural community. The creeks are ecologically linked to the marshes by a common medium, water, and support important areas of submerged aquatic vegetation.

Healthy freshwater marshes and creeks furnish many ecological benefits. Marshes enhance water quality, help contain floodwaters, buffer against shoreline erosion, produce large amounts of nutrients and energy, and provide habitats for a vast array of vertebrates and invertebrates. Tidal freshwater creeks rich in submerged aquatic vegetation provide spawning and nursery areas for fish and other aquatic animals and food for wintering waterfowl.

PRIMARY ECOLOGICAL BOUNDARY: At Gordon Creek, the primary boundary includes the vast tidal freshwater marsh and portions of the associated tidal creeks.

SECONDARY ECOLOGICAL BOUNDARY: The secondary boundary delineates a buffer of forested upland around the wetlands and water courses. The purpose of the forested buffer is to protect the water quality and hydrologic integrity of the wetland resource by reducing the sediment load and possibly the nutrients and other contaminants in surface water runoff, minimizing impacts from groundwater drawdown, preventing shore erosion and the resultant sedimentation and turbidity, and attenuating stormwater surges. By protecting the water quality and hydrologic regime, the structure and function of the marsh and creeks are maintained.

There has been an enormous amount of research regarding the appropriate width of wetland buffering strips. Widths ranging from fifty feet to 330 feet have been recommended based on the various data. The only point the immense body of literature on the subject has emphasized is that there is really no single equation for buffer strip width that applies to every situation. Given the high erodibility of the soil types, the extreme sensitivity and significance of the natural heritage resource, and the apparent trend towards intensive residential development in the area, 330 feet was chosen as the appropriate width for the forested buffer strip for this site. A 330 foot buffer strip was also designed around swamps and both perennial and intermittent streams which feed into the natural area. Since those tributaries communicate directly with the core area, their water quality also becomes a concern for protection. Where the height-of-land (drainage divide) occurs closer than 330 feet to the edge of the wetlands or water course, the secondary boundary runs along the drainage divide.

OWNERSHIP AND ZONING: Gordon Creek Natural Area is entirely within private ownership. A few of the tracts are large (800-1000 acres), but many are residential lots on one or a few acres. A majority of the marsh is owned by a private hunt club. There are thirty-five tracts, in whole or in part, in Gordon Creek Natural Area.

The entire natural area is currently zoned general agricultural.

PRIMARY ACREAGE: 1760 acres

SECONDARY ACREAGE: 960 acres

PROTECTION RECOMMENDATIONS: All of the area within the primary boundary is afforded some regulatory protection by the Federal Clean Water Act and similar state and local tidal wetlands laws which regulate the alteration of wetlands. The marsh also falls under the jurisdiction of the James City County Chesapeake Bay Preservation Ordinance which restricts most development from within 100 feet of wetlands and watercourses in the Chesapeake Bay area of Virginia. It is recommended that some additional form of protection such as management agreements or natural area registries be added to the area within the primary boundary.

The 100 foot buffer from the edge of wetlands and watercourses provided by the Chesapeake Bay Ordinance generally gives the inner third of the secondary boundary some form of protection. More permanent protection for the entire 330 foot buffer zone is needed. Owners of buffer areas should be approached regarding the placement of conservation easements or natural area registries on the appropriate portion of their land. Efforts should concentrate first on the larger tracts because they represent large sections of the buffer area.

STEWARDSHIP RECOMMENDATIONS: Land disturbing activity such as development, timber cutting, ditching, well-digging, road and utility construction, and the riding or driving of off-road vehicles should be restricted from within the natural area. Wastewater discharge should not be permitted within the natural area. Hunting, fishing, and canoeing are uses generally compatible with the viability of the natural heritage resource of the natural area.

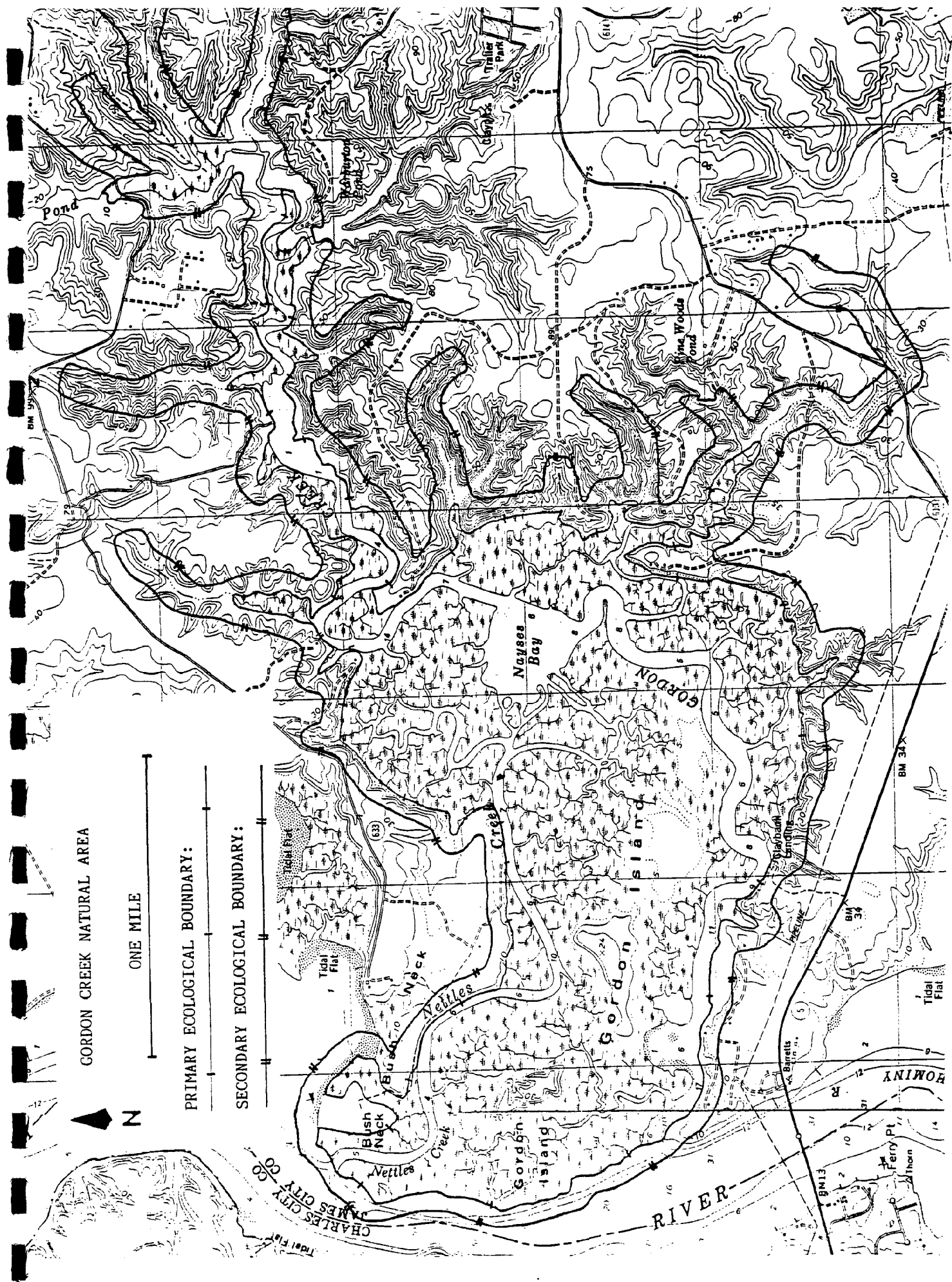
Gordon Creek Natural Area is subject to a moderate amount of motorized boat traffic. Studies in the Chesapeake Bay area of Maryland have indicated that operation of motorboats in tidal creeks can have adverse effects on marshes, shores, creek bottoms, and water quality. The disturbance and resuspension of bottom sediments through the turbulence produced by boat propellers, damage to marshes, shorelines, and submerged aquatic vegetation, and the release of sewage and toxic compounds are problems associated with motorboat traffic in these sensitive areas. Similar studies have not been conducted in the Lower Peninsula project area. Because of the large number of variables involved, such as amount and speed of boat traffic, hull sizes and shapes, creek widths and depths, and amount of natural (wind-generated) wave action, results documented from one specific site cannot be inferred to be the situation at another site. For this reason, the establishment of a research program to determine the effects, if any, of motorboat traffic in this and the other Chickahominy River natural areas is recommended. The Shoreline Erosion Advisory Service of the Virginia Department of

Conservation and Recreation or the Virginia Institute of Marine Science may be willing to lead the research effort. Funding for such a study may be available from the Coastal Zone Management Program. Appropriate actions for the preservation of the tidal marsh and creek ecosystems should be instituted based on the results of the study.

The private campground should be encouraged to manage the portion of their tract that falls within the secondary boundary in a manner consistent with the preservation of the neighboring natural heritage resource.

The tidal freshwater marsh should be monitored on a regular basis. Several permanent sampling plots should be established in random locations in the marsh (pending permission from the landowner). In each sampling plot, species composition and relative abundances should be measured at least once per five years during the later part of the growing season. Additionally, water quality and soil composition factors should also be recorded on these visits. Such a biological monitoring program will not only provide insight as to the structure and function of this exemplary wetland community, but also sound early warnings to adverse changes in the ecology of the marsh from such subtle threats as problem species, hydrologic disturbance, or water pollution. Common reedgrass is the most threatening problem species that could invade Gordon Creek Natural Area or any of the other Chickahominy River natural areas. Once established, common reedgrass can displace native diverse marsh communities with single species stands of the weed, ruining the beauty, structure, and function of the wetland. Department of Conservation and Recreation staff scientists are available to provide guidance with the design and implementation of a biological monitoring program.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: The area surrounding Gordon Creek is relatively undeveloped. Scenic easements could be established with the existing property owners to preserve the visual integrity of the area. The freshwater marsh could be promoted as an interpretive opportunity. Gordon Creek provides good fishing. An informal canoe and cartop boat launch could be established within the area to provide additional opportunities for access to the water.



GRAFTON PONDS

SIZE: 2640 acres

BIODIVERSITY RANK: B3

LOCATION: York County and City of Newport News
Poquoson West and Yorktown quadrangles

GENERAL DESCRIPTION: The Grafton Ponds Natural Area, the finest natural area in York County, consists of a complex of about 70 coastal plain sinkhole ponds. The ponds are usually ephemeral, but during years that are cooler and/or with above average precipitation, they are perennial. Normally the ponds begin to fill in January or February and dry up between August and October. The ponds range in size from about 40 feet in diameter to more than 100 feet across and in shape from nearly circular to elliptical. Adjacent ponds coalesce into irregular basins with a combined drainage area of several acres. The basin floors vary from a few feet to more than 15 feet below the elevation of the terrace surface upon which they develop. The depth below the adjacent land surface is usually three to seven feet. The ponds are randomly distributed on the Grafton and adjoining plains, the Huntington and Todd flats and the higher Lackey and Grove plains.

This natural area is generally forested by mixed oak-pine forest, second growth hardwood forest, second growth pine forest, and planted pine plantations. The site is traversed by a number of light, medium, and heavy duty roads and utility corridors. Soils in the natural area are developed on sediments of the Chuckatuck Formation and generally consist of Bethera-Izagora-Slagle varieties characterized by poorly to moderately well-drained clays and loams on level to gently sloping terrain. Underlying the surface soils is the calcareous Yorktown formation which contains abundant soluble shell and shell sand.

The natural area is surrounded by residential, commercial, and industrial development to the east and west, but some large forested areas still remain immediately to the south and north of the natural area boundaries. Most of the natural area is owned by the Newport News Waterworks Department which manages the site as a public water supply, local park, and timber resource area.

In addition to the pond complex, the natural area also contains three known rare animal species and five rare plant species.

NATURAL HERITAGE RESOURCES: The pond system of this natural area is the best remaining example of a **coastal plain sinkhole pond complex** in Virginia; an exemplary occurrence of a rare natural community type. The ponds occupy sinkhole basins. These basins form when the limey beds in the underlying Yorktown Formation are leached by groundwater and the overlying sediments slowly subside or collapse suddenly into the void created by dissolution. The sinkholes form as shallow depressions on the otherwise level plain, and increase in depth and areal extent with time as the

underlying lime is dissolved. Initially the depressions are too shallow and too areally restricted to hold water for an extended period of time (Early Phase). As time passes, the depressions expand in size, attaining sufficient size to collect water and retain water for longer periods of time (Middle Phase). As the depressions increase in area, the basins coalesce and compound sinkholes form; many of which hold figure-eight ponds. The sinkholes eventually fill with sediment and are breached by headward eroding streams (Late Phase). Most sinkholes of the Grafton area are in the Middle phase of development, whereas those elsewhere on the coastal plain are either younger and less well developed or are older and less distinct due to filling and erosion.

The ponds range in age from 80,000 to 800,000 years old. The pond-bottom sediments of the older ponds contain an extensive fossil pollen record. Studies of fossil pollens can reveal important clues as to the climate and vegetation of the prehistoric past. The older ponds have also accumulated thicker layers of bottom sediments within them while the younger ponds have less sediments. These sediments retard water loss, so that ponds with thicker sediments will hold water longer than ponds of the same size with thinner sediments.

The ponds' hydrology is influenced by a combination of groundwater and surfacewater. Because of the particularly porous nature of the geology of the area and the lack of topographic relief, a tremendous amount of infiltration and downward percolation occurs with little lateral movement of groundwater. Water seeping downward is captured in a perched water table, an aquifer close to the surface separated from the deeper groundwater aquifers by an impermeable layer. During the wetter seasons (late winter through early spring) rainfall percolates down to the perched aquifer. The filled aquifer then retards further downward movement of water. Because the flat topography discourages fast runoff and the filled perched water table retards quick percolation, rainwater finds its way into the sinkhole-caused depressions forming seasonal ponds.

Most ponds fill in the winter and spring, loose water to evaporation and percolation through the late spring and summer, and are usually dry again by the late summer or early autumn. The decrease of each pond's water level depends on the pond's age, size, depth, location, and vegetation. Each pond's hydrology is further influenced by the varying amounts of precipitation from one year to the next, ponds will have more water for longer periods during wet years than drought years. During the relatively cool, wet summer of 1992, for example, many ponds which are ordinarily dry by the end of the summer retained water well into the fall. Naturally fluctuating water levels maintain open or semi-open forest canopies and create zones of vegetation types along the pond margins and bottoms. Since fish cannot survive in these seasonal ponds, the ponds provide predator-free breeding habitat for many amphibian.

Because of the many variables affecting hydrology, each pond has a unique hydrologic regime which may also vary from year to year. Additionally, most of the ponds are beneath a closed forest canopies, but some ponds that are larger or wetter or both have less tree cover resulting in well-developed shrub and herbaceous layers. For those reasons, larger and wetter ponds will generally be more biologically diverse than smaller ponds. This variability among ponds multiplied by the large number of ponds results in an extremely diverse complex of isolated freshwater depression wetlands. Thus the pond complex supports a similarly diverse array of habitats and harbors several rare plant and animal species. Because of this diversity, the pond complex as a whole is more valuable than the sum of each of the ponds taken individually.

Harper's fimbristylis is a diminutive plant in the sedge family that is very rare throughout its range and extremely rare in Virginia. The species occurs in only a handful of sites on the Atlantic Coastal Plain from Delaware to Georgia with only one known location in Virginia: the Grafton Ponds Natural Area. Harper's fimbristylis is a very small annual sedge that appears late in the summer in ponds (or sometimes ditches) which have been subject to substantial water-level draw-down. The plant grows only in full sunlight. Seeds from this plant can remain dormant in the soil for many years, not germinating until suitable environmental conditions occur, creating what is referred to as a "seed bank." Harper's fimbristylis was first discovered at a single pond in 1986. Plants were sprouting in several square yards of a dry pond bottom. The species was not seen at Grafton Ponds in 1987 and 1988, despite extensive searches. In 1991, a botanist located six plants of the species that had emerged in a different pond in the natural area. Only a fraction of the seeds of the seed bank in the pond bottom will germinate in a given year and then only if conditions are right. If the pond dries out too early or too late one year, no seeds will germinate. The specificity of environmental conditions required for successful reproduction of this species has made it very sensitive to alterations in the hydrology of its habitats. Harper's fimbristylis is listed as an endangered species under the Virginia Endangered Plant and Insect Act and is a candidate for listing under the Federal Endangered Species Act.

A substantial population of **Cuthbert's turtlehead** occurs in the western part of the natural area. This perennial herbaceous plant of the figwort family grows up to three feet tall and bears clusters of purple flowers in the late summer. Cuthbert's turtlehead is rare throughout its range and very rare in Virginia, occurring in nine counties. It is one of the many mountain-coastal plain disjunct species found on the Lower Peninsula; the species is found in Virginia's mountainous and coastal regions, but not on the intervening piedmont. This plant normally grows in unshaded seepage wetlands and has been found at Grafton Ponds in seepage areas along powerline rights-of-way and along the edges of a few ponds which are influenced by groundwater seepage.

A rare amphibian, **Mabee's salamander**, has been known from the Grafton Ponds since 1983. Recent surveys found both adult and larval forms of the species and indicated that Grafton Ponds contains the largest known population of Mabee's salamander in Virginia. Mabee's salamander is at the northern edge of its range in southeastern Virginia. The species' range is restricted; Mabee's salamanders occur only on the coastal plain of South Carolina, North Carolina, and Virginia. The salamander is known from six sites in Virginia, only four of which are confirmed reproductive populations. Mabee's salamander is listed as threatened under the Virginia Endangered Species Act. Adults are three to four inches long, dark gray or brown, and have light specks along their sides. In the family known as the mole salamanders, Mabee's salamanders spend most of their lives crawling through leaf litter or burrowing through soft ground in search of food (primarily ground-dwelling invertebrates). Individuals may range as far as 1000 feet from their breeding ponds, but the salamanders must return to the seasonal ponds to reproduce.

Another rare amphibian, the **barking treefrog** reaches the northern limit of its range in southeastern Virginia. This species is found chiefly on the coastal plain from Virginia to Florida and Louisiana. The barking treefrog is considered extremely rare in Virginia due largely to the low number of populations in the state, but also to the species restricted range in the Commonwealth: barking treefrogs are found only in the southeastern part of the state. The species is listed as threatened under the Virginia Endangered Species Act. Barking treefrogs were first discovered in the Grafton Ponds in 1990. Additional survey is necessary to accurately estimate population size and status. Barking treefrogs are relatively large for treefrogs and most individuals have dark round spots further distinguishing them from other species in the treefrog family. The species is adapted to climbing vegetation and do most of their courtship calling, a bark-like sound as the name implies, from shrubs and low trees. Barking treefrogs will also burrow into the ground to escape hot, dry days. The species is dependant upon fish-free seasonal wetlands such as the ponds within this natural area for completion of its life-cycle. Eggs are laid in the water and larvae are completely aquatic until they develop into adult frogs.

At Grafton Ponds, the **slender marsh pink** has been found in wet areas along utility corridors. The slender marsh pink is a plant in the gentian family that is very rare in Virginia but much more common in other parts of its range. This species is found on the coastal areas of Massachusetts to Louisiana, locally inland to Indiana and Kentucky, and in the West Indies. The species is known to occur in eleven counties in Virginia. Like Cuthbert's turtlehead, the slender marsh pink is also a mountain-coastal plain disjunct species. The slender marsh pink is a perennial wetland herb that grows 8 to 24 inches tall and is graced with pink and yellow flowers in July and August. The species usually is found in wetlands and prefers direct sunlight. Slender marsh

pink may also appear in ponds of the natural area when substantial water-level draw-down occurs in the larger, open-canopy pond basins.

The southern twayblade of the orchid family was first found in the Grafton Ponds in 1990 at the edge of one of the sinkhole ponds. Seventeen plants were found again in 1991. The species is uncommon over most of its range and is rare in the Commonwealth. In Virginia, southern twayblade is known to occur in eight counties on the coastal plain. Plants are small and inconspicuous with deep green leaves and reddish purple flowers which bloom in the early spring. The species is normally associated with seasonally flooded to moist, shaded woodland habitat, such as that found around some of the smaller ponds in the Grafton Pond complex.

Collins' sedge is known from one site in the natural area, but continued searching may locate additional plants. Collin's sedge is a medium-sized, shade-tolerant species of sedge found on mossy hummocks in some types of forested wetlands. The species occurs mostly on the coastal plain from Rhode Island to Georgia and is known from ten Virginia counties. Collins' sedge is rare in the Commonwealth and somewhat more common throughout the remainder of its range.

The occurrence of the star-nosed mole in the Grafton Ponds has been documented through the discovery of only one individual. The species is secretive, spending almost all of its time either underground or underwater, and is difficult to trap, two factors which make determining its presence and abundance difficult. Searches specifically oriented to the star-nosed mole may show a substantial population residing in the natural area. The star-nosed mole is a small mammal of the insectivore family covered with a coarse coat of dark fur. The mole has tiny, nearly useless eyes and an unmistakable array of 22 fleshy sensory appendages around its nostrils. In addition to burrowing through the ground like other moles, star-nosed moles are also strong swimmers. The species has a low reproductive rate; the female has only one small litter per year, making the populations very sensitive to environmental perturbations. Although star-nosed moles are fairly common in the stronghold of their range further north, the species is near the southern limit of its range in Virginia and is considered rare in the state.

PRIMARY ECOLOGICAL BOUNDARIES: The primary boundary encompasses the exemplary sinkhole pond complex and the habitat of all eight rare species known to occur in the natural area. Although most of the natural heritage resource significance of the natural area centers on and around the isolated depression wetlands and seepage areas, land around all of these wetlands is included in the primary boundary for three reasons. First, the pond complex as a whole, not each individual pond, holds the greatest ecological significance. The flora and fauna of each pond is slightly different from the others. It is the large number of ponds and the diversity of their structure and function that make

this an exemplary occurrence of a coastal plain sinkhole pond complex. Second, avenues of genetic communication among the ponds are essential for the long term viability of the rare species populations. Dispersal of plants (via seeds) and animals to other sites helps prevent "inbreeding" problems associated with isolated populations in which organisms lose their ability to cope with their environment. Third, Mabee's salamanders spend most of their time away from their breeding sites, ranging up to 1000 feet away from the ponds. The primary boundary is designed to encompass at least 1000 feet of natural habitat around all the potential breeding ponds for this species except where that is not possible due to existing development.

SECONDARY ECOLOGICAL BOUNDARIES: The purpose of the secondary boundary at this site is to protect the water quality and hydrologic regime of the ponds. The secondary boundary is generally not different from the primary boundary. The movement of the groundwater here is mostly vertical with little lateral movement, so there are generally no large areas of groundwater recharge beyond the primary boundary that need to be protected. In some areas the surface water flow was not sufficiently protected by the primary boundary; the secondary boundary is extended far enough to assure water quality and quantity in those areas. The design of the secondary boundary may change as our understanding of the hydrology of the sinkhole pond complex increases.

Extensions of the secondary boundary of the Grafton Ponds Natural Area have been designed at the northern and southern ends of the site. The purpose of these extensions is to provide corridors of natural habitat to adjacent sites. Beaverdam Creek Natural Area and Lackey Ponds Natural Area lie to the north and Kentucky Farms Natural Area lies to the south. These three natural areas harbor several of the same natural heritage resources as the Grafton Ponds such as sinkhole ponds and Mabee's salamanders. Corridors of continuous habitat among these sites are essential to the long-term viability of the natural heritage resources at the smaller, peripheral natural areas.

OWNERSHIP AND ZONING: Nearly all of the Grafton Ponds Natural Area is owned by the City of Newport News which manages the land for its natural resource value. Some of the peripheral portions of the natural area include parts of private tracts. There are also several powerline, railroad, and highway rights-of-way traversing the natural area. Parts of six tracts are included in the York County portion of the natural area.

About three-fourths of the Grafton Ponds Natural Area is zoned limited industrial. A portion of the natural area is zoned as "residential conservation." This land use designation allows for forestry, agriculture, and limited residential development. Remaining properties along the major road which traverses the southern portion of the natural area (Denbigh Boulevard) are zoned for commercial uses and residential development.

Property ownership and zoning research was not conducted for the portion of the natural area which lies within the city limits of Newport News.

PRIMARY ACREAGE: 2370 acres

SECONDARY ACREAGE: 270 acres

PROTECTION RECOMMENDATIONS: The isolated depression wetlands of the Grafton sinkhole pond complex may receive some protection from alteration through the Federal Clean Water Act. Wetlands regulations and interpretations of those regulations change often and should not be depended upon to protect the sinkhole ponds. Additionally, the Clean Water Act has exemptions for forestry activities and provides no protection of the upland habitats surrounding the ponds. Mabee's salamanders and barking treefrogs receive limited protection from the Virginia Endangered Species Act, but their habitats are not adequately protected at Grafton Ponds by that legislation. Similarly, Harper's fimbriatilis receives a small degree of protection from the Virginia Endangered Plant and Insect Act. If Harper's fimbriatilis is federally listed (it is currently a candidate for federal listing), the species would receive protection at Grafton Ponds only from projects that are conducted, funded, or regulated by federal government agencies.

City ownership of the Grafton Ponds Natural Area is critical to the long-term protection of this sinkhole pond complex. A variety of protection tools ranging from voluntary placement of the property on the Virginia Registry of Natural Areas to natural area dedication could be considered. The key to the protection of the natural heritage resources, however, is the careful preparation of a management plan and commitment from the City of Newport News to implement protective management on the site.

A management agreement in the guise of a formal Memorandum of Understanding among the City of Newport News, York County, the Virginia Department of Game and Inland Fisheries, and the Department of Conservation and Recreation is recommended. Similar agreements could be pursued with the managers of the utility corridors. The few private property owners need to be approached regarding protection of the appropriate portions of their tracts. Protection arrangements may range from management agreements for implementation of Best Management Practices and nutrient management programs on agricultural land between the primary and secondary boundary or the placement of conservation easements on land occurring within the primary boundary.

STEWARDSHIP RECOMMENDATIONS: Development of land should be restricted from within the secondary boundary. Similarly, ditching or drilling of wells should not occur within the secondary boundary of the natural area as these actions may alter the hydrology of the pond complex.

The current timber management techniques practiced in the natural area should be reviewed as to the compatibility with the long-term survival of the natural heritage resources known from the site. Department of Conservation and Recreation, Department of Game and Inland Fisheries, and York County staff should meet on site with Newport News watershed managers to learn in detail how the land is currently being used and what the proposed future uses are. One or more such meetings will educate each group as to the other's activities and concerns and open a dialog among the localities and the state. The logical next step will be to begin negotiation of a management agreement.

Whatever management practices are agreed upon should also consider the habitat corridors connecting Grafton Ponds to Beaverdam Creek, Lackey Ponds, and Kentucky Farms.

Additional, rare species inventory is needed in this natural area. Inventory efforts should focus on finding any additional sites for the rare plant species known to occur in the natural area, defining the population size and status of the known rare animal species, and searching for additional rare vertebrate and invertebrate species.

A long-term monitoring program focusing on hydrologic and plant community dynamics should be established for the pond complex. Such monitoring will facilitate early diagnosis of any affects to the hydrologic regime of the ponds and plant community structure from changes in surrounding land use.

Population dynamics of each rare species should also be monitored. Because of the large size of the natural area, the number of the rare species, and the secretive or elusive nature of some of the rare species, a comprehensive monitoring program will have to involve experts of several biological disciplines. Ideally each pond should be checked at the proper time of year for each rare species for which it contains appropriate habitat. Such an effort is too labor intensive even for a team of experts. If representative ponds of several general types are chosen for intensive monitoring, the scope of the monitoring project may be more realistic. Other ponds could be checked as time and conditions allow.

Department of Conservation and Recreation staff are available to conduct rare species inventory and to help implement and coordinate hydrologic, plant community, and rare species monitoring efforts.

Problem species may become a threat to this natural area, especially invasive plant species Japanese honeysuckle or common reedgrass that may displace the more sensitive rare plant species. Monitoring for invasive species should occur during the rare species monitoring visits. Any aggressive species determined to be a threat to the viability of the natural heritage resources of the site should be controlled or suppressed with environmentally sensitive techniques.

Because collection can be a threat to rare plant populations, the precise locations of the rare plants should be kept confidential.

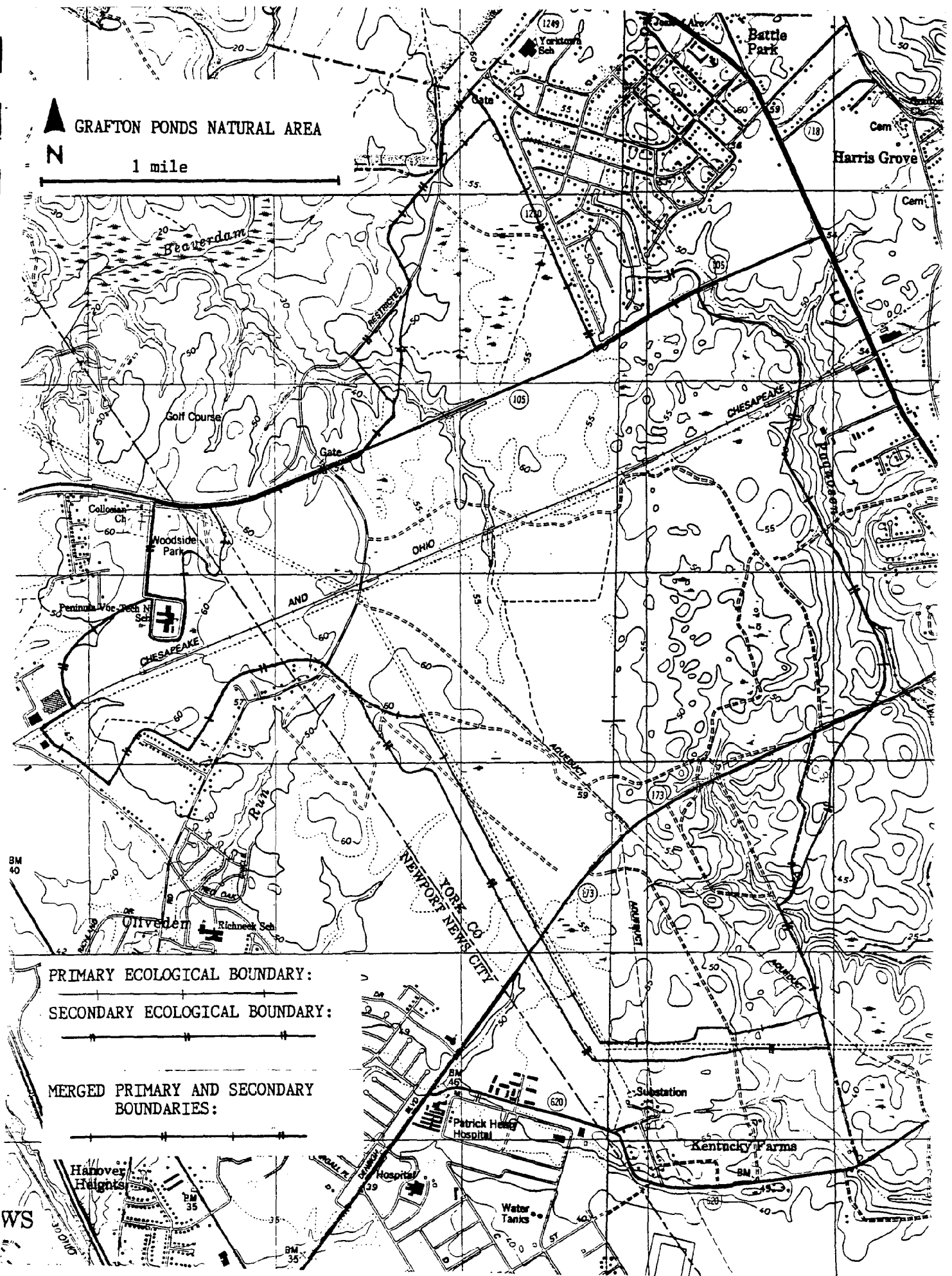
RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: Natural areas nearby with similar characteristics could be linked with Grafton Ponds by a designated greenway or series of connected open spaces. Some walking trails could be developed within the greenway to provide connections for pedestrians. There may be an opportunity to designate some trails for bicyclists. If bicyclists are allowed to use the trails, an effort to educate users to the importance of remaining on the trails will be required.

The unique character of the Grafton Ponds Natural Area makes it suitable as a research area and as a specialized outdoor classroom.

GRAFTON PONDS NATURAL AREA

N

1 mile



PRIMARY ECOLOGICAL BOUNDARY:

SECONDARY ECOLOGICAL BOUNDARY:

MERGED PRIMARY AND SECONDARY BOUNDARIES:

GROVE CREEK

SIZE: 890 acres

BIODIVERSITY RANK: B3

LOCATION: James City County
Hog Island quadrangle

GENERAL DESCRIPTION: Grove Creek Natural Area supports a rare natural community, four rare plant species, and one rare animal species. The natural area includes a system of steep-walled ravines leading into bottomland swamps and the forests surrounding the ravines. The site is adjacent to two small lakes, the Rhine River and Warehams Pond, to the north and west and adjacent to the James River to the south. Grove Creek flows south through the natural area to the James River. The natural area is forested with stands of young pine, mixed pines and hardwoods, and maturing mixed hardwoods.

Soils in the swampy ravine bottoms consist of Bohicket muck. Where the ravine bottoms broaden into a tidal marsh, Bohicket muck is replaced by a series of soils known as the Johnston complex. Soils on the steep ravine sides consist of Emporia complex, a series of deep, well-drained, highly erodible fine sandy loams. Emporia complex soils are formed over marl (calcium-rich ancient shell) deposits which were exposed when streams cut the ravines into the underlying Yorktown Formation. The marl component of the Emporia complex significantly affects the chemistry of the soils, producing calcium-rich, alkaline substrates on the ravine slopes. The Craven-Uchee complex, a set of highly erodible loamy fine sands, is found around the crests of the ravines. The more level lands surrounding the ravines are characterized by several fine sandy loams, such as Slagle fine sandy loam, Kempsville-Emporia fine sandy loam, and Uchee loamy fine sand.

Because of the steepness of the slopes, the ravines have been subject to little land use in the past. The surrounding level lands have been used for forestry and agriculture and a large part of the natural area includes a former military base (Camp Wallace). A planned community development, a large amusement park, and a brewery now occupy the lands west of the site. Three major highways run along the north and east of the natural area. A strip of residences along one of these highways lines the eastern border of the natural area and a sewage treatment plant is found to the south. Construction has begun on a golf course east of the natural area. Part of this golf course will intrude into the eastern part of the natural area.

NATURAL HERITAGE RESOURCES: A nesting pair of bald eagles have been active on Grove Creek Natural Area since at least 1987. Bald eagles are the largest species of raptor (birds-of-prey) found in Virginia and, because of their size and mobility, require large areas of habitat. Although bald eagles normally

mate for life and usually nest in the same area each year, mated pairs may use two or more alternate nest sites in the same area from year to year. Any conservation plans for a nesting area must therefore consider habitat for alternate nest sites. In addition to extensive forested areas for nesting, bald eagles also require large open trees for roosting and substantial stretches of wooded shoreline for foraging habitat. Different pairs of eagles show different levels of sensitivity to human activity, but all bald eagles are vulnerable to human disturbance, especially if normal human activity patterns to which eagles have habituated are suddenly changed or increased. Visual screening from human activities is critical for bald eagle reproductive success.

Bald eagles are rare throughout most of their range, including Virginia. The species is listed as endangered by both the Federal and Virginia Endangered Species Acts. Although bald eagle populations have made a substantial recovery since the ban on the use of certain persistent pesticides in the United States, the species is now threatened by habitat loss and human disturbance.

Grove Creek Natural Area contains the best example of a **marl ravine forest** in the Commonwealth. Marl ravine forests are a rare natural community type which occur on the coastal plain where streams have eroded away surface layers exposing the calcium-rich Yorktown Formation. The calcareous soils of the ravine walls tend to be more alkaline than soils of the swampy ravine bottoms or the soils of the plains above the ravines. The steep mountain-like topography formed by the ravines produces a cooler, more humid microclimate.

The flora of marl ravine forests is most notable for is mountain-coastal plain disjuncts, such as chestnut oak, pagoda dogwood, and spikenard. These disjuncts include species whose principle range is in the mountainous regions in the western part of the state, but also occur in areas of severe topography on the coastal plain while being absent from the intervening piedmont region. The coastal plain populations of mountain species are relicts of a cooler climate and have persisted in the ravines because of the generally lower temperatures, higher humidities, and more alkaline soils. The Grove Creek marl ravine forest also harbors many plant species at or near their northern range limit, such as southern sugar maple, southern black-haw, and shadow witch orchid. Adding to the significance of the marl ravine forest is the fact that all the rare plants known from Grove Creek Natural Area occur on or at the base of the ravine slopes.

A small population of **sweet pine-sap**, a herbaceous perennial of the indian-pipe family, was discovered in Grove Creek Natural Area in the autumn of 1991. Sweet pine-sap derives its nutrients from other plants; it is not photosynthetic. The plants are small (no taller than four inches) and pale (due to the lack of chlorophyll). The reddish-purple flowers bloom in either the spring or autumn (but not both). The species is rare throughout

its range which includes most of the southeastern states. Known from only fifteen Virginia counties, the plant is very rare in the state. Sweet pine-sap is a very fragile plant; trampling, damage to the host plant, erosion, and sedimentation can quickly extirpate a population.

Mountain camellia is a mountain-coastal plain disjunct which occurs in the Grove Creek Natural Area. Mountain camellia has become uncommon throughout its range, the southeastern U.S., and is considered very rare in Virginia because it is known to occur in only five counties. A shrub of the tea family, mountain camellias have simple, oval leaves and bear white flowers in mid-summer. A small population of the species consisting of three stations has been known from Grove Creek Natural Area since 1983. Several of the shrubs bore fruit in 1992. Mountain camellia tends to grow on wooded bluffs and slopes with alkaline soils. Threats to populations include direct habitat destruction from clearing or erosion and also alteration of the species' microclimate through clearing of adjacent lands.

The **hoary skullcap** is a plant in the mint family that is extremely rare in Virginia. The species is known to occur at only four sites in the Commonwealth, although it is much more common in other parts of its range, primarily the mid-Atlantic and midwestern states. About ten plants of this species grow on a ravine slope near the amusement park. Hoary skullcaps are herbaceous plants that grow up to three feet tall usually and bear blue flowers in the summer. In addition to threats to its habitat, hoary skullcap must also contend with damage from trampling, deer browsing, and collecting.

Though it is fairly common in some parts of its range which covers most of the southeastern and southcentral states, **Shumard's oak** is considered rare in Virginia. This tree is known from less than ten sites and is limited to a distribution of four counties in the Commonwealth. Shumard's oak closely resembles scarlet oak in appearance and the acorns are sometimes needed to discern the species from each other. The species occurs at Grove Creek as handful of trees scattered along some of the lower ravine slopes in the northern part of the natural area. Shumard's oak prefers moist habitats such as those provided by the Grove Creek ravines.

PRIMARY ECOLOGICAL BOUNDARY: For the bald eagle habitat, the primary boundary includes a large forested area around the existing nest tree to provide alternate nesting sites, roosting areas, and shoreline foraging perches. For the exemplary natural community and rare plant populations, the primary boundary includes the slopes of the significant ravines which harbor the rare natural community and the rare plants. The ravine bottoms are also included within the primary boundary to avoid fragmentation of the ravine slope habitats and furnish a dispersal corridor among the ravine slopes. Ravine bottoms which have already been impounded, however, were excluded from within the boundary.

SECONDARY ECOLOGICAL BOUNDARY: The secondary boundary around the bald eagle habitat is intended to provide a wooded buffer zone that will screen the bald eagles from human activities outside the natural area. Substantial research has been conducted regarding the appropriate width of buffer zones intended to shelter eagles from human activity. Various research projects have indicated from 330 feet up to 1/4 mile is necessary to adequately screen eagles from disturbance. The buffer width needed depends on the sensitivity of the particular eagles being considered, the type of the activity, and whether the buffer zone is open or has dense, screening vegetation. The minimal 330 foot buffer width is designed around the eagle habitat at Grove Creek; most of the eagle buffer is already provided, however, by the primary boundaries around the adjacent rare plant habitats. The 330 foot buffer is extended into the James River along the shoreline of the eagle habitat. This open water buffer is to protect foraging eagles from disturbances by boating activities close to the shore. Further study or a change in land and water use patterns may indicate a need for wider buffers.

The secondary boundary around the exemplary natural community and rare plant habitats provides a forested buffer with a minimum width of 100 feet except where existing development makes a full 100 foot forested buffer impossible. The purpose of the forested buffer zone is to protect the ravine habitats from erosion, sedimentation, aggressive species invasion, and alteration of the microclimate in the ravines.

OWNERSHIP AND ZONING: Grove Creek Natural Area includes parts of seven tracts and part of one subdivision. A substantial portion of the site is owned by a large corporate landholder. A large private foundation is also a major land-holder in the natural area; the foundation owns a wide corridor of land running through the middle of natural area.

Grove Creek Natural Area is currently zoned for general and planned community residential development and for limited industry.

PRIMARY ACREAGE: 550 acres

SECONDARY ACREAGE: 340 acres

PROTECTION RECOMMENDATIONS: Bald eagles receive some regulatory protection from the Federal Endangered Species Act and the Virginia Endangered Species Act. The legislation does not provide complete protection of bald eagle habitats, however. Parts of some marl ravines are designated as Resource Protection Areas under the James City County Chesapeake Bay Preservation Ordinance. The Bay Ordinance restricts most types of physical development from within the Resource Protection Areas. The wide corridor of property owned by the private foundation has a scenic easement placed upon it which may provide some protection to part of the natural area. Some of the natural area may be protected

by the Federal Clean Water Act and similar state and local tidal wetland laws which regulate the alteration of wetlands.

Because of the high significance of the site, the lack of any strong existing protection, the simple ownership portfolio, and the threats from development, conservation easements are the recommended protection tool for Grove Creek Natural Area. The corporate property owner should be made aware of the highly significant biological resources on their property and approached regarding the placement of the natural area under a conservation easement. Failing easements, placement of Grove Creek on the Virginia Registry of Natural Areas should be pursued.

Appropriate protection alternatives should also be pursued with the other owners of the natural area.

STEWARDSHIP RECOMMENDATIONS: The corporate landholder is already working with the Virginia Department of Game and Inland Fisheries, Virginia's regulatory and management agency for state endangered animals, regarding the management of bald eagle habitat on their property. A formal management agreement should be negotiated between the Department of Game and Inland Fisheries and the corporate landholder to insure the long-term viability of nesting bald eagles at Grove Creek Natural Area. Generally, the eagle habitat should be left undisturbed, although some land uses are compatible with eagle management if appropriately executed. Ideally, the area of the secondary boundary that extends into the James River should be restricted from boating activity to minimize disturbance to foraging eagles.

Land-disturbing activities, such as physical development, road construction, and timber harvest, should be restricted from within the natural area around the exemplary natural community and rare plant habitats. Clearing of the ravine slopes or forested bottoms or impoundment of any of the streams should not be allowed. It is critical that the buffer zone between the primary and secondary boundaries also remain forested to protect the ravine from erosion, sedimentation, nutrient pollution, and alteration of microclimate.

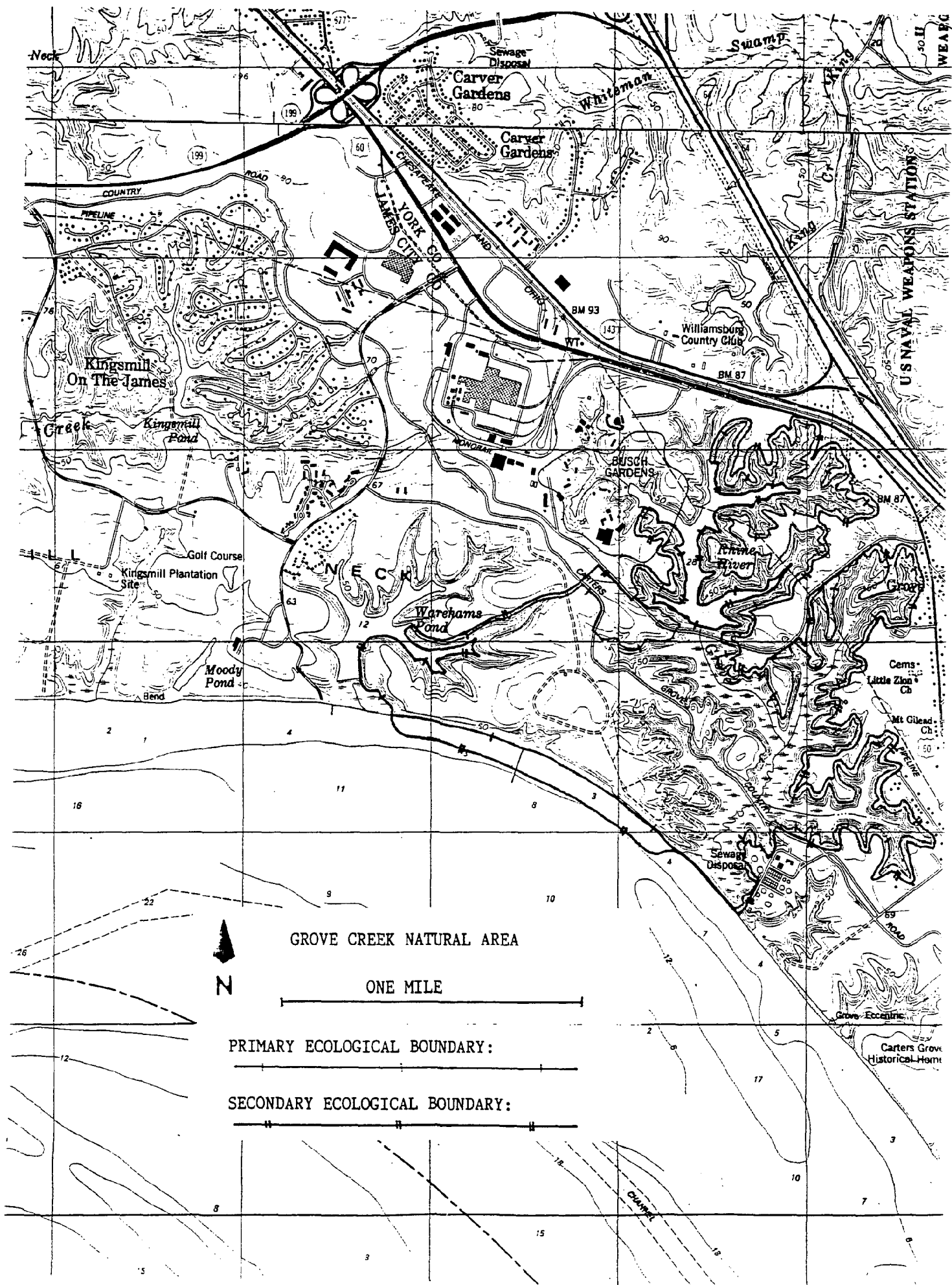
Scientific research has been conducted in the ravine system of Grove Creek for many years. This research should be allowed to continue, as it may provide valuable insight as to the curious biology of marl ravine forests and mountain-coastal plain disjuncts. The rare plant populations should be monitored annually to provide an early warning of any drastic population declines. Monitoring could probably be performed during the visits to the sites by the scientific researchers.

Several problem species threaten Grove Creek Natural Area. Pernicious weeds such as common reedgrass, millet grass, and Japanese honeysuckle, are already present in the natural area and may invade rare plant habitats. White-tailed deer browsing has recently damaged some of the rare plants of Grove Creek. The threats of problem species in the natural area should be

monitored during the rare plant monitoring visits. Any problem species determined to be threatening the viability of the rare plant populations should be controlled or suppressed using environmentally sensitive techniques.

Because collection can be a threat to rare plant populations, the precise locations of the rare plants should be kept confidential.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: The corporate landowner should be encouraged to incorporate information about this natural area into an interpretive or educational aspect of the recreational program they are providing. The use of development proffers to provide protection for various habitat and the inclusion of interpretive education in community site designs may also be appropriate.



MOUNT PLEASANT CHURCH

SIZE: 80 ACRES

BIODIVERSITY RANK: B3

LOCATION: James City County
Norge and Williamsburg Quadrangles

GENERAL DESCRIPTION: This natural area encompasses the headwaters of Mill Creek which was impounded in colonial times by Indigo Dam (the dam has long since been breached). The site contains populations of two globally rare plant species. A portion of the site was logged in 1979 and a thicket of young vegetation now dominates the timbered areas. Soils in the natural area are of the Slagle-Emporia-Uchee associations which are characterized by gently sloping to very steep, deep, well-drained loams. The natural area is surrounded by residential development on the east, south, and west sides. A major road borders the natural area to the north; a small industrial park and an active agricultural field lay north of the road. A small church and cemetery occupies the northwest portion of the natural area.

NATURAL HERITAGE RESOURCES: **New Jersey rush**, one of the rare plants known from Mt. Pleasant Church Natural Area, was first discovered at this site in 1921 by a botany professor of the College of William and Mary. The species was rediscovered at the site in 1980, again by a William and Mary botany professor. The site had been clearcut in 1979 and the New Jersey rush was flourishing in the direct sun. The combination of continual groundwater seepage and high light levels are very important to the survival of the species in this natural area. Approximately 300 tussocks of the rush in three or four stations were counted in 1981. As young trees and shrubs have grown on the clearcut area over the past decade, the New Jersey rush population has declined. Only fourteen tussocks of the species were found in 1989 and only about ten were found in 1992. The rush is apparently being shaded out by the competing vegetation.

New Jersey rush is very rare throughout its range and is a candidate for listing under the Federal Endangered Species Act. The species is known only from about ten counties in Virginia, Maryland, and New Jersey. Four of those counties are in Virginia. Habitat at many of the New Jersey rush sites in these ten counties has been severely degraded by wetlands alteration in the past decade. New Jersey rush is a very distinctive species in a large plant family (the rush family). The species is easily distinguished from other rush species by its gray-green (rather than bright green) foliage and by having six (rather than three) flower stamens. This rush is an inhabitant of wet, acidic soils and has a very narrow window of hydrological conditions under which it will grow. In addition to the species' hydrological sensitivity, New Jersey rush prefers direct sun exposure allowing it to be outcompeted easily by woody or weedy vegetation.

A globally rare plant in the lily family, the **Virginia least trillium**, occurs within the Mount Pleasant Church Natural Area. Virginia least trillium (also called Virginia dwarf trillium or Virginia least wake-robin) is very rare throughout its range (Virginia to South Carolina) and occurs in only eight counties in the Commonwealth. The plant is a candidate for listing under the Federal Endangered Species Act. Least trillium is a small perennial herbaceous plant. Adult plants normally grow three narrow leaves, while seedlings usually have only one. A single white to pink flower (color depends on flower age) adorns a small percentage of the plants in each population in the early spring; the majority of the plants do not flower each year, but may spread vegetatively. Least trillium occurs primarily in moist soils, but it does not occur in standing water habitats. The species is, in fact, very fastidious as to its hydrologic requirements. Any alteration in the hydrology of trillium habitat that makes the soil wetter or dryer will result in decline or extirpation of the colony.

Two discrete populations of least trillium are contained within the natural area. One population lies near Route 615 in the northern section of the site, the other near the remnants of the old Indigo Dam in the southern part of the natural area. The northern colony had a handful of flowering adult plants, hundreds of vegetative adults, and a thousand or more seedlings during the 1990 season. The southern population was smaller than the northern colony in 1990 with about fifty plants total.

PRIMARY ECOLOGICAL BOUNDARIES: The primary boundary encompasses the occupied and contiguous unoccupied habitat of Virginia least trillium and New Jersey rush. Generally, this includes all the bottomland wetlands and the surrounding slopes where groundwater seeps create appropriate soil conditions for these plant species.

SECONDARY ECOLOGICAL BOUNDARIES: The principle purpose of the secondary boundary is to protect the water quality of the rare plant habitats. Ideally the secondary boundary would run along the height-of-land (drainage divide) around the primary boundary. This would protect all of the surface water and much of the groundwater that influences the habitats within the primary boundary. The primary boundary is completely surrounded by roads and development, therefore the secondary boundary is designed to exclude those features to facilitate realistic protection and stewardship objectives. The one exception to this rule is that the church and cemetery are included in the secondary boundary. The close proximity of the church and cemetery grounds to the rare plant populations makes it essential to include those areas within the secondary boundary. Certain grounds maintenance activities, such as over-fertilization of lawns or spraying of certain herbicides, could significantly influence the viability of the rare plant populations downslope from the church property. Other objectives of the secondary boundary are to provide a woodland buffer to the core habitats of the natural area and to help shelter the natural heritage resources from problem species encroaching from the adjacent developments and roadways.

OWNERSHIP AND ZONING: Mount Pleasant Church Natural Area is a relatively small site in diverse ownership. Ownership in the natural area includes the Virginia Department of Transportation right-of-way for the Route 199 extension, subdivision "greenspace," parts of subdivision lots, two currently forested tracts owned by a development company, and several private holdings fronting Route 615 and extending back into the natural area. The natural area includes part or all of nineteen tracts plus parts of two subdivisions and one apartment complex.

Most of the natural area is zoned for residential development. The remainder is zoned general business.

PRIMARY ACREAGE: 25 acres

SECONDARY ACREAGE: 55 acres

PROTECTION RECOMMENDATIONS: Because the rare plant populations do not occur on federal land and because they are not yet listed as endangered or threatened, they receive little protection from the Federal Endangered Species Act. None of the natural area is designated as Resource Protection Area and so does not benefit from protection under the James City County Chesapeake Bay Preservation Ordinance. Parts of the natural area may enjoy limited protection from the Federal Clean Water Act depending upon which wetlands delineation methodologies are used. The Clean Water Act regulates the alteration of wetlands.

The ownership pattern and impending land uses of this natural area will make its protection difficult. The alignment of the planned Route 199 extension runs through the southern and western parts of the natural area; the road corridor has already been approved by all pertinent regulatory agencies and its construction will begin within four years. The highway construction may directly destroy some of the Virginia least trillium plants and will also have indirect effects, such as habitat fragmentation, increased runoff, and non-point source pollution, on the rare plant habitats. A stormwater management basin has been proposed in the natural area and additional residential development in the area seems likely. In fact, due to the impending highway construction, proposed stormwater pond, and probable residential development, the long-term viability of this natural area is very questionable.

Nevertheless, efforts should be made to approach the owners of the larger tracts regarding protection of the sensitive parts of their land. Which protection tools are used will probably be determined on a case-by-case basis depending upon the attitude and land management goals of the owner. A public education program regarding the natural area should be instituted for the owners of the many subdivision lots that reach into the site. It may be possible to convince many of the residents to practice environmentally sensitive lawn management techniques to help preserve the neighboring natural heritage resources.

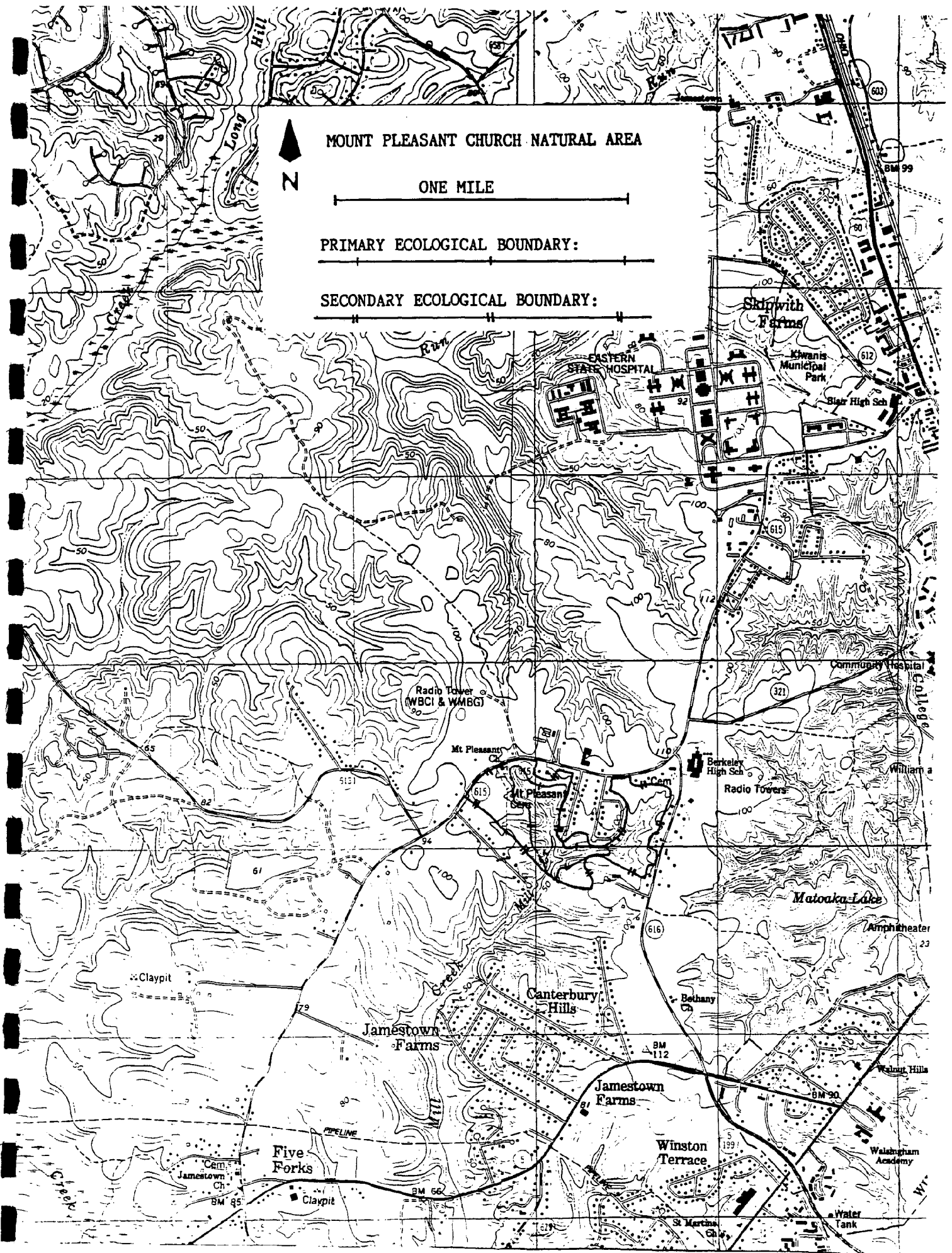
STEWARDSHIP RECOMMENDATIONS: Ideally, land disturbing activities such as development, timber cutting, ditching, road and utility construction, and the operation of off-road vehicles should be restricted from within the primary boundary. Most of these activities should also be discouraged within the secondary boundary, although some environmentally sensitive forestry practices may be compatible with preservation of the natural heritage resources. The administration of the church and cemetery should be approached to encourage environmentally sensitive management techniques on their grounds.

Each rare plant population in the natural area should be monitored for population size and status on an annual basis. The rare plant sites should be visited at least once per year to collect information on the population size, evidence of reproduction, and vigor of the plants for each rare plant station. The rare plant habitats should also be searched for evidence of problem species during these visits. Any plants or animals that aggressively threaten the viability of the rare plant populations should be controlled using environmentally sensitive techniques. Botanical staff of the College of William and Mary may be willing to carry out these annual monitoring activities.

Other than monitoring and protection from problem species and inappropriate land use, least trillium requires little active management. The New Jersey rush population, however, is being shaded out by competing vegetation. Normally, the reintroduction of a natural disturbance (such as fire) to keep the rush habitat in an earlier successional state is recommended for such circumstances. Because of the proximity of the natural area to residential development and major roads, controlled burning in the site may be contraindicated. Instead, vegetation may have to be cleared manually on an annual basis to insure the long-term viability of the New Jersey rush at this site.

Since collection can be a threat to rare plant species, the precise location of the rare plant occurrences should be kept confidential.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS:
Recreational access to this property should not be encouraged due to the size of the property and the presence of very sensitive globally rare wetland species.



MOUNT PLEASANT CHURCH NATURAL AREA

ONE MILE

PRIMARY ECOLOGICAL BOUNDARY:

SECONDARY ECOLOGICAL BOUNDARY:

Skipwith Farms

EASTERN STATE HOSPITAL

Khwanis Municipal Park

Blair High Sch

Radio Tower (WBCI & WMBG)

Mt Pleasant

Mt Pleasant

Berkeley High Sch

Radio Towers

Community Hospital

William a

Matoaka Lake

Amphitheater

Canterbury Hills

Jamestown Farms

Jamestown Farms

Winston Terrace

Five Forks

Walshing Academy

Water Tank

Claypit

Claypit

Jamestown Ch

BM 85

BM 66

St. Martha Ch

BM 112

Bethany

BM 90

Walshing Hills

BM 90

Walshing Hills

BM 90

Walshing Hills

BM 90

Walshing Hills

BM 90

TASKINAS CREEK

SIZE: 400 acres

BIODIVERSITY RANK: B3

LOCATION: James City County
Gressit quadrangle

GENERAL DESCRIPTION: This natural area near the York River harbors two rare plant species. The majority of the site is in hardwood forests. Dominant species of the canopy include chestnut oak, white oak, red oak, and tuliptree. The understory is generally open, but with scattered patches of dense mountain laurel and American holly. The topography of the natural area is gently to steeply sloping into several ravines and one tidal tributary to the York River, Taskinas Creek.

Soils in most of the natural area are of the Emporia complex. Emporia complex consists of deep, moderately to steeply sloped, well-drained sandy loams formed over ancient shell deposits (marl). The steep slopes and calcareous chemistry of Emporia complex soils greatly influence the vegetation growing in them. Erosion hazard is very high with this soil type.

Historic land uses in the natural area were predominantly agriculture (crops and pasture) and silvaculture. Most of the natural area is now within York River State Park. Current land uses include hiking, horseback riding, bicycle riding, and hunting. The natural area is surrounded by a rural landscape that is being quickly converted into residential developments.

NATURAL HERITAGE RESOURCES: Taskinas Creek Natural Area contains two populations of the **Florida adder's-mouth**. Florida adder's-mouth, an inconspicuous herbaceous plant in the orchid family, is very rare in Virginia occurring in only 6 counties on the coastal plain of the state. The species is rare to uncommon throughout its range: Virginia south to Florida.

The fragile Florida adder's-mouth grows two to eight inches tall and sprouts one or two oval leaves from a bulbous base. This perennial species bears a few to many small flowers with orange "lips" on a central stalk in middle to late summer. Florida adder's-mouth is a plant of moist soils and is usually found along streambanks, swamp margins, or wet mossy areas in Virginia. The adder's-mouth is a shade species. In addition to direct habitat loss from conversion of land to other uses, clearing, erosion, sedimentation, and hydrologic disturbance may significantly degrade Florida adder's-mouth habitat.

Florida adder's-mouth was first discovered at Taskinas Creek Natural Area in 1990 and also was documented there in 1991 and 1992. One population of the adder's-mouth grows at the northwest end of the natural area and is in good to excellent condition. During a 1990 survey, 236 plants were found along the streambank

and floodplain at this site. Most of the watershed in which this population is found is still forested. The other population of the rare orchid, in the southeast part of the natural area, is in fair condition. This population is smaller (42 plants were counted in 1990) and close to the parking lot and visitor center of the state park. A heavily used trail crosses the ravine in which the plants occur only a short distance upslope from the plant stations. The trail has lead to erosion and sedimentation of the rare plant habitat below it. Additionally, because of this site's proximity to open areas, Japanese honeysuckle has found its way into the rare plant habitat. Japanese honeysuckle is an invasive species that could destroy the rare plant population.

A population of the **mountain camellia** occurs in the central section of the natural area. The population is in good to excellent condition; twenty-two plants were counted over a large area in 1990 and the species was found again at the site in 1991 and 1992.

Mountain camellia is a deciduous shrub in the tea family. White flowers bloom among its oval leaves in early to middle summer; its fruits are woody, nut-like capsules. Mountain camellia is somewhat uncommon throughout its range which is from Virginia south to Georgia and west to Alabama, Tennessee, and Kentucky. The species is very rare in Virginia, occurring in five counties. As the name implies, mountain camellia usually is found in mountainous regions, but also is found on the coastal plain where steep slopes and marl-influenced soils mimic mountain conditions. This phenomenon found in many of the rare plants of the Lower Peninsula is called a mountain-coastal plain disjunction. On the Lower Peninsula, the mountain camellia occurs on dry marl-influenced slopes with a westerly to southerly aspect. Normally, these slopes overlook rivers, marshes, or lakes. The species is sensitive to alterations of its habitat through development, logging, or similar activities. The soil types in which mountain camellia are found on the Lower Peninsula are highly susceptible to erosion. Loss of individuals from direct damage or disturbance can also threaten a population.

PRIMARY ECOLOGICAL BOUNDARY: In the case of the Florida adder's-mouth, the primary boundary is designed to include the streambanks, floodplains, and swamp margins in the vicinity of the known plant stations. The primary boundary around the mountain camellia population includes the slopes upon which the rare plants grow and all south and west facing marl-influenced slopes adjacent to the known camellia sites.

SECONDARY ECOLOGICAL BOUNDARY: The secondary boundaries at this natural area are generally designed along the height-of-land (drainage divide) around the primary boundaries. This boundary protects the quality of the surface water influencing the rare plants, prevents erosion and sedimentation of the rare species habitats, and buffers the area within the primary boundary from habitat alterations that may impact the rare plant populations.

The secondary boundary is also extended to include the marshes of Taskinas Creek. This prevents impoundment, ditching, or filling of the marsh which would possibly affect the rare plant habitats.

OWNERSHIP AND ZONING: Most of the natural area is owned and managed by the Virginia Department of Conservation and Recreation as York River State Park. The northwestern portion of the natural area is in private ownership. Most of this section is owned by a large development company. Part of one residential tract also falls within the secondary boundary there.

All of the land within the natural area is mapped as a general agricultural zone. The James City County government technically has no authority, however, to regulate land use on the state-owned portion of the natural area.

PRIMARY ACREAGE: 100 acres

SECONDARY ACREAGE: 300 acres

PROTECTION RECOMMENDATIONS: The wetlands in the natural area, which include some of the Florida adder's-mouth habitat, receive some regulatory protection under the Federal Clean Water Act and similar state and local tidal wetland laws which regulates the alteration of wetlands. The fact that most of the natural area is in a state park will help protect the natural heritage resources from development pressures. Taskinas Creek has also been designated as a National Estuarine Research Reserve. This designation recognizes the environmental significance and sensitivity of the wetland and encourages its preservation and use for education and research.

The portion of the natural area occurring on York River State Park is already fairly well protected through ownership of a natural resource management agency. Designation of Taskinas Creek as a National Estuarine Research Reserve provides additional indirect protection to a portion of the natural area. Some form of permanent protection which specifically recognizes the natural heritage resources of the site is desirable. Natural area dedication of the state-owned portions of the site may be one possible option. The owners of the private lands in the northwestern edge of the natural area should also be approached regarding protection of the appropriate parts of their tracts.

STEWARDSHIP RECOMMENDATIONS: Land disturbing activities such as physical development, timber cutting, ditching, and road and utility construction should be restricted from within the natural area. Activities such as hunting, hiking, and nature observation are generally compatible uses within the natural area. The Florida adder's-mouth is sensitive to trampling, however, and pedestrian and other traffic through the habitats of this species should be discouraged. Since collection can be a threat to rare plant species, the precise location of the rare plants should be kept confidential. Bicycle and horseback riding can be allowed within the natural area as long as the activities are restricted

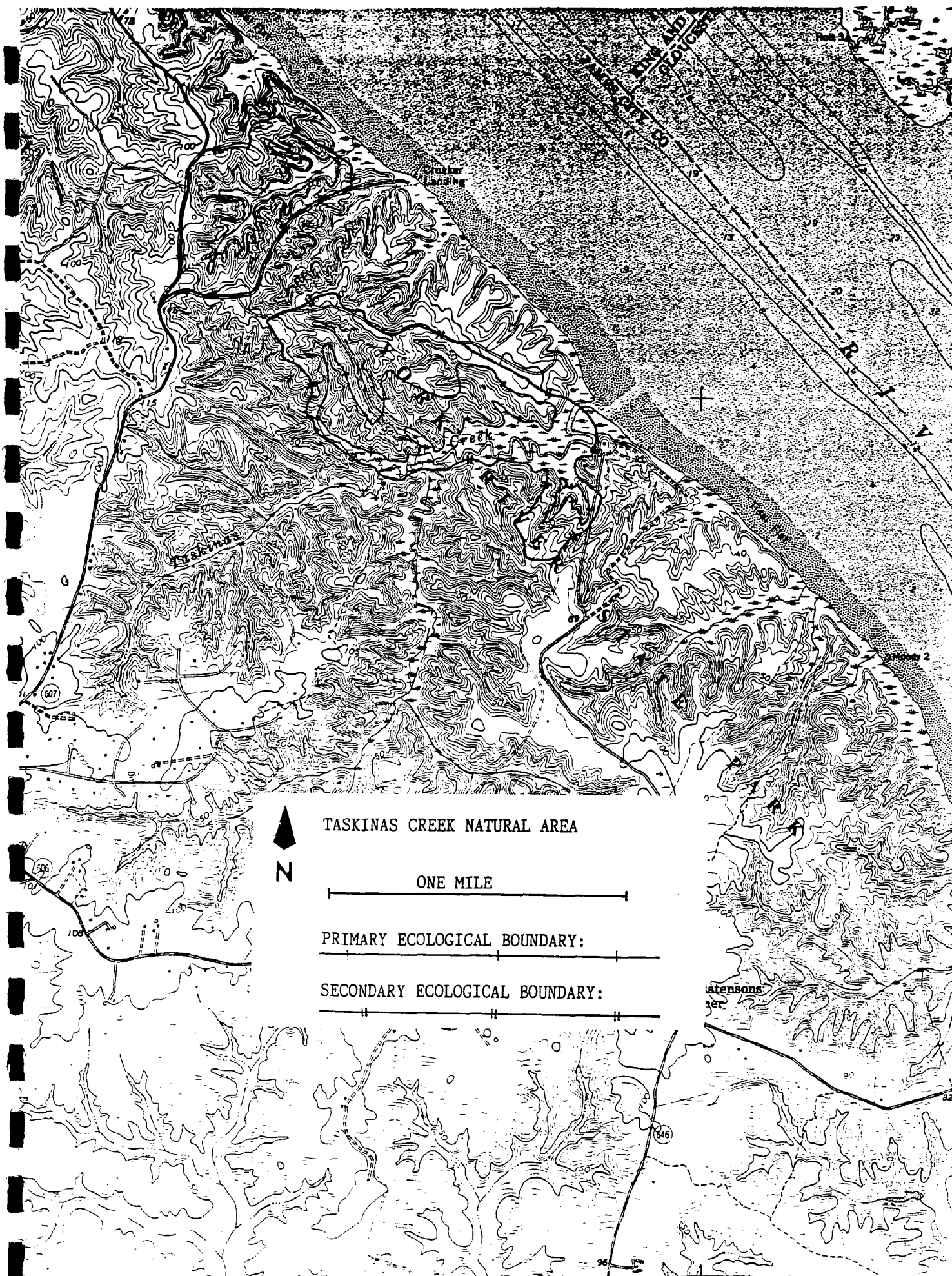
to well constructed trails that minimize erosion and do not adversely affect the rare plant habitats.

It is recommended that the trail upslope of the smaller Florida adder's-mouth population be moved. The existing trail is causing erosion and sedimentation problems in the rare plant habitat and provides unwanted pedestrian access to this sensitive area. If the trail can be rerouted at least one hundred feet upslope of the existing alignment and is constructed in such a manner as to minimize erosion, it will have little impact on the rare plant population. The old trail bed should be planted with species native to the area. The parking area for horse trailers is just upslope (to the south) of the smaller Florida adder's-mouth population. The addition of a vegetated buffer strip past the top of the slope is desirable.

The rare plant sites should be monitored annually for population size and status. One visit per year during the fruiting period for each species should collect information of population size and vigor, evidence of reproduction, and threats. The rare plant habitats should also be searched for potentially invasive species during these visits. Any plants or animals that aggressively threaten the viability of the rare plant populations should be controlled using environmentally sensitive techniques. Japanese honeysuckle may be threatening the smaller Florida adder's-mouth population and should be monitored closely there. Staff of the York River State Park should conduct these monitoring activities under the guidance of Department of Conservation and Recreation stewardship staff.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS:

Recreational recommendations will be made for this site in conjunction with the York River State Park Management plan. Visual assessments from the park may also be incorporated into the State Park management recommendations.



YARMOUTH CREEK

SIZE: 3790 acres

BIODIVERSITY RANK: B3

LOCATION: James City County
Norge quadrangle

GENERAL DESCRIPTION: Yarmouth Creek Natural Area features a large tidal freshwater marsh on the Chickahominy River. Three large islands are included in the marsh. The marsh and its associated woodlands harbor two rare animal species and three rare plant species. The marsh is dominated by wild rice, pickerelweed, and a variety of other herbaceous species. The islands and surrounding low uplands are forested with mixed pines and hardwoods. Loblolly pine, Virginia pine, white oak, water oak, red maple, and sweetgum dominant the forest canopy. The natural area also includes parts of a forested ravine system dominated by dry-site hardwoods such as southern red oak.

Soils in the marsh consist of Levy silty clay, a deep, nearly level, very poorly drained, strongly acidic, regularly inundated soil type. Soils on the islands and surrounding low uplands include several types of alluvial sandy loams such as Seabrook loamy fine sand, Nimmo fine sandy loam, and Bojac sandy loam. The ravine slopes contain the Emporia complex. Emporia complex is a group of intermixed, well-drained, highly erodible soil types found on steep ravine slopes over underlying deposits of ancient shells.

Almost all of Yarmouth Creek Natural Area is covered with either marsh or woodland vegetation. Silviculture is the principle use of the forested parts of the natural area and there are indications that forest management was a predominant land use within the natural area in the past. Although little active agriculture takes place within the natural area today, remnants of cropfields indicate farming took place on portions of the natural area historically. The lands and waters within the natural area have been used extensively for fishing and hunting which continue to be major activities in the natural area along with recreational boating. The landscape immediately surrounding the natural area is mostly forested with some agriculture and rural residences. Major residential developments have recently been constructed east of the site and development pressures in the county are increasing.

NATURAL HERITAGE RESOURCES: Yarmouth Creek Natural Area contains a highly significant tidal freshwater marsh, a rare natural community. The extensive size and near pristine condition of this marsh makes it an outstanding example of this natural community type.

Tidal freshwater marshes occur in the narrow range where estuarine salinities are very low but the rivers and creeks are

still tidal. Although characterized by low salinity levels, salt concentrations in freshwater tidal areas may vary over time due to changing wind, temperature, and precipitation conditions. Because of the fluctuating salinity levels, freshwater marshes are usually identified by their plant composition. Cattails, sweet flag, wild rice, rice cutgrass, arrow arum, pickerelweed, and broad-leaved arrow-head distinguish freshwater marshes in Virginia from more saline marshes. The streams and channels that meander through the marsh are also an essential part of the natural community. The creeks are ecologically linked to the marshes by a common medium, water, and support important areas of submerged aquatic vegetation.

Healthy freshwater marshes and creeks furnish many ecological benefits. Marshes enhance water quality, help contain floodwaters, buffer against shoreline erosion, produce large amounts of nutrients and energy, and provide habitats for a vast array of vertebrates and invertebrates. Tidal freshwater creeks rich in submerged aquatic vegetation provide spawning and nursery areas for fish and other aquatic animals and food for wintering waterfowl.

A very rare plant species, the sensitive joint-vetch, was first documented in marshes of Yarmouth Creek in 1984. This species of the legume family is considered very rare throughout its range which historically included the Atlantic Coastal Plain of Pennsylvania, New Jersey, Delaware, Maryland, Virginia, and North Carolina. Sensitive joint-vetch no longer occurs in Pennsylvania or Delaware. Virginia is a stronghold for the species: it occurs at 30 sites in 9 counties in the Commonwealth. Sensitive joint-vetch is listed as a threatened species under the Federal Endangered Species Act and has been proposed for listing under the Virginia Endangered Plant and Insect Act.

Sensitive joint-vetch is an annual, herbaceous plant that can grow up to six feet tall. The plants have compound leaves and small yellow flowers bloom from lateral branches. Sensitive joint-vetch occurs almost exclusively in tidal freshwater marshes. Populations are sensitive to degradation of water quality and to alterations in the hydrologic regime. Large fluctuations in population size from year to year are common. The population of joint-vetch at Yarmouth Creek Natural Area is in good to fair condition; the known population is relatively small at present, but unoccupied habitat is extensive.

Yellow cowlily is an of aquatic plant in the water-lily family. Yellow cowlilys are rooted in creek and river bottoms and their elongated leaves float at the water's surface. The showy yellowish to green flowers bloom through the spring and summer. Yellow cowlily often grows in deep, mid-channel waters. In addition to being sensitive to degradation of water quality and disturbance of the hydrologic regime, the plant's habit of growing in open water makes it very vulnerable to direct damage from boat traffic.

Yellow cowlily is rare throughout its range, the coastal regions of Virginia, North Carolina, and South Carolina, and extremely rare in Virginia. The subspecies occurs at only seven sites in the Commonwealth, all of which are in three counties along the tidal portion of the Chickahominy River. The population at Yarmouth Creek Natural Area is small and occurs in Shipyard Creek, a tidal tributary to the Chickahominy River.

A small population of **blueflag** grows along the marsh edge of one of the islands in the natural area. Blueflag is very rare in Virginia; the species is found at only eleven sites in eight counties of the Commonwealth. This member of the iris family is at the southern edge of its range in Virginia and is much more common in other parts of its range further north.

Blueflag ranges from 8 inches to almost three feet in height. The plants have long narrow leaves and bear purple or blue flowers in the spring. Blueflag normally occupies wetland habitats such as marshes and swamps and is therefore vulnerable to degradation of water quality and to disturbance of the hydrologic regime. Although the population at Yarmouth Creek is small, it is in good condition.

At least three **bald eagle** nest sites have been documented from the Yarmouth Creek Natural Area within the last decade. Although bald eagles normally mate for life and usually nest in the same area each year, mated pairs may use two or more alternate nest sites in the same area from year to year. Since no two of the nest sites at Yarmouth Creek have been active during the same year at Yarmouth Creek, the three nests probably represent alternate nest sites for a single mated pair. Bald eagles are the largest species of raptor (birds-of-prey) found in Virginia and require large areas of habitat because of their size. In addition to extensive forested areas for nesting and roosting habitat, bald eagles also require substantial stretches of wooded shoreline for foraging habitat. Although different pairs of eagles show different levels of sensitivity to human activity, all bald eagles are vulnerable to human disturbance, especially if normal human activity patterns to which eagles have habituated are suddenly changed or increased. Visual screening from human activity is critical to bald eagle reproductive success.

Bald eagles are rare throughout most of their range, including Virginia. The species is listed as endangered by both the Federal and Virginia Endangered Species Acts. Although bald eagle populations have made a substantial recovery since the ban on the use of certain persistent pesticides in the United States, the species is now even more threatened by habitat loss and human disturbance.

The **eastern pondmussel** has been found from the reaches of Yarmouth Creek just downstream of Cranstons Pond. The eastern pondmussel is a member of a freshwater mussel family (Unionidae) that is one of the most imperiled animal groups on Earth. Although this species is not critically imperilled at this time,

eastern pondmussels are rare in Virginia and are becoming more uncommon in other parts of their range. Freshwater mussels live in the bottoms of rivers and streams and filter food from the water. Accordingly, freshwater mussels are extremely sensitive to water quality degradation. Impoundment of moving water habitats and competition with exotic species (particularly the zebra mussel and the Asiatic clam) further threaten the future of this family.

Eastern pondmussels have been documented at Yarmouth Creek through the discovery of a single individual. Although the habitat appears degraded, it is recoverable, and additional searches of Yarmouth Creek and its tributaries may reveal more eastern pondmussels in the natural area.

PRIMARY ECOLOGICAL BOUNDARY: Because all of the rare plant species are associated with the marsh or the creeks, the primary boundary designed around the exemplary marsh community also encompasses the rare plant occurrences. The primary boundary is also designed to include forested habitat around each of the three bald eagle nest sites as well as some forested shoreline to serve as foraging habitat. The primary boundary extends up Yarmouth Creek far enough to include all contiguous streambottom habitat for the eastern pondmussel.

SECONDARY ECOLOGICAL BOUNDARY: The secondary boundary provides a forested buffer to the freshwater marsh and its rare plant species, the rare mussel habitat, and to the bald eagle habitat. In many sections of the natural area, these two buffers overlap and the single buffer zone serves both purposes.

The primary purpose of the buffer around the marsh is to protect the water quality and hydrologic regime of the marsh and its creeks. There has been an enormous amount of research regarding the appropriate width of wetland buffering strips. Widths ranging from 50 feet to 330 feet have been recommended based on the various data. The only point the immense body of literature on the subject has emphasized is that there is really no single equation for buffer strip width that applies to every situation. Given the high erodibility of the soil types surrounding the wetlands and the extreme sensitivity and significance of the natural heritage resources, 330 feet was chosen as the appropriate width for the forested buffer strip for the wetlands of this natural area. A 330 foot buffer strip was also designed around swamps and both perennial and intermittent streams which feed into the marsh. Since those tributaries communicate directly with the core area, their water quality is also a concern for protection. Where the height-of-land (drainage divide) occurs closer than 330 feet to the edge of the wetlands or water course, the secondary boundary runs along the drainage divide. The secondary boundary was also extended 330 feet into the Chickahominy River where the river is adjacent to the marsh for stewardship reasons.

The 330 foot wide buffer zones indicated by the secondary boundary also protect the water quality and quantity of the rare mussel habitat.

Like wetland buffers, substantial research has been conducted regarding the appropriate width of buffer zones intended to shelter eagles from human activity. Various research projects have indicated from 330 feet up to 1/4 mile is necessary to adequately screen eagles from disturbance. The width of the buffer depends on the sensitivity of the eagle to human activity, the type of the activity, and whether the buffer zone is open or has dense, screening vegetation. Because current activities in the natural area appear to be generally compatible with nesting bald eagles and the shorelines are forested, a 330 foot wide buffer is designed around eagle habitat in the natural area. Further study or a change in land and water use patterns may indicate a need for wider buffers.

A very small portion of Yarmouth Creek Natural Area's secondary boundary overlaps with Shield's Point Natural Area's secondary boundary.

OWNERSHIP AND ZONING: Yarmouth Creek Natural Area is entirely within private ownership. The natural area includes parts or all of 35 tracts. Five of those tracts are more than 500 acres in size; the largest is 1320 acres. Most of the large tracts are controlled by hunt clubs or a timber company. The tidal creeks associated with the marsh are classified as "waters of the state" and may therefore be considered in public ownership.

Almost all of the natural area is zoned general agricultural. The remainder is zoned for residential development.

PROTECTION RECOMMENDATIONS: The freshwater marsh and its creeks and channels are afforded some protection by the Federal Clean Water Act and similar state and local tidal wetland laws and the James City County Chesapeake Bay Preservation Ordinance. The Clean Water Act regulates alteration of wetlands and the Chesapeake Bay Ordinance provides a 100 foot buffer around the edge of wetlands and watercourses of the Bay; most types of development are restricted from within the 100 foot buffer zone. Although sensitive joint-vetch is a federally threatened species, the Endangered Species Act provides the Yarmouth Creek population with little protection from direct harm because it is a plant growing on private land (animals receive stronger protection). The Act does provide some indirect protection to the plants through funds that may be available for research or acquisition of habitat and the presence of a federally listed wetland species would have some bearing on any permit applications for alteration of the Yarmouth Creek marsh. The bald eagle is also listed at the federal level and by the state government. Unlike the situation for plants, listed animals are provided certain protection from direct harm under the Federal Endangered Species Acts even on private property. Bald eagles also enjoy the same potential for indirect benefits from the Act.

Because laws and their interpretation can change, additional protection for the area within the primary boundary is recommended. Most of the primary boundary is controlled by hunt clubs or a timber company who already manage the site to some extent for its natural resource value. Natural area registry along with formal management agreements with those organizations would facilitate continued use of the tracts for hunting, fishing, and forestry while assuring the long-term preservation of the natural heritage resources. Although the Department of Conservation and Recreation will be pleased to work out the details of the management agreements regarding the tidal freshwater marsh and the rare plant species, the Virginia Department of Game and Inland Fisheries, Virginia's primary regulatory and management authority over endangered animal species, should be involved in the formulation of management agreements pertaining to the bald eagles.

Lands within the secondary boundaries receive some protection from the Chesapeake Bay Act as described above, but more complete protection is desirable. Management agreements would be the easiest protection tool to implement on the buffer zones, although perpetual conservation easements would be more permanent and binding.

PRIMARY ACREAGE: 2530 acres

SECONDARY ACREAGE: 1270 acres

STEWARDSHIP RECOMMENDATIONS: Most of the stewardship necessary for the long-term viability of the natural area would be set forth in the management agreements among the Department of Conservation and Recreation, the Department of Game and Inland Fisheries, and the landowners, but some general guidelines can be stated here. The construction of new physical developments such as residential housing and boat piers should be restricted from within the natural area boundaries. Activities that would degrade the water quality or alter the hydrologic regime of the marsh such as land-clearing, wastewater discharge, ditching, filling, impounding, and withdrawal of large amounts of surface or groundwater should be prohibited from within the natural area. Hunting, fishing, canoeing, and certain forest management practices are generally compatible with the natural heritage resources of Yarmouth Creek, but these activities should be conducted with a high degree of environmental sensitivity. Details as to the places, times, and methods appropriate for those activities, especially timber harvest, should be addressed in the management agreements. The use of off-road vehicles within the natural area should be discouraged, except as provided for in the management agreements.

Yarmouth Creek Natural Area is subject to a moderate amount of motorized boat traffic. Studies in the Chesapeake Bay area of Maryland have indicated that operation of motorboats in tidal creeks can have adverse effects on marshes, shores, creek bottoms, and water quality. The disturbance and resuspension of

bottom sediments through the turbulence produced by boat propellers, damage to marshes, shorelines, and submerged aquatic vegetation, and the release of sewage and toxic compounds are problems associated with motorboat traffic in these sensitive areas. Similar studies have not been conducted in the Lower Peninsula project area. Because of the large number of variables involved, such as amount and speed of boat traffic, hull sizes and shapes, creek widths and depths, and amount of natural (wind-generated) wave action, results documented from one specific site cannot be inferred to be the situation at another site. For this reason, the establishment of a research program to determine the effects, if any, of motorboat traffic in this and the other Chickahominy River natural areas is recommended. The Shoreline Erosion Advisory Service of the Virginia Department of Conservation and Recreation or the Virginia Institute of Marine Science may be willing to lead the research effort. Funding for such a study may be available from the Coastal Zone Management program. Appropriate actions for the preservation of the tidal marsh and creek ecosystems should be instituted based on the results of the study.

Further inventory for the eastern pondmussel is necessary to determine the status and conservation needs of that species at Yarmouth Creek Natural Area. Department of Conservation and Recreation scientists are qualified to conduct such work.

The yellow cowlily colony in the natural area may be damaged by motorboats passing through it. Steps to help abate motorboat damage to the yellow cowlily populations would greatly enhance their long-term viability. Preventative measures could include posting of educational signs at area marinas and boat ramps or possibly in or near yellow cowlily colonies themselves. The signs could provide a description of the plant, explain its sensitivity and significance, and request boaters to voluntarily navigate around, rather than through, cowlily colonies.

All of the natural heritage resources should be monitored. The tidal freshwater marsh should be monitored regularly. Several permanent sampling plots should be established in random locations in the marsh. In each sampling plot, species composition and relative abundances should be measured at least once every five years during the late growing season. Water quality and soil composition factors should also be recorded on these visits. Such a biological monitoring program will not only provide insight as to the structure and function of this exemplary wetland community, but also sound early warnings to adverse changes in the ecology of the marsh from such threats as invasive species (especially common reedgrass), hydrologic disturbance, or water pollution. The rare plant populations should also be monitored; normally at least one visit each year is required to monitor plant populations status. The population size and vigor, evidence of reproduction, and condition of and threats to the rare plants' habitat should be documented during each visit. Searches for invasive species should also be conducted during the rare plant monitoring visits. Department of

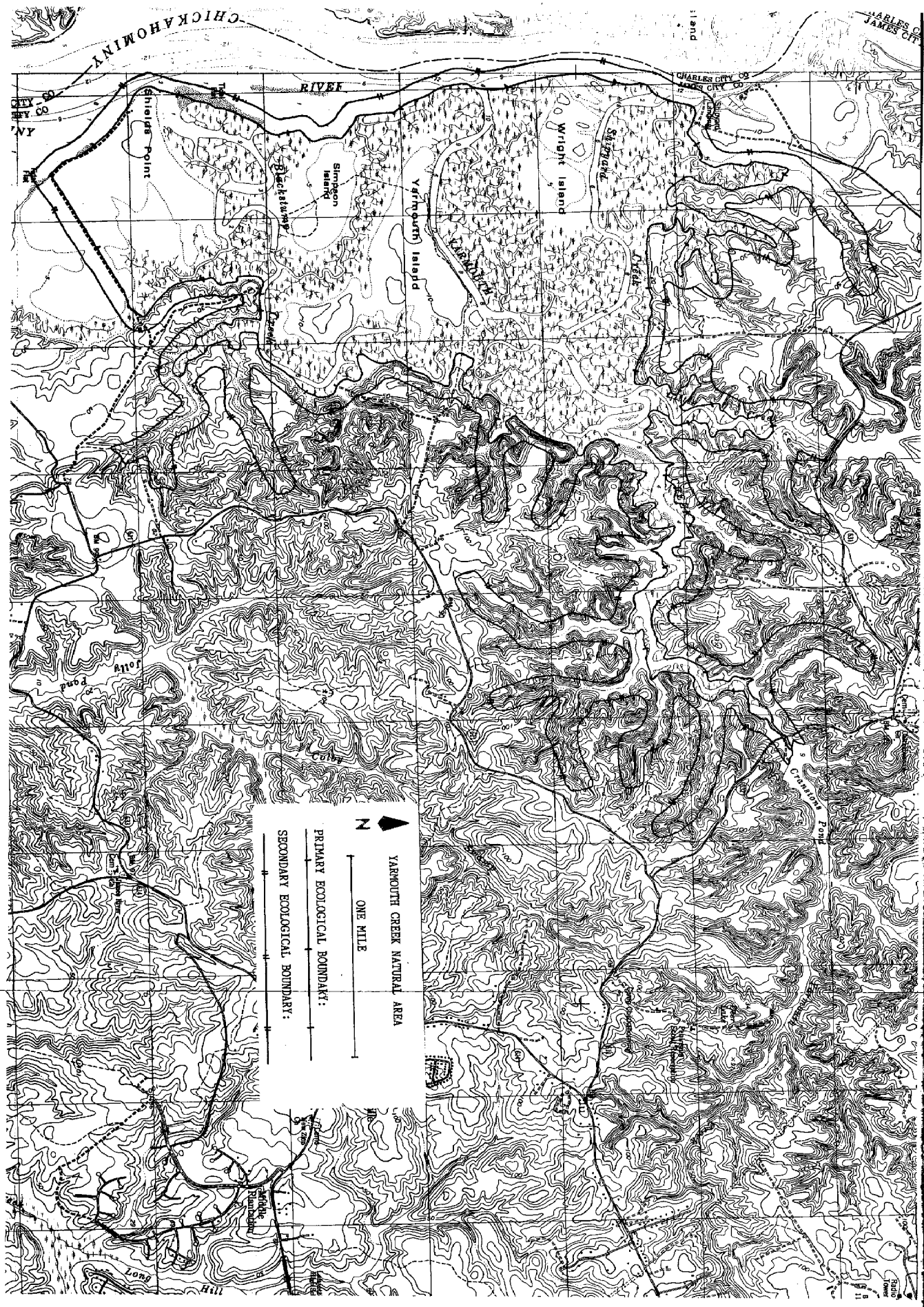
Conservation and Recreation staff scientists are available to assist with the design and implementation of the natural community and rare plant monitoring programs.

Monitoring of bald eagle nest sites and productivity through aerial survey is carried out on a statewide basis by the Nongame and Endangered Species Program of the Virginia Department of Game and Inland Fisheries. Information from the eagle survey can be used to help evaluate and modify the stewardship measures set forth in the management agreements.

Because collection can be a threat to rare plant populations, the precise locations of the rare plant occurrences should be kept confidential.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: This natural area is near Shipyard Landing. Since canoeing is possible from the reservoir to Shipyard Landing, an interpretive trail could be established. This trail would provide educational information on the freshwater marsh.

Yarmouth Creek offers a pristine visual environment. This waterway could be designated a local scenic water resource.



BEAVERDAM CREEK

SIZE: 600 acres

BIODIVERSITY RANK: B4

LOCATION: York County
Yorktown quadrangle

GENERAL DESCRIPTION: Beaverdam Creek Natural Area includes a group of springs, a tributary stream to Beaverdam Creek formed by the springs, and a portion of Beaverdam Creek just north of the Lee Hall Reservoir. The natural area supports two rare plant species, a bird nesting colony, and a rare crustacean.

The entire natural area, save areas of open water, is forested. Forest stands at the site include open swamps in the lower portion of the creek, bottomland hardwoods in the upper part of the creek, and pine or mixed pine and hardwood stands of varying ages on the surrounding uplands. Historic land uses include mostly agriculture and forestry. Several battles of the Revolutionary and Civil Wars were fought in the vicinity and tactical earthworks can still be discerned in some parts of the natural area. Part of the natural area is currently managed as a historical park, the remainder as a local recreational park and timber resource area. Much of the lands within the natural area are disturbed by intensive forestry, beaver activity, and exotic plant species. The surrounding areas are mostly forested with some residential and commercial development to the east and south.

In the lower swamp near the reservoir, soils consist of Levy silty clay. The remaining swamp and bottomlands consist of a series of nearly level, poorly drained silt loams known as the Johnston complex. Soils sloping from the upland plain to the bottomland include Emporia complex and Craven-Uchee complex, a set of highly erodible fine sandy loams. The level upland areas mostly consist of Slagle fine sandy loam with a minor component of Peawick silt loam and Bethra silt loam.

NATURAL HERITAGE RESOURCES: Florida adder's-mouth has been documented from Beaverdam Creek Natural Area through the discovery of a single individual in 1990. Counts of emergent plants can underestimate populations of Florida adder's-mouth because the individuals of this species may remain dormant in the soil as bulbs for extended periods of time. Additional survey may locate more plants in the future, but no plants were found in a 1992 survey of the site.

Florida adder's-mouth, an inconspicuous herbaceous plant in the orchid family, is very rare in Virginia, occurring at only nine sites on six coastal plain counties of the state. The species is rare to uncommon throughout its range: Virginia south to Florida.

The Florida adder's-mouth grows two to six inches tall and sprouts one or two oval leaves from a bulbous base. This perennial species bears a few to many small white flowers with orange "lips" on a central stalk in middle to late summer. Florida adder's-mouth is a plant of moist, shaded soils and is usually found along streambanks, swamp margins, or wet mossy areas. In addition to direct habitat loss from conversion of land to other uses, threats to the species include clearing, erosion, sedimentation, trampling, and hydrologic disturbance.

A large and healthy population of the **northern spring sideswimmer**, a small freshwater crustacean, inhabits headwater springs of Beaverdam Creek. Northern spring sideswimmers are very common throughout the principle portion of their range which includes the Great Lake and east-central states and provinces, but the population at this natural area is the only known site for the species in Virginia. Another population is known to occur at one site in Maryland, but the next closest site for the northern spring sideswimmer is in central New York. The population at Beaverdam Creek was first "discovered" in 1990 during the York County Natural Areas Inventory, but subsequent consultation with the zoological specimens of the Smithsonian Natural History Museum indicated that the species had been collected from this site historically. The severely disjunct nature of the Beaverdam Creek occurrence makes the natural area's population highly biologically significant and possibly genetically distinct from populations in the main part of the species' range.

Sideswimmers resemble small shrimp in appearance and usually feed on detritus (dead animal and plant matter). Northern spring sideswimmers typically inhabit springs, seeps, and small, cool streams. Because the species is aquatic and a detritus feeder, it is very sensitive to water quality and its presence is considered an indicator of unpolluted water. Sideswimmers are also vulnerable to alterations in the hydrologic regime and alterations of the surrounding habitat. For example, clearing of land around the springs would result in warmer water temperatures, less detritus upon which to feed, and increased sedimentation and nutrients in the spring.

Spanish moss is a common plant in southeastern North America and into Central and South America. A small population of Spanish moss has been documented in the natural area. The species is at the northern edge of its range in southeastern Virginia. Historic references indicate the species' range may have formerly extended north into Maryland. Spanish moss is known from only nine sites in four southeastern Virginia counties. The species is considered very rare in the Commonwealth not only because of the few number of locations for it, but also due to its very limited distribution in the state.

Spanish moss is a pale stringy plant of the pineapple family which grows in clumps on the branches and leaves of trees in wet areas. In addition to the destruction of host trees, Spanish

moss is also threatened by alteration of its habitat and collecting.

One of the largest heron nesting colonies in Virginia occurs at Beaverdam Creek Natural Area. The colony supports up to 500 nests each year of great blue herons and great egrets, the two largest waterbirds found in the Commonwealth. Colonial nesting birds "put all their eggs into one basket" by packing large numbers of reproductive birds into a few, small areas. This makes entire populations vulnerable to a single disturbance. Herons are very sensitive to activity around their nesting sites, especially during the courtship and nestbuilding stages. Disturbance of the heron colony by such activities as construction, off-road vehicles, or even pedestrians can cause nesting failure and desertion of the colony. The colonial breeding behavior of the species and the decline of the wetland habitats used for nesting make both species biologically significant and sensitive.

In addition to the trees currently used for nests, heron colonies require additional habitat around the nest sites for resting perches and colony expansion. Adult birds also require large areas of wetland habitat for foraging.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary around the Florida adder's-mouth includes the location of the known plant plus a small amount of contiguous suitable habitat that may support the species. The springs which support the northern spring sideswimmer are encompassed by that species' primary boundary. In addition to including the nesting colony itself, the primary boundary for the herons is also designed to include a small amount of additional habitat around the colony for resting perches and colony expansion and a substantial wetland area for foraging. The spanish moss habitat is included within the heron foraging habitat.

SECONDARY ECOLOGICAL BOUNDARY: The secondary boundary around the Florida adder's-mouth is designed to buffer the water quality and quantity of the species' habitat. Areas of probable groundwater recharge are included in the buffer zone as well as sufficient forested strips along the rare plant habitat to protect the surface water from sedimentation and nutrient loading. Because it is a groundwater dependant species, the secondary boundary around the northern spring sideswimmer also surrounds the probable groundwater recharge zones for the springs. As our understanding of the groundwater system of this area increases, the secondary ecological boundary may need to be altered appropriately. The sideswimmer's secondary boundary also includes a forested buffer zone around the immediate vicinity of the springs to protect the sideswimmer population from habitat alteration.

The secondary boundary around the heron nesting colony generally follows the primary boundary at a distance of 1000 feet. The purpose of the 1000 foot zone is to buffer the heron colony from

visual and noise disturbances. A narrower forested buffer zone, 100 feet wide, surrounds the heron foraging habitat. In addition to partially screening the foraging herons from human activities, the 100 foot wide buffer zone will also help to protect the water quality of the wetland habitat upon which the herons depend. A similar small buffer zone is necessary around the Spanish moss's primary boundary to protect it from habitat alteration caused by conversion of surrounding lands to other uses. The secondary boundary around the heron foraging habitat delineates the buffer zone for the Spanish moss as well.

OWNERSHIP AND ZONING: Beaverdam Creek Natural Area is entirely in public ownership. Parts of two tracts are included in the natural area; one tract is owned by the City of Newport News Waterworks Department, the other by the National Park Service.

The city owned property is zoned "residential conservation" which allows agriculture, forestry, and a limited amount of residential development. The city property is currently managed for recreation, timber, and public water supply. The York County government does not have authority to control land use on the federally owned property.

PRIMARY ACREAGE: 100 acres

SECONDARY ACREAGE: 500 acres

PROTECTION RECOMMENDATIONS: Beaverdam Creek Natural Area is already fairly well protected through its ownership by two public agencies which manage the property to some degree for its natural resources. The great blue herons, great egrets, and their nest trees are protected from direct destruction or disturbance by the Migratory Bird Treaty Act. The wetland habitats within the natural area also receive some protection from the Federal Clean Water Act which regulates the alteration of wetlands.

A management agreement among the County of York, the City of Newport News, the National Park Service, the Virginia Department of Game and Inland Fisheries (because of the heron colony), and the Department of Conservation and Recreation should be negotiated. In the guise of a formal Memorandum of Understanding, the management agreement should outline land use practices and ecological management and monitoring in the natural area for the long-term viability of its natural heritage resources.

STEWARDSHIP RECOMMENDATIONS: Details as to the land uses which are and are not compatible within the natural area should be established in the management agreement. Generally, lands within the primary boundaries should be left undisturbed and access discouraged (except on the existing nature trail of the local park which crosses through the heron foraging habitat). Lands between the secondary and primary boundary can continue to be used for certain types of environmentally sensitive forest management, recreational, and educational activities, but

seasonal restrictions may apply to the buffer zone around the heron colony. Wastewater discharge should not be permitted within the natural area. Septic systems should not be allowed until hydrological research indicates they will not contaminate the site's groundwater.

Additional inventory should be conducted over the next several years for Florida adder's-mouth and Spanish moss in order to determine the true status of these rare species in the natural area. Research on the groundwater flow patterns in the area would allow more precise refinement of the secondary boundaries for the sideswimmer and adder's-mouth. Studies to determine the actual foraging areas of the herons are needed to insure that the current heron primary boundary includes sufficient foraging habitat for the colony. Genetic research should be conducted on the Beaverdam Creek population of northern spring sideswimmers to determine its genetic distinctiveness or similarity to other populations of the species.

The nesting colony should be monitored at least annually for numbers of individuals, numbers of active nests, and numbers of eggs and young. It is best to check the colony two or more times during the reproductive season to get the most accurate assessment of the colony's status and reproductive success. Because of limiting resources, however, more than one visit is not always possible. Great care should be taken to minimize disturbance to the nesting herons while conducting monitoring activities. The best monitoring technique for collecting the most accurate data while causing the least disturbance is through aerial survey. Researchers from the College of William and Mary and the Virginia Nongame and Endangered Species Program routinely monitor heron nesting colonies in Virginia. This colony has been and probably will be included in their aerial surveys, although lack of financial resources are ever a threat to the statewide monitoring program.

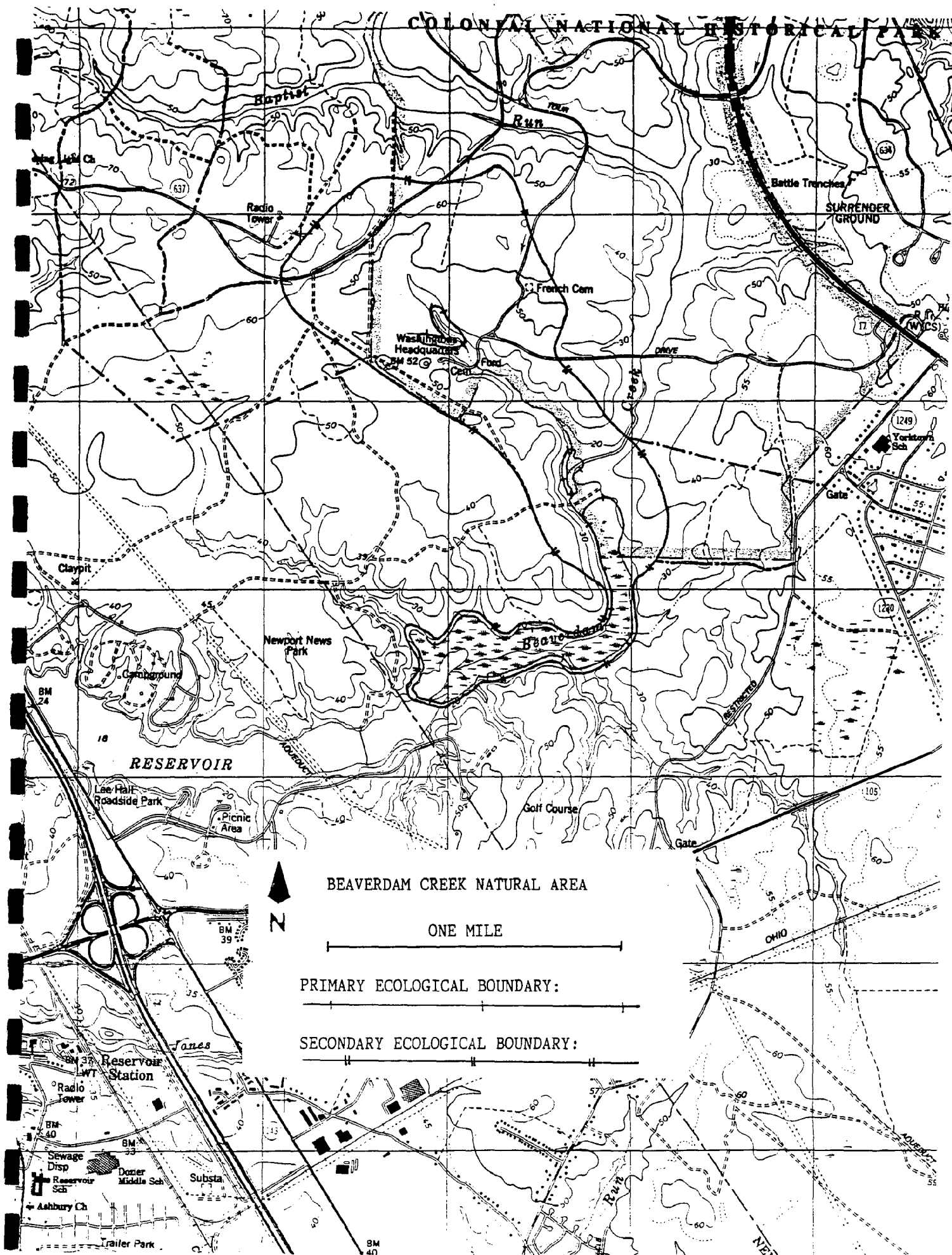
The population of northern spring sideswimmers should also be monitored. Department of Conservation and Recreation scientists are available to conduct or coordinate this monitoring effort.

Several problem species may threaten the natural area. Millet grass, an exotic wetland plant ubiquitous at the site, has already invaded some parts of the natural area to the degree of displacing all other native herbaceous plant species. White-tailed deer are abundant and, if the species becomes overpopulated, may damage rare plant populations either directly by browsing the plants or indirectly by browsing the forest to a degree that habitats are altered. Evidence of beaver is widespread along Beaverdam Creek. Through their impressive engineering activities, beaver could damage rare plant populations by flooding habitat or by altering habitat from tree-felling. These and other problem species should be carefully monitored at the natural area. If any problem species are determined to be threatening the viability of the natural heritage resources of the site, the problem species should be

suppressed or controlled using environmentally sensitive techniques.

Because collection can be a threat to rare plant populations, the precise locations of the rare plant occurrences should be kept confidential.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: The Beaverdam Creek site encompasses portions of the Colonial National Historical Park and Newport News Park. Existing boardwalks and trails could be enhanced through the installation of interpretive exhibits about the site's natural heritage resources. Additional interpretive trails could also be considered. Consideration for making a greenway connection to the Grafton Ponds site for pedestrians and bicyclists would enhance the recreational potential of the area.



BEAVERDAM CREEK NATURAL AREA

ONE MILE

PRIMARY ECOLOGICAL BOUNDARY:

SECONDARY ECOLOGICAL BOUNDARY:

BIG MARSH POINT

SIZE: 310 acres

BIODIVERSITY RANK: B4

LOCATION: James City County
Brandon quadrangle

GENERAL DESCRIPTION: Big Marsh Point is a large rectangular marsh island in the Chickahominy River; a smaller marsh contiguous with the rivershore is adjacent. This natural area harbors an rare natural community type and a population of a rare plant species.

The wetlands are covered with typical tidal freshwater marsh plants and scattered bald cypress trees. Soils in the marsh are Levy silty clay, a deep, level, poorly-drained, regularly flooded, acidic substrate.

Because of its inaccessibility and regular flooding, Big Marsh Point has been used for little other than hunting and fishing in past years. Hunting and fishing, along with recreational boating, continue to be the major activities in and around the site. Much of the surrounding lands are intensively developed with residences, marinas, piers, and bulkheads. The remaining lands are forested and timber management is the principle land use.

NATURAL HERITAGE RESOURCES: Big Marsh Point Natural Area includes a good example of a rare wetland community: a tidal freshwater marsh. Tidal freshwater marshes occur in the narrow range where estuarine salinities are very low but the rivers and creeks are still tidal. Although characterized by low salinity levels, salt concentrations in tidal freshwater areas may vary daily due to changing wind, temperature, and precipitation conditions. Because of the fluctuating salinity levels, freshwater marshes are usually identified by their plant composition. Cattails, wild rice, rice cutgrass, arrow arum, pickerelweed, and broad-leaved arrow-head distinguish freshwater marshes in Virginia from more saline marshes. The streams and channels that meander through the marsh are also an essential part of the natural community. The creeks are ecologically linked to the marshes by a common medium, water, and often support important areas of submerged aquatic vegetation.

Healthy freshwater marshes and creeks furnish many ecological benefits. Marshes enhance water quality, help contain floodwaters, buffer against shoreline erosion, produce large amounts of nutrients and energy, and provide habitats for a vast array of vertebrates and invertebrates. Tidal freshwater creeks rich in submerged aquatic vegetation provide spawning and nursery areas for fish and other aquatic animals and provide food for wintering waterfowl.

Yellow cowlily is rare throughout its range, the coastal regions of Virginia, North Carolina, and South Carolina, and extremely rare in Virginia. The plant occurs at only seven sites in the Commonwealth, all of which are in three counties along the tidal portion of the Chickahominy River. The population at Big Marsh Point is medium-sized and in good condition, but damage to some clumps of the species from motorboats is evident.

Yellow cowlily is an aquatic plant in the water-lily family. Yellow cowlilys are rooted in creek and river bottoms and their elongated leaves float at the water's surface. The showy yellowish to green flowers bloom through the spring and summer. Yellow cowlily often grows in deep, mid-channel waters. In addition to being sensitive to degradation of water quality and disturbance of the hydrologic regime, the plant's habit of growing in open water makes it very vulnerable to direct damage from boat traffic.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary at Big Marsh Point Natural Area includes the tidal freshwater marsh, its associated creeks, channels, and mudflats and the open water habitat where yellow cowlily has been documented.

SECONDARY ECOLOGICAL BOUNDARY: The secondary boundary is coincident with the primary boundary over most of its distance. Where the marsh is contiguous with upland, however, the secondary boundary is extended to the edge of existing development to provide a hydrologic buffer to the marsh. The purpose of the buffer zone is to protect the water quality and quantity flowing from the upland into the marsh.

OWNERSHIP AND ZONING: Big Marsh Point Natural Area is entirely within private ownership. The site includes part or all of three tracts and parts of a few lots in an adjacent subdivision. The large marsh island which represents the majority of the land acreage of the natural area is under single ownership. As "waters of the state," the open water habitats included in the natural area boundary are publicly owned.

Big Marsh Point Natural Area is zoned for agriculture, except for the northern edge of the site which is zoned for residences.

PRIMARY ACREAGE: 290 acres

SECONDARY ACREAGE: 20 acres

PROTECTION RECOMMENDATION: Most of the natural area (all of the site's wetlands) has been designated as Resource Protection Area under the James City County Chesapeake Bay Preservation Ordinance. The Bay Ordinance prohibits most types of physical development within the Resource Protection Areas. All of the marsh and the open water fall under the jurisdiction of the Federal Clean Water Act and similar state and local tidal wetland laws which regulate the draining, dredging, and filling of wetlands. Discharges and water withdrawal within the

Chickahominy River are also regulated by the State Water Control Board and the Virginia Department of Health.

Existing legislation will probably protect the natural area from serious degradation. The site could be placed on the Virginia Registry of Natural Areas, however, and the adjacent subdivision lot owners could be approached regarding a management agreement designed to protect the water quality and quantity entering the natural area from uplands.

STEWARDSHIP RECOMMENDATIONS: Land-disturbing activities such as ditching, filling, and land-clearing should be restricted from within the natural area. Hunting, fishing, canoeing, and nature observation are uses compatible with the natural heritage resources of the site. Wastewater discharge should not be permitted within the natural area.

The Chickahominy River in the vicinity of Big Marsh Point is subject to heavy motorboat traffic from fishing boats, ski boats, pleasure boats, and personal watercraft. Studies in the Chesapeake Bay area of Maryland have indicated that operation of motorboats in tidal creeks can have adverse effects on marshes, shores, creek bottoms, and water quality. The disturbance and resuspension of bottom sediments through the turbulence produced by boat propellers, damage to marshes, shorelines, and submerged aquatic vegetation, and the release of sewage and toxic compounds are problems associated with motorboat traffic in these sensitive areas. Similar studies have not been conducted in the Lower Peninsula project area. Because of the large number of variables involved, such as amount and speed of boat traffic, hull sizes and shapes, creek widths and depths, and amount of natural (wind-generated) wave action, results documented from one specific site cannot be inferred to be the situation at another site. For this reason, the establishment of a research program to determine the effects, if any, of motorboat traffic in this and the other Chickahominy River natural areas is recommended. The Shoreline Erosion Advisory Service of the Virginia Department of Conservation and Recreation or the Virginia Institute of Marine Science may be willing to lead the research effort. Funding for such a study may be available from the Coastal Zone Management program. Appropriate actions for the preservation of the tidal marsh and creek ecosystems should be instituted based on the results of the study.

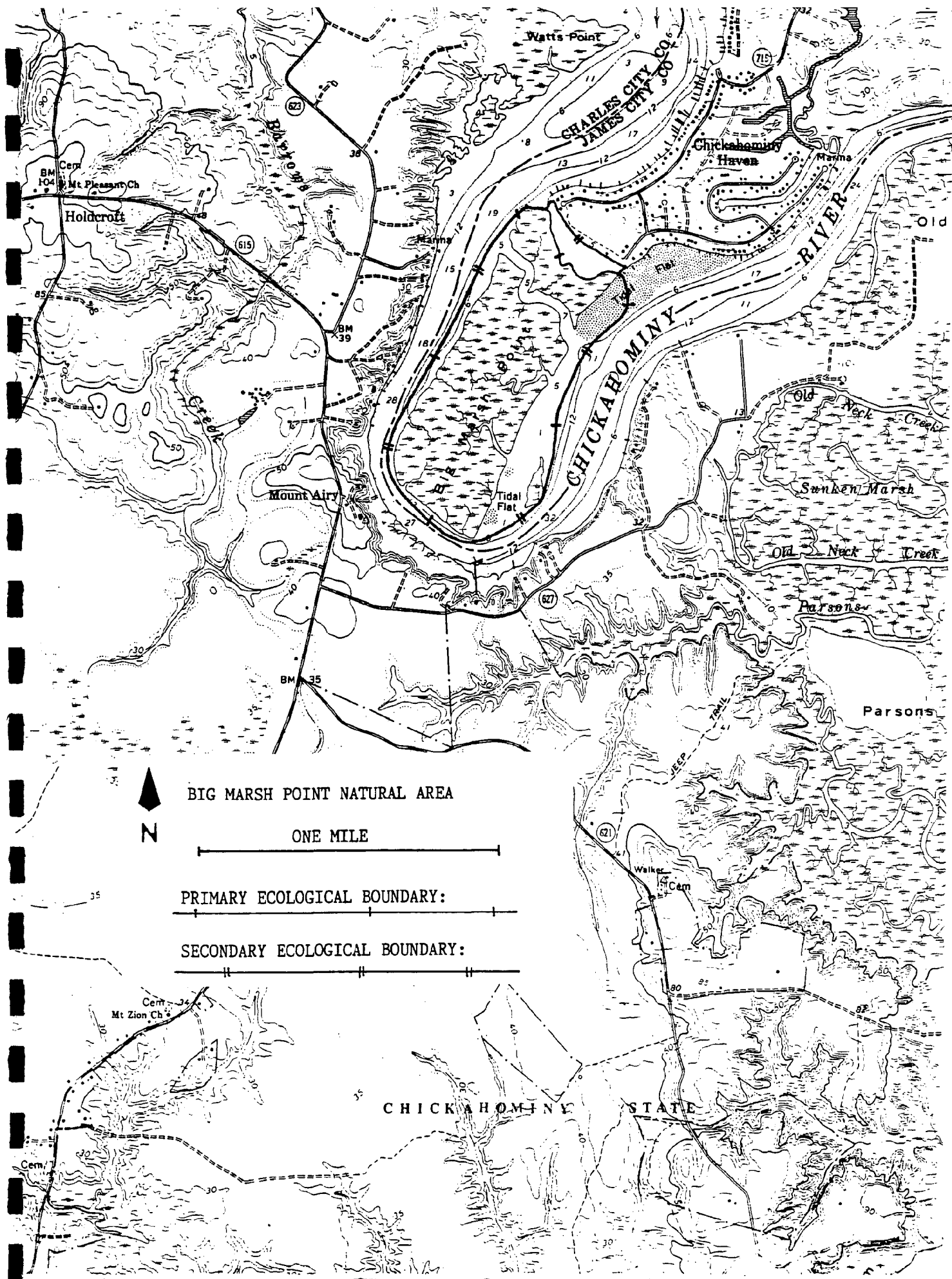
Yellow cowlily colonies in Big Marsh Point Natural Area often show signs of damage from motorboats passing through them. Steps to help abate motorboat damage to the yellow cowlily populations would greatly enhance their long-term viability. Preventative measures could include posting of educational signs at area marinas and boat ramps and possibly in or near yellow cowlily colonies themselves. The signs could provide a description of the plant, explain its sensitivity and significance, and request boaters to voluntarily navigate around, rather than through, the colonies.

The yellow cowlily population should be monitored annually for its size and condition. At least one visit to the site each year during the growing season should be conducted to record numbers and locations of plants as well as evidence of reproduction, disease, or damage. The marsh should be monitored as well. Several permanent sampling plots should be established at random locations within the marsh. In each sampling plot, plant species composition and relative abundances along with water quality and soil composition factors should be measured once every five years at approximately the same time each year. Such monitoring will facilitate early detection of such threats as sea-level rise, aggressive species invasion (especially by common reedgrass), and erosion. Department of Conservation and Recreation staff are available to assist with the design and implementation of the biological monitoring program.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: The Big Marsh Point island is just south of the Chickahominy Haven Marina, therefore, the area directly adjacent to the island receives heavy boat traffic.

Information pertaining to Big Marsh Point could be placed at the marina to educate the public. Also, an educational seminar series for local residents would increase their awareness of the resources located in this area.

The shorebank which is located north of Route 627 along the Chickahominy River should be visually protected. This shoreline provides an important scenic component of the river.



DEER LAKE

SIZE: 80 acres

BIODIVERSITY RANK: B4

LOCATION: James City County
Norge quadrangle

GENERAL DESCRIPTION: Deer Lake Natural Area is centered upon a moist ravine which supports a small population of a globally rare plant species. The natural area is covered by a middle-aged forest. The canopy layer is dominated by American beech, black walnut, and white oak. American holly, spicebush, and common paw paw predominate in the understory and shrub layer. Herbs such as shadow witch orchid are found on the ground.

Soils in the ravine consist of a series of highly erodible sandy loams, the Emporia complex. Emporia complex soils are formed over marl (ancient shell) deposits, making their chemistry decidedly calcareous. Soils on the surrounding, more level lands within the natural area consist of several types of fine sandy loams such as the Craven-Uchee complex. Erosion hazard is also severe for these soil types.

Evidence suggests that lands in and around the natural area have been managed for their timber resources in the past. Current uses of the site include forest management and activities of a summer camp.

NATURAL HERITAGE RESOURCES: Deer Lake Natural Area contains a population of the Florida adder's-mouth. Florida adder's-mouth, an inconspicuous herbaceous plant in the orchid family, is very rare in Virginia, occurring at only nine sites on six coastal plain counties of the state. The species is rare to uncommon throughout its range: Virginia south to Florida.

The Florida adder's-mouth grows two to six inches tall and sprouts one or two oval leaves from a bulbous base. This perennial species bears a few to many small flowers with orange "lips" on a central stalk in middle to late summer. Florida adder's-mouth is a plant of moist, shaded soils and is usually found along streambanks, swamp margins, or wet mossy areas. In addition to direct habitat loss from conversion of land to other uses, threats to the species include clearing, erosion, sedimentation, trampling, and hydrologic disturbance.

A population of eight individuals was discovered in a seepage area in the ravine in 1990. A 1992 visit to the site discovered that a large branch of a nearby white oak tree had been blown down and landed precisely upon the known rare plant population. Only one plant had emerged in that area in 1992, but another individual was found a few yards from the original colony. Erosion and sedimentation from a poorly constructed road and utility corridor and recent clearcuts upslope of the rare plant

sites may be affecting the rare plant habitat. Additionally, there is evidence that the rare plant habitat is occasionally trampled by campers.

Although the future of Florida adder's-mouth at Deer Lake Natural Area is uncertain, there is reason to be hopeful. Individuals of the species often undergo extended dormant periods, so the actual population size may be larger than initially estimated. Also, there is plenty of suitable habitat available and, if the natural area is properly managed, this rare treasure may persist.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary encompasses the rare plant habitat of the natural area. This includes the streambanks and floodplains in the ravine bottom, wet areas around feeder springs, moist mossy seepage areas on the ravine slopes, and corridors of natural habitat connecting these areas. The extent of the calcareous Emporia complex soils were used as the principle guide in designing the primary boundary.

SECONDARY ECOLOGICAL BOUNDARY: The primary purpose of the secondary boundary is to provide a hydrologic buffer to the rare plant habitat. Because Florida adder's-mouth is influenced by surfacewater and groundwater, the design of the hydrologic buffer must include considerations for soil erosion, sedimentation and nutrient loading of surface runoff, contamination of groundwater, and disturbance of the surfacewater and groundwater regimes. To accommodate all of these factors, the secondary boundary is designed at the height-of-land (drainage divide) around the rare plant habitat.

The secondary boundary also provides a forested buffer to the rare plant habitat from surrounding land uses. Such a forested buffer helps maintain the microclimatic conditions in the ravine and inhibits the spread of some invasive species from adjacent lands.

OWNERSHIP AND ZONING: Deer Lake Natural Area is owned entirely by a private non-profit corporation which operates the tract as a summer camp. The natural area occupies roughly one-tenth of the total tract.

The site is currently zoned agricultural.

PRIMARY ACREAGE: 20 acres

SECONDARY ACREAGE: 60 acres

PROTECTION RECOMMENDATIONS: Neither Florida adder's-mouth nor its habitat are currently protected at Deer Lake by any existing legislation. The camp owners should be approached regarding the placement of Deer Lake on Virginia's Registry of Natural Areas. Details regarding compatible land uses within the primary and secondary boundaries should be discussed with the camp owners and managers.

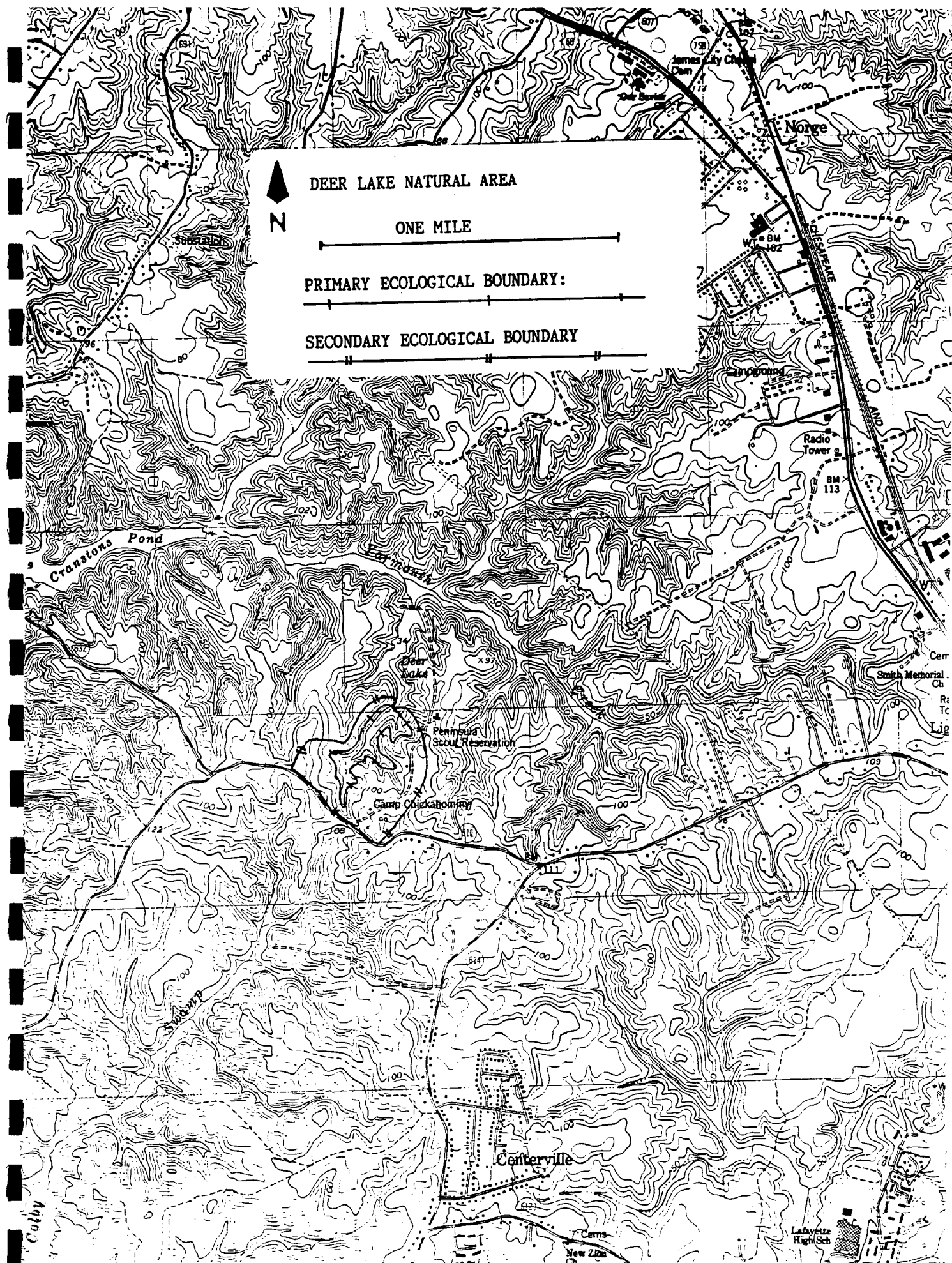
STEWARDSHIP RECOMMENDATIONS: Any land-disturbing activities such as timber harvest, road construction, and physical development should be restricted from within the primary boundary, although lands between the secondary and primary boundaries are suitable for environmentally compatible management. Possible consequences of activities that may alter the hydrology of the natural area, such as ditching or groundwater withdrawal, should be carefully considered before implementation.

Additional searches should be conducted for Florida adder's-mouth at the site. Known stations of the species should be monitored annually. Due to the relatively small size of the natural area, both the inventory and monitoring tasks could be accomplished during a single visit each year while the plants are in fruit. Department of Conservation and Recreation scientists are available to design or coordinate the inventory and monitoring efforts.

Searches for invasive species, such as Japanese honeysuckle, should also be conducted during the annual site visits. If invasive species are determined to be threatening the viability of the rare plant population, the problem plants or animals should be controlled or suppressed using environmentally sensitive techniques.

Because collection can be a threat to rare plant populations, the precise locations of the rare plant occurrences should be kept confidential.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: No recreational or visually related comments due to the small size of this site.



SHIELD'S POINT

SIZE: 320 acres

BIODIVERSITY RANK: B4

LOCATION: James City County
Norge quadrangle

GENERAL DESCRIPTION: This natural area features a significant tidal freshwater marsh on the Chickahominy River in western James City County. The marsh is characterized by big cordgrass, cattails, marsh hibiscus, and arrow arum. Bald cypress and pines line the shore and the upland forests surrounding the marsh are dominated by loblolly pine, red maple, and sweetgum.

Soils in the marsh consist of Levy silty clay, a deep, level, regularly inundated soil typical of the freshwater marshes of the Chickahominy River. The low swampy woodlands associated with the marsh contain soils that are nearly level, very poorly drained, frequently inundated silt loams and clay loams of the Johnston complex. Soils of the slopes surrounding the lowlands consist of Emporia complex, a series of well-drained, highly erodible sandy loams formed over ancient shell shell deposits. Soils of the level upland in the natural area are predominantly deep, moderately well drained silty or sandy loams. More than half of the natural area is wetland.

Some of the woodlands surrounding the marsh of the site show signs of past timber harvest, but the predominant historic and current land use in the vicinity is farming. Recreational boating, fishing, and hunting also occur in or near the natural area. At the present, most of the surrounding landscape is forested, some is agricultural, and a small portion is residential.

NATURAL HERITAGE RESOURCES: Shield's Point Natural Area contains an outstanding example of a tidal freshwater marsh, an uncommon to rare natural community. The condition of the marsh is near pristine and, although it does not have the large size of the marshes at Gordon Creek and Yarmouth Creek, the marsh does have a high level of species diversity.

In the narrow range where estuarine salinities are very low, but the rivers and creeks are still tidal, tidal freshwater marshes may occur. Although characterized by low salinity levels, salt concentrations in freshwater tidal areas may vary due to changing wind, temperature, and precipitation conditions. Because of the fluctuating salinity levels, freshwater marshes are usually identified by their plant composition. Cattails, sweet flag, wild rice, rice-cutgrass, arrow arum, pickerelweed, and broad-leaved arrowhead distinguish freshwater marshes in Virginia from their more saline counterparts. The streams and channels that meander through the marsh area are also an essential part of the natural community. The creeks are ecologically linked to the

marshes by a common medium, water. The watercourses support important areas of submerged aquatic vegetation.

Healthy freshwater marshes and creeks furnish many ecological benefits. Marshes enhance water quality, help contain floodwaters, buffer against shoreline erosion, produce large amounts of nutrients and energy, and provide habitats for a vast array of vertebrates and invertebrates. Tidal freshwater creeks rich in submerged aquatic vegetation provide spawning and nursery areas for fish and other aquatic animals.

Special Note: Because of additional information discovered during the course of this project, the habitat of the globally rare animal species mentioned in the inventory site report for this natural area has been merged into the adjacent Yarmouth Creek Natural Area.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary includes the exemplary tidal freshwater marshes of the natural area and their associated creeks and channels. The primary boundary is broken into two units where the marshes of the site are separated by a small peninsula of upland.

SECONDARY ECOLOGICAL BOUNDARY: The secondary boundary delineates a buffer of forested upland around the wetlands and watercourses of the natural area. The purpose of the forested buffer is to protect the water quality and hydrologic integrity of the wetland resource by filtering sediments and other contaminants from surface runoff, minimizing impacts from groundwater drawdown, preventing erosion and the resultant sedimentation and turbidity, and attenuating stormwater surges. By protecting the water quality and hydrologic regime, the structure and function of the marshes and creeks are maintained.

There has been an enormous amount of research regarding the appropriate width of wetland buffering strips. Widths ranging from 50 feet to 330 feet have been recommended based on the various data. The only point the immense body of literature on the subject has emphasized is that there is really no single equation for buffer strip width that applies to every situation. Given the high erodibility of the soil types and the extreme sensitivity and significance of the natural heritage resource, 330 feet was chosen as the appropriate width for the forested buffer strip for this site.

A 330 foot buffer strip was also designed around swamps and both the perennial and intermittent streams which feed into the natural area. Since those tributaries communicate directly with the core area, their water quality also requires protection. Where the height-of-land (drainage divide) occurs closer than 330 feet to the edge of the wetlands or water course, the secondary boundary runs along the drainage divide. The secondary boundary is also extended 330 feet offshore of the marshes for stewardship purposes.

A single residence is included in the secondary boundary.

PRIMARY ACREAGE: 130 acres

SECONDARY ACREAGE: 190 acres

OWNERSHIP AND ZONING: Except for open water, Shield's Point Natural Area is entirely within private ownership. The natural area's boundaries include parts of eight property tracts. The open water portions of the site are considered "waters of the state."

The entire natural area is zoned general agricultural.

PROTECTION RECOMMENDATIONS: All of the area within the primary boundary is protected by the Federal Clean Water Act and similar state and local tidal wetland laws which regulate the alteration of wetlands. The marshes, creeks, and a 100 foot wide band of upland around these features are designated as Resource Protection Areas by the James City County Chesapeake Bay Preservation Ordinance. Most types of physical development are restricted from within Resource Protection Areas.

More complete protection for the natural area is desirable. Landowners should be approached regarding the placement of the appropriate parts of their property under a conservation easement or on the Virginia Registry of Natural Areas. Efforts should concentrate first on the larger tracts because they represent large sections of the buffer area.

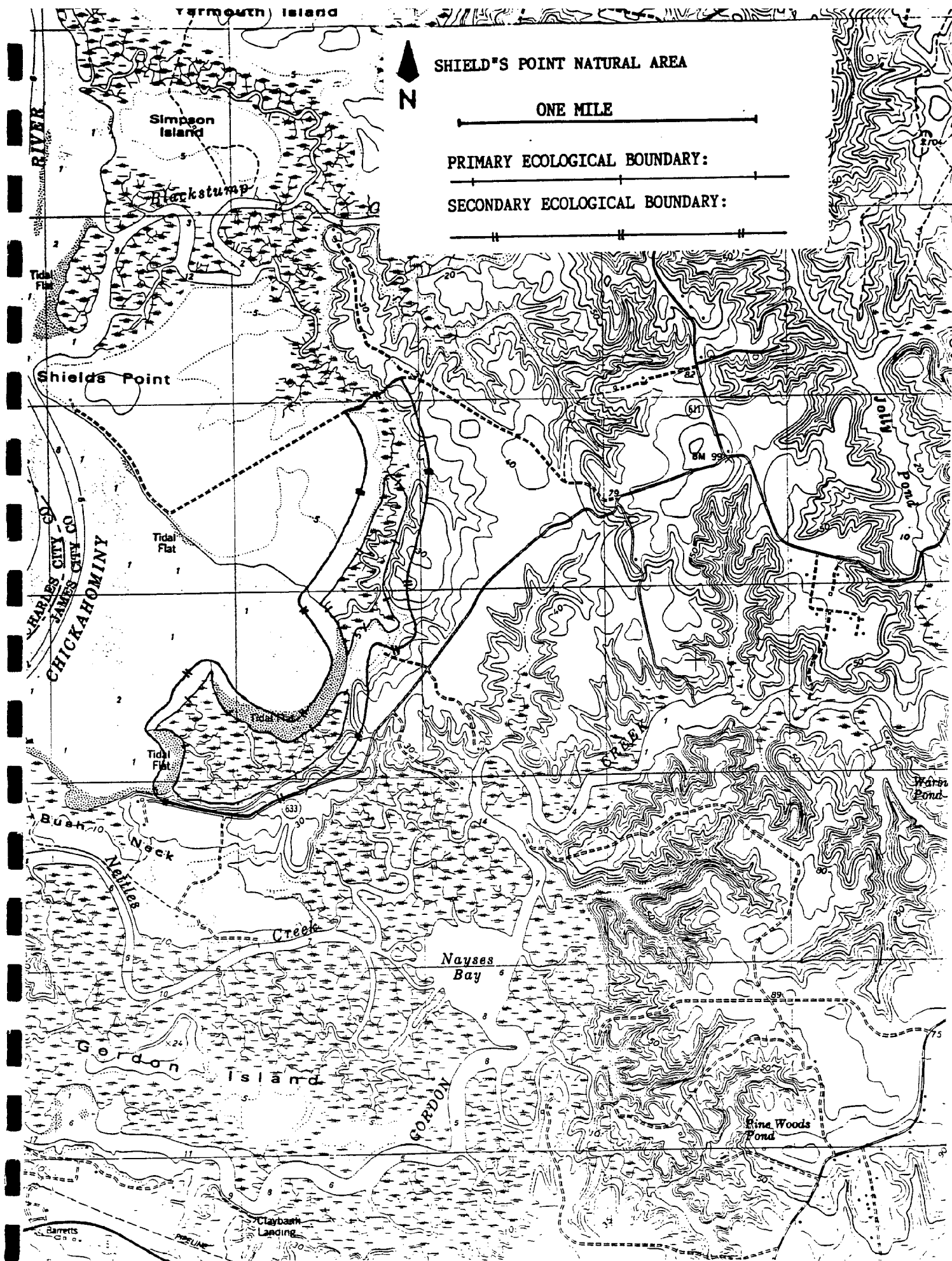
STEWARDSHIP: Land disturbing activity such as development, ditching, well-digging, road and utility construction, and the riding or driving of off-road vehicles should be restricted from within the natural area. Hunting, fishing, nature observation, and canoeing are uses generally compatible with the viability of the natural heritage resource of the site. Wastewater discharge should not be permitted in the natural area.

Shield's Point Natural Area is subject to a moderate amount of motorized boat traffic. Studies in the Chesapeake Bay area of Maryland have indicated that operation of motorboats in tidal creeks can have adverse effects on marshes, shores, creek bottoms, and water quality. The disturbance and resuspension of bottom sediments through the turbulence produced by boat propellers, damage to marshes, shorelines, and submerged aquatic vegetation, and the release of sewage and toxic compounds are problems associated with motorboat traffic in these sensitive areas. Similar studies have not been conducted in the Lower Peninsula project area. Because of the large number of variables involved, such as amount and speed of boat traffic, hull sizes and shapes, creek widths and depths, and amount of natural (wind-generated) wave action, results documented from one specific site cannot be inferred to be the situation at another site. For this reason, the establishment of a research program to determine the effects, if any, of motorboat traffic in this and the other

Chickahominy River natural areas is recommended. The Shoreline Erosion Advisory Service of the Virginia Department of Conservation and Recreation or the Virginia Institute of Marine Science may be willing to lead the research effort. Funding for such a study may be available from the Coastal Zone Management program. Appropriate actions for the preservation of the tidal marsh and creek ecosystems should be instituted based on the results of the study.

The tidal freshwater marsh should be monitored regularly. Several permanent sampling plots should be established in random locations in the marsh. In each sampling plot, species composition and relative abundances should be measured at least once every five years during the late growing season. Soil composition factors and the threat of problem species should also be analyzed on these visits. Such a biological monitoring program will not only provide insight as to the structure and function of this exemplary wetland community, but also sound early warnings to adverse changes in the ecology of the marsh from such threats as invasive species, hydrologic disturbance, or water pollution. Department of Conservation and Recreation staff scientists are available to assist with the design and implementation of such a biological monitoring program.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: The incorporation of visual easements or a local scenic designation could provide some protection for the scenic resources of the Chickahominy River in this area.



SKIFFE'S CREEK

SIZE: 30 acres

BIODIVERSITY RANK: B4

LOCATION: James City County
Yorktown quadrangle

GENERAL DESCRIPTION: Skiffe's Creek is a small natural area nestled within an area of very intense land use. The site is centered on a small, broad ravine which supports a population of a globally rare plant species. Surrounding land use includes timber clearcuts, farm crops, multiple utility corridors, a clay quarry, dense residential development, and a large industrial park.

The natural area is forested with middle-aged mixed hardwoods, such as American beech, red maple, and southern red oak. The understory features American holy and flowering dogwood. Shadow witch orchid and drooping bulrush, generally uncommon species in Virginia, are found in abundance in the ground level flora.

Soils in the ravine consist of a series of highly erodible sandy loams, the Emporia complex. Emporia complex soils are formed over marl (ancient shell) deposits, making their chemistry decidedly calcareous. Soils on the surrounding, more level lands within the natural area are entirely Peawick silt loam, a deep, moderately well-drained soil with low erosion hazard and a slow rate of surface runoff.

NATURAL HERITAGE RESOURCES: Skiffe's Creek Natural Area supports a population of **Florida adder's-mouth**. Florida adder's-mouth, an inconspicuous herbaceous plant in the orchid family, is very rare in Virginia, occurring at only nine sites on six coastal plain counties of the state. The species is rare to uncommon throughout its range: Virginia south to Florida.

The Florida adder's-mouth grows two to six inches tall and sprouts one or two oval leaves from a bulbous base. This perennial species bears a few to many small white flowers with orange "lips" on a central stalk in middle to late summer. Florida adder's-mouth is a plant of moist, shaded soils and is usually found along streambanks, swamp margins, or wet mossy areas. In addition to direct habitat loss from conversion of land to other uses, threats to the species include clearing, erosion, sedimentation, trampling, and hydrologic disturbance.

Florida adder's-mouth was first located at this site in 1990 when ten plants were found. Six of the ten plants produced fruit that year. Five plants of the species were relocated in 1992; at least one of those five produced fruit. It is normal for population sizes of Florida adder's-mouth to appear to fluctuate from year to year. The species has an ability to remain dormant

in the soil as a bulb for long periods of time, awaiting ideal conditions for emergence.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary encompasses the rare plant habitat of the natural area. This includes the swampy ravine bottom, moist mossy seepage areas on the ravine slopes, and corridors of natural habitat connecting these areas. The extent of the calcareous Emporia complex soils were used as the principle guide in designing the primary boundary.

SECONDARY ECOLOGICAL BOUNDARY: The main purpose of the secondary boundary is to provide a hydrologic buffer to the rare plant habitat. Because Florida adder's-mouth is influenced by surfacewater and groundwater, the design of the hydrologic buffer must include considerations for soil erosion, sedimentation and nutrient loading of surface runoff, contamination of groundwater, and disturbance of the surfacewater and groundwater regimes. Because the Peawick silt loam soils that dominate the buffer area have low erodibility and slow runoff rates, a buffer of 330 feet would be sufficient to protect surface water quality for the rare plant habitat. The buffer must also protect groundwater quality and quantity, however, so the secondary boundary is designed to encompass areas of probable groundwater recharge.

The secondary boundary also provides a forested buffer to the rare plant habitat from surrounding land uses. Such a forested buffer helps maintain the microclimatic conditions in the ravine and inhibits the spread of some invasive species from adjacent lands. The forested buffer is essential to Skiffe's Creek Natural Area considering the intense surrounding land use.

OWNERSHIP AND ZONING: This diminutive natural area is privately owned. It occurs entirely within one tract, covering about one tenth of the property.

The natural area is currently zoned for industry.

PRIMARY ACREAGE: 5 acres

SECONDARY ACREAGE: 25 acres

PROTECTION RECOMMENDATIONS: About one third of the land within the primary boundary is designated as Resource Protection Area under the James City County Chesapeake Bay Preservation Ordinance. Most types of development are restricted from within Resource Protection Areas. A small portion of the natural area may receive some protection from the Federal Clean Water Act which regulates the alteration of wetlands.

The property owner should be approached regarding the placement of Skiffe's Creek Natural Area on the Virginia Registry of Natural Areas. Site management needs should also be discussed.

STEWARDSHIP RECOMMENDATIONS: Land-disturbing activities such as timber harvest, road construction, and physical development

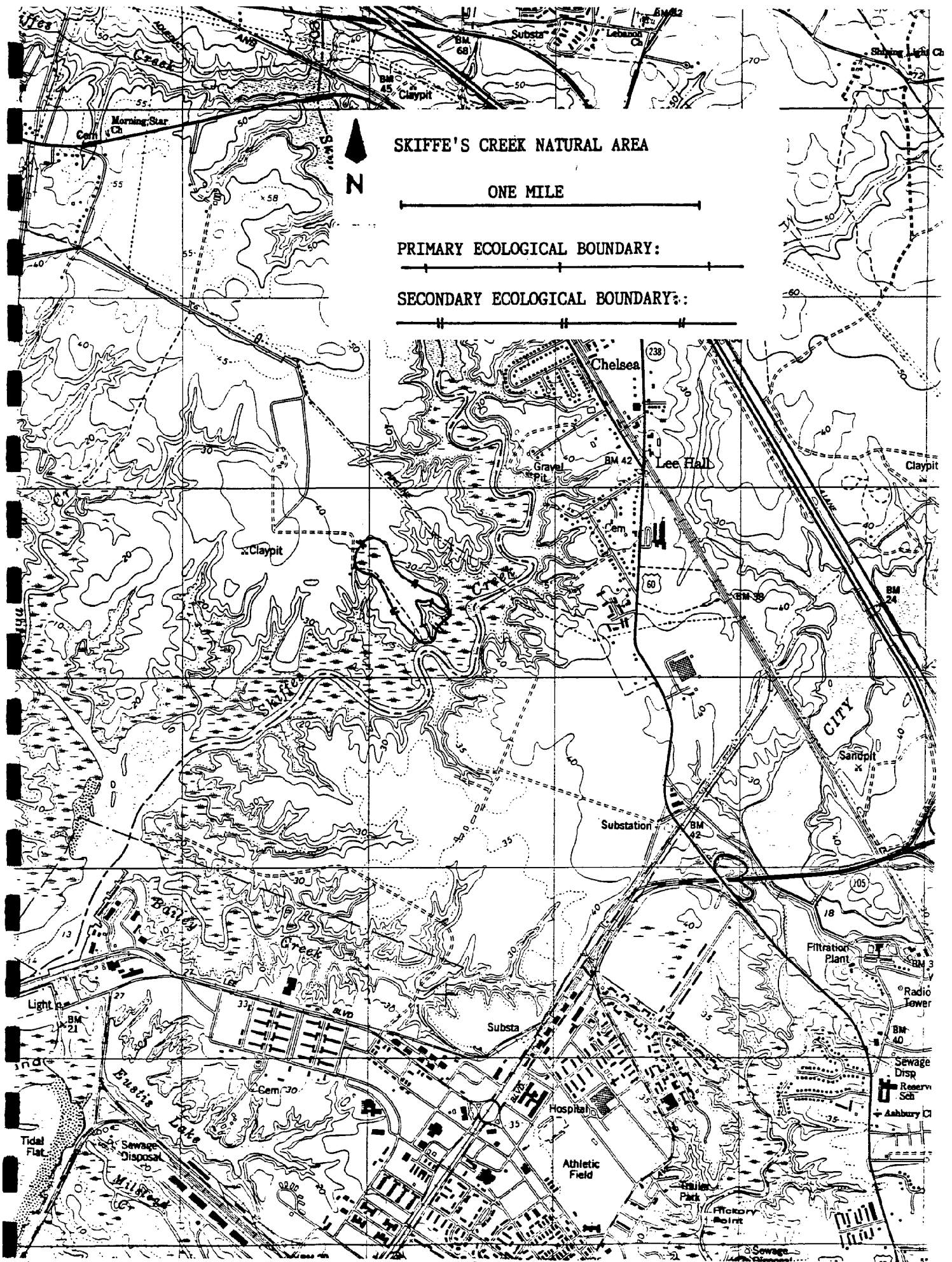
should be restricted from within the natural area, although lands between the secondary and primary boundaries are suitable for some environmentally sensitive uses. Possible consequences of activities that may alter the hydrology of the natural area, such as ditching or groundwater withdrawal, should be carefully considered before implementation.

Known stations of the species should be monitored annually. Due to the relatively small size of the natural area, the monitoring tasks could be accomplished during a single visit each year while the plants are in fruit. Department of Conservation and Recreation scientists are available to conduct or coordinate the monitoring efforts.

Searches for invasive species, such as Japanese honeysuckle, should also be conducted during the annual site visits. If invasive species are determined to be threatening the viability of the rare plant population, the problem species should be controlled or suppressed using environmentally sensitive techniques.

Because collection can be a threat to rare plant populations, the precise location of the rare plant occurrences should be kept confidential.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: No recreational or visual comments due to the small size of the site.



WARE CREEK

SIZE: 2830 acres

BIODIVERSITY RANK: B4

LOCATION: James City County, New Kent County
Toano and Gressit quadrangles

GENERAL DESCRIPTION: Ware Creek Natural Area includes a tidal creek, its marshes and headwater streams, and the surrounding uplands. Steep forested bluffs border the marsh. Ware Creek forms the boundary between James City and New Kent Counties. The natural area supports an exemplary natural community, a rare tree species, and a bird nesting colony.

Except for marsh and open water, all of the natural area is forested. The natural area has been managed intensively for its timber resources in the past. Forestry continues to be the principle land use at Ware Creek along with hunting and fishing. The surrounding lands are rural in character with large forested tracts, agricultural fields, and rural residences. Part of Ware Creek will be dammed to form the Ware Creek Reservoir for a public water supply. Additionally, a very large planned community development is proposed in the area. The planned developments will greatly compromise the biodiversity significance of this site. Because of these future land uses, the viability of Ware Creek Natural Area is doubtful.

The soils of the marshes are Bohicket muck which is level, poorly drained, and regularly inundated. The bottomland soils in the headwater streams of the tidal creek are Johnston complex, a series of poorly drained, hydric soils. Soils on the slopes surrounding the marsh and bottomlands invariably consist of the Emporia complex, a series of highly erodible fine sandy loams formed over marl (ancient shell) deposits. The level upland areas contain fine sandy loams such as the Craven-Uchee complex or Suffolk fine sandy loam.

NATURAL HERITAGE RESOURCES: Ware Creek Natural Area contains exemplary **tidal brackish and freshwater marshes**. Brackish marshes are a relatively common community type, but freshwater marshes are rare to uncommon. The marsh is medium-sized (about 600 acres) and in good condition. Though, the marshes at the mouth of Ware Creek are decidedly brackish, salinities and tidal influence decrease gradually as one moves upstream. Marsh vegetation follows the same pattern, starting with typical brackish water species near the mouth or the creek such as saltmarsh cordgrass. Big cordgrass replaces saltmarsh cordgrass as the dominant species in the middle sections of the marsh. Scattered individuals of freshwater marsh species are seen among the big cordgrass. The upper marsh harbors typical freshwater marsh species such as cattails and wild rice.

Healthy marshes and tidal creeks furnish many ecological benefits. Marshes enhance water quality, help contain storm and flood waters, buffer against shoreline erosion, produce large amounts of nutrients and energy, and provide habitats for a vast array of vertebrates and invertebrates. Tidal creeks rich in submerged aquatic vegetation provide spawning and nursery areas for fish and other aquatic animals. High quality marshes and creeks are essential to the health and productivity of the Chesapeake Bay.

A small stand of **sand post oak** was found at Ware Creek Natural Area in 1990. Six healthy trees were discovered overlooking the marsh and additional survey may locate more individuals. Sand post oak is a small tree or shrub with leathery, round-lobed leaves. The species is closely related to post oak from which it was only recently taxonomically separated. Sand post oak often grows in loose sandy soils which makes it especially vulnerable to erosion and wind-throw.

Sand post oak is common throughout most of its range which includes the southeastern states. The species reaches its northern range limit in southeastern Virginia. Sand post oak, also known as scrubby post oak and dwarf post oak, is known from nineteen sites in Virginia, all in six southeastern counties. Because of the low number of sites and its limited distribution in the Commonwealth the species is considered very rare in Virginia. Ware Creek Natural Area is the only known site for sand post oak on the Lower Peninsula.

Ware Creek Natural Area supports a medium-sized **heron nesting colony**. The colony is utilized solely by great blue herons. Like most colonial nesting birds, great blue herons "put all their eggs into one basket" by packing large numbers of reproductive birds into a few, small areas. This makes entire populations vulnerable to a single disturbance. Great blue herons are very sensitive to activity around their nesting sites, especially during the courtship and nestbuilding stages. Disturbance of the heron colony by such activities as construction, off-road vehicles, or even pedestrians can cause nesting failure and desertion of the colony. Although great blue herons are not particularly rare, the colonial breeding behavior of the species and the decline of the wetland habitats used for nesting and foraging make the species biologically significant and sensitive.

In addition to the trees currently used for nests, great blue heron colonies require additional habitat around the nest sites for resting perches and colony expansion. Herons also require large areas of wetland habitat for foraging.

PRIMARY ECOLOGICAL BOUNDARY: Most of the natural area's primary boundary encompasses the exemplary marsh. A portion of the primary boundary also includes the known stand of sand post oak and a small amount of adjacent habitat. The primary boundary around the heron colony includes the existing nest trees as well

as some of the surrounding forested habitat for resting perches and colony expansion. The significant marsh also provides foraging habitat for the herons.

SECONDARY ECOLOGICAL BOUNDARY: The primary purpose of the secondary boundary around the exemplary marsh is to provide a hydrologic buffer. The buffer zone around the marsh protects the water quality and hydrologic regime of the marsh and its creeks. There has been an enormous amount of research regarding the appropriate width of wetland buffering strips. Widths ranging from 50 feet to 330 feet have been recommended based on the various data. The only point the immense body of literature on the subject has emphasized is that there is really no single equation for buffer strip width that applies to every situation. Given the high erodibility of the soil types surrounding the Ware Creek wetlands and the extreme sensitivity and significance of the natural heritage resources, 330 feet was chosen as the appropriate width for the forested buffer strip for the marsh of this natural area. A 330 foot buffer strip was also designed around swamps and perennial and intermittent streams which feed into the marsh. Since those tributaries communicate directly with the core area, their water quality is also a concern for protection. Where the height-of-land (drainage divide) occurs closer than 330 feet to the edge of the wetlands or water course, the secondary boundary runs along the drainage divide. The secondary boundary was also extended 330 feet into the York River where the river is adjacent to the marsh for stewardship reasons.

To protect its habitat from erosion, high winds, and alteration of microclimate, a 100 foot buffer zone was designed around the sand post oak's primary boundary.

The secondary boundary around the great blue heron nesting colony essentially follows the primary boundary 1000 feet distant from it. The purpose of the secondary boundary in this case is to buffer the nesting colony from human activity. The buffer zone around the exemplary marsh will also serve to screen foraging herons from human activity.

OWNERSHIP AND ZONING: A very large percentage of Ware Creek Natural Area (on both the James City and New Kent County sides) is owned by a single corporate landholder. The natural area includes less than one-tenth of the 11,712 acre James City County tract. Hunt clubs lease some of the these lands. The natural area also includes parts of seven smaller private tracts in James City County and about three acres of land owned by the James City county government. Open water within the natural area is considered "waters of the state."

Although all of the land within the James City County side of the natural area was formerly zoned general agricultural, much of the property has recently been rezoned for planned community development.

Property ownership and zoning research was not conducted for the New Kent County side of the natural area.

PRIMARY ACREAGE: 650 acres

SECONDARY ACREAGE: 2180 acres

PROTECTION RECOMMENDATIONS: The exemplary marsh downstream of the future dam location has been designated as Resource Protection Area under the James City County Chesapeake Bay Preservation Ordinance. Under the Ordinance, wetlands and watercourses of the Bay along with a 100 foot wide upland buffer around these features are restricted from most types of development. Wetlands in the natural also benefit from a certain amount of protection under the Federal Clean Water Act and similar state and local tidal wetland laws which regulate the alteration of wetlands. The great blue herons and their nests, eggs, and young receive some protection from the Federal Migratory Bird Treaty Act. The U.S. Fish and Wildlife Service may issue permits under that legislation, however, allowing the "taking" of great blue heron nesting colonies.

The Ware Creek reservoir will destroy the great blue heron nesting colony and a substantial portion of the upper marsh of Ware Creek. The intensive residential, commercial, and industrial development proposed for the area will also greatly affect the ecological integrity of the watershed.

Most of the exemplary marsh and the rare tree population could be salvaged. James City County should require that the developer place conservation easements on all lands between the primary and secondary boundaries of the natural area below the dam. The same protection measures should be instituted on the New Kent County side of the natural area; protecting half of the buffer zones is insufficient for the viability of the marsh. The area within the primary boundary should be added to the Virginia Registry of Natural Areas.

STEWARDSHIP RECOMMENDATIONS: Land-disturbing activities, such as clearing, well-digging, ditching, and road and utility construction, should not occur within the natural area. Wastewater discharge should not be permitted within the natural area and the consequences of septic systems should be carefully considered before being permitted. The buffer zone between the primary and secondary boundaries should remain forested. All human activity should be restricted from the 1000 foot buffer zone around the heron nesting colony during the nesting season, February through August (until the site is destroyed by the reservoir). Except during the restricted season around the nesting colony canoeing, hiking, hunting, fishing, and some other recreational activities are compatible uses within the natural area.

Additional inventory should be conducted for sand post oak. If additional stands of the rare tree are located, some of the natural area boundaries may have to be altered to protect them.

The exemplary marsh should be monitored for its composition and condition to provide early warnings of any degradation of its structure and function. Several permanent study plots should be established at randomly determined locations in the marsh. Species composition and abundance, water quality and soil composition factors, and the presence and status of problem species should be carefully noted in each plot once every five years. Measurements should be taken at approximately the same time each year the plots are monitored, preferably late in the growing season.

If problem species such as common reedgrass or beaver are determined to be threatening the viability of the natural heritage resources, the problem species should be controlled or suppressed using environmentally sensitive techniques.

Although motorboat traffic appears to be light in the natural area at present, motorized boating traffic should be monitored to determine its effect on the marsh vegetation and soils. If motorboats are determined to be causing significant marsh erosion or increased creek channel turbidity, steps should be taken to attenuate the problem.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: Since much of this natural area is within developable areas of the James City County, it is recommended that the county:

- * Provide through the Parks and Recreation Department, Planning Department, or local schools an educational program which focuses on natural resources within the area.
- * Make the developers aware of the natural resource issues relevant to the area. Encourage developers to include public interpretive opportunities and conservation mechanisms in design plans for the area.
- * Provide education to future contractors which will enhance their awareness and willingness to comply with recommendations made on behalf of the natural heritage resources present within the site.
- * Establish locally recognized scenic viewsheds along Ware Creek.
- * Incorporate a cartop boat launch access into Ware Creek.



WARE CREEK NATURAL AREA

N

ONE MILE

PRIMARY ECOLOGICAL BOUNDARY:

SECONDARY ECOLOGICAL BOUNDARY:

NEW KENT CO. KING AND QUEEN CO.
JAMES CITY CO. JAMES CITY CO.

CRAB NECK MARSHES

SIZE: 650 acres

BIODIVERSITY RANK: B5

LOCATION: York County
Poquoson West quadrangle

GENERAL DESCRIPTION: This natural area consists of exemplary saltmarshes on the Chesapeake Bay near the mouth of the York River. The saltmarshes are dominated by saltmarsh cordgrass, saltmeadow hay, and black needlerush with marsh elder ringing the marsh edges. A few islands within the marshes are dominated by loblolly pine. Marsh soils consist of Axis very fine sandy loam, a deep, very poorly drained, regularly inundated soil typical of saltmarshes in the area. The soils found in the forested islands include Nimmo and Tomotley fine sandy loams.

Although the marshes are only used for hunting today, historical use may have been more intense. There are remnants of old ditches in the marsh and the marshes may have been grazed by domestic livestock in years past. Surrounding land use is mostly light to moderate residential development. Commercial and recreational boating traffic in the area is heavy. A large petroleum refinery is only a few miles northwest of the natural area. A serious spill from the refinery or one of its tankers could easily destroy the structure and function of the marshes.

NATURAL HERITAGE RESOURCES: Crab Neck Marshes Natural Area contains and exemplary tidal saltmarsh. The exemplary saltmarsh at this site is not unlike many that line the Chesapeake Bay, but the Crab Neck marshes are in excellent condition and support a high amount of natural diversity.

Healthy marshes furnish many ecological benefits. Marshes enhance water quality, help contain flood and storm waters, buffer against shoreline erosion, produce large amounts of nutrients and energy, and provide habitats for a vast array of vertebrates and invertebrates.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary encompasses the extent of the significant marsh community, its associated tidal mudflats, and the forested islands within it.

SECONDARY ECOLOGICAL BOUNDARY: Where the marsh is adjacent to the open water of the Chesapeake Bay, the secondary boundary is coincident with the primary. Where the marshes are contiguous with land, the secondary boundary extends 100 feet beyond the primary boundary.

The primary purpose of secondary boundary is to provide a hydrologic buffer zone around the marsh to protect the water quality and hydrologic regime. There has been an enormous amount of research regarding the appropriate width of wetland buffering

strips. Widths ranging from 50 feet to 330 feet have been recommended based on the various data. The only point the immense body of literature on the subject has emphasized is that there is really no single equation for buffer strip width that applies to every situation. The 330 foot width was chosen because of the extreme significance and sensitivity of the natural heritage resource. A 100 foot wide buffer strip should provide sufficient protection to the marsh considering the low amount of surface runoff in the area.

OWNERSHIP AND ZONING: Crab Neck Marshes Natural Area is entirely within private ownership and includes parts of 20 tracts and parts of two subdivisions.

About three-fourths of the natural area is zoned residential conservation. The remainder is zoned rural residential.

PRIMARY ACRES: 580 acres

SECONDARY ACRES: 70 acres

PROTECTION RECOMMENDATIONS: Virtually the entire natural area is protected by the York County Chesapeake Bay Preservation Ordinance. The wetlands of the site are protected by the York County Tidal Wetlands Ordinance and the Federal Clean Water Act. The Bay Ordinance has designated the marsh and a 100 foot buffer around the marsh as Resource Protection Area. Most types of physical development are restricted from within the Resource Protection Area. The Clean Water Act and the Wetlands Ordinance regulate the alteration of wetlands.

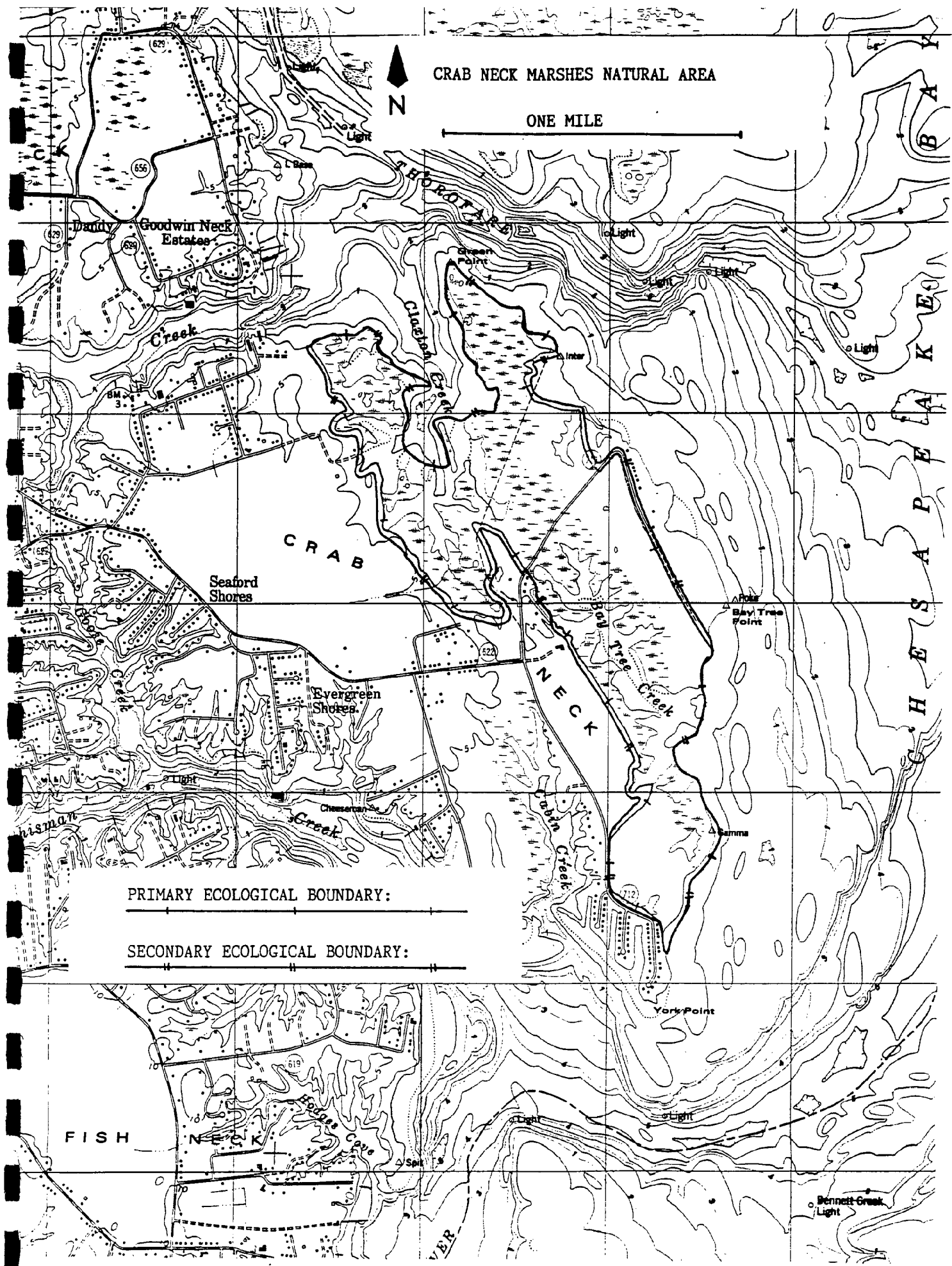
STEWARDSHIP RECOMMENDATIONS: Land-disturbing activities such as physical development and ditching should not be allowed within the natural area. New or increased wastewater discharge or septic systems should not be permitted in the natural area. Hunting, fishing, canoeing, and some other recreational activities are compatible within the natural area, and the marsh might even be used for public education and nature observation.

Except for existing development, the buffer zone between the primary and secondary boundaries should be forested and should remain undisturbed.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: Private property owners may consider placing scenic easements on their properties to protect the visual integrity of the area. Educational material could be provided along the waterway for recreational boaters.

CRAB NECK MARSHES NATURAL AREA

ONE MILE



PRIMARY ECOLOGICAL BOUNDARY:

SECONDARY ECOLOGICAL BOUNDARY:

GOODWIN ISLANDS

SIZE: 770 acres

BIODIVERSITY RANK: B5

LOCATION: York County
Poquoson West quadrangle

GENERAL DESCRIPTION: The Goodwin Islands are an archipelago of forested and saltmarsh islands at the mouth of the York River. The marshes are vegetated by typical salt marsh species such as saltmarsh cordgrass, saltmeadow hay, and black needle rush. About fifty percent of the largest island is forested by loblolly pine, northern red oak, and black gum. Marsh soils consist of Axis very fine sandy loam, a deep, very poorly drained, regularly inundated soil typical of salt marshes in the area. The soils found in the forested area include Nimmo and Tomotley fine sandy loams.

Historically, the Goodwin Islands have been used for waterfowl hunting and for fishing. Harvest of Chesapeake Bay seafood has and continues to occur in the waters surrounding the islands. The remains of large mooring posts and an area of disturbed soil in the northeastern part of the largest island indicate that a more intensive use of the land may have occurred in the past. Currently, the Goodwin Islands are used for environmental education and scientific research. A large oil refinery and petroleum storage facility lies less than two miles west of the site.

The Goodwin Islands Natural Area supports a bird nesting colony and a population of a rare animal species.

NATURAL HERITAGE RESOURCES: A medium-sized population of least bitterns nests on the Goodwin Islands. The least bitterns is a secretive, marsh-nesting bird of the heron family. Because there are only thirteen known breeding sites in just seven counties for the species in Virginia, least bitterns are considered very rare in the Commonwealth. Least bitterns are more common in some other parts of their breeding range which includes most of the eastern United States.

A nesting colony of great blue herons is found in the forested part of the natural area. Like most colonial nesting birds, great blue herons put "all their eggs into one basket" by packing large numbers of reproductive birds into a few, small areas. This makes entire populations vulnerable to a single disturbance. Great blue herons are very sensitive to activity around their nesting sites, especially during the courtship and nestbuilding stages. Disturbance of the heron colony by such activities as construction, off-road vehicles, or even pedestrians can cause nesting failure and desertion of the colony. Although, great blue herons are not particularly rare, the colonial breeding behavior of the species and the decline of the wetland habitats

used for nesting make the species biologically significant and sensitive.

In addition to the trees currently used for nests, great blue heron colonies require additional habitat around the nest sites for resting perches and colony expansion. Great blue herons also require areas of wetland habitat for foraging.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary essentially encompasses the entire archipelago, its channels, and tidal mud flats. Included in this boundary is the nesting and foraging habitat for least bitterns, the heron nesting colony along with additional forested habitat for resting perches and colony expansion, and foraging habitat for the herons.

SECONDARY ECOLOGICAL BOUNDARY: The secondary boundary generally follows the primary boundary at a distance of 330 feet. The purpose of the secondary boundary is to provide an open water buffer zone around the sensitive bird habitats.

OWNERSHIP AND ZONING: The Goodwin Islands Natural Area is entirely owned by the College of William and Mary, a state supported university. The islands are designated and managed as a National Estuarine Research Reserve by William and Mary's Virginia Institute of Marine Science. The open water within the secondary boundary is considered "waters of the state."

The Goodwin Islands are zoned residential conservation, although York County technically has no authority to regulate land use at the site because it is state-owned.

PRIMARY ACREAGE: 480 acres

SECONDARY ACREAGE: 290 acres

PROTECTION RECOMMENDATIONS: The great blue herons and least bitterns receive protection from the Federal Migratory Bird Treaty Act. The Bird Act prohibits the direct destruction of the herons and bitterns as well as the destruction of their nests, eggs, and young. All of the Goodwin Islands are designated as Resource Protection Area under the York County Chesapeake Bay Preservation Ordinance. Most types of physical development are restricted within Resource Protection Areas. The wetlands of the natural area also receive protection from the Federal Clean Water Act and the York County Tidal Wetlands Ordinance which regulate the alteration of wetlands. Designation of the islands as a National Estuarine Research Reserve formally recognizes the environmental significance and sensitivity of the wetlands and encourages their preservation for research and education.

The Goodwin Islands Natural Area is quite well protected by its state ownership, designation as a National Estuarine Research Reserve, and existing wetlands legislation.

STEWARDSHIP RECOMMENDATIONS: The current use of the natural area for scientific research and environmental education is generally compatible with the viability of the natural heritage resources. Managers of the Reserve should be advised not to disturb the heron colony during the sensitive nesting season, February through August. Ideally, recreational boat traffic should be restricted from within the secondary boundary during the nesting season to minimize disturbances to foraging herons and bitterns. This restriction need not apply to commercial vessels. Because Chesapeake Bay watermen are normally very regular and unobtrusive in their seafood harvest activities, foraging herons are usually able to habituate easily to their boats.

The natural area is in need of further biological inventory. During the biological surveys of the site, several species of rare birds were identified in the marshes, but only least bitterns were confirmed as breeding there. Additional survey should focus on determining the presence or absence of additional rare breeding birds and the status of their (and the least bittern) populations.

The heron nesting colony should be monitored at least annually for numbers of individuals, numbers of active nests, and numbers of eggs and young. It is best to check the colony two or more times during the reproductive season to get the most accurate assessment of the colony's status and reproductive success. Because of limiting resources, however, more than one visit is not always possible. Great care should be taken to minimize disturbance to the nesting herons while conducting monitoring activities. The best monitoring technique for collecting the most accurate data while causing the least disturbance is through aerial survey. Researchers from the College of William and Mary and the Virginia Nongame and Endangered Species Program routinely monitor heron nesting colonies in Virginia. This colony has not been included in their aerial survey route in the past, but could probably added.

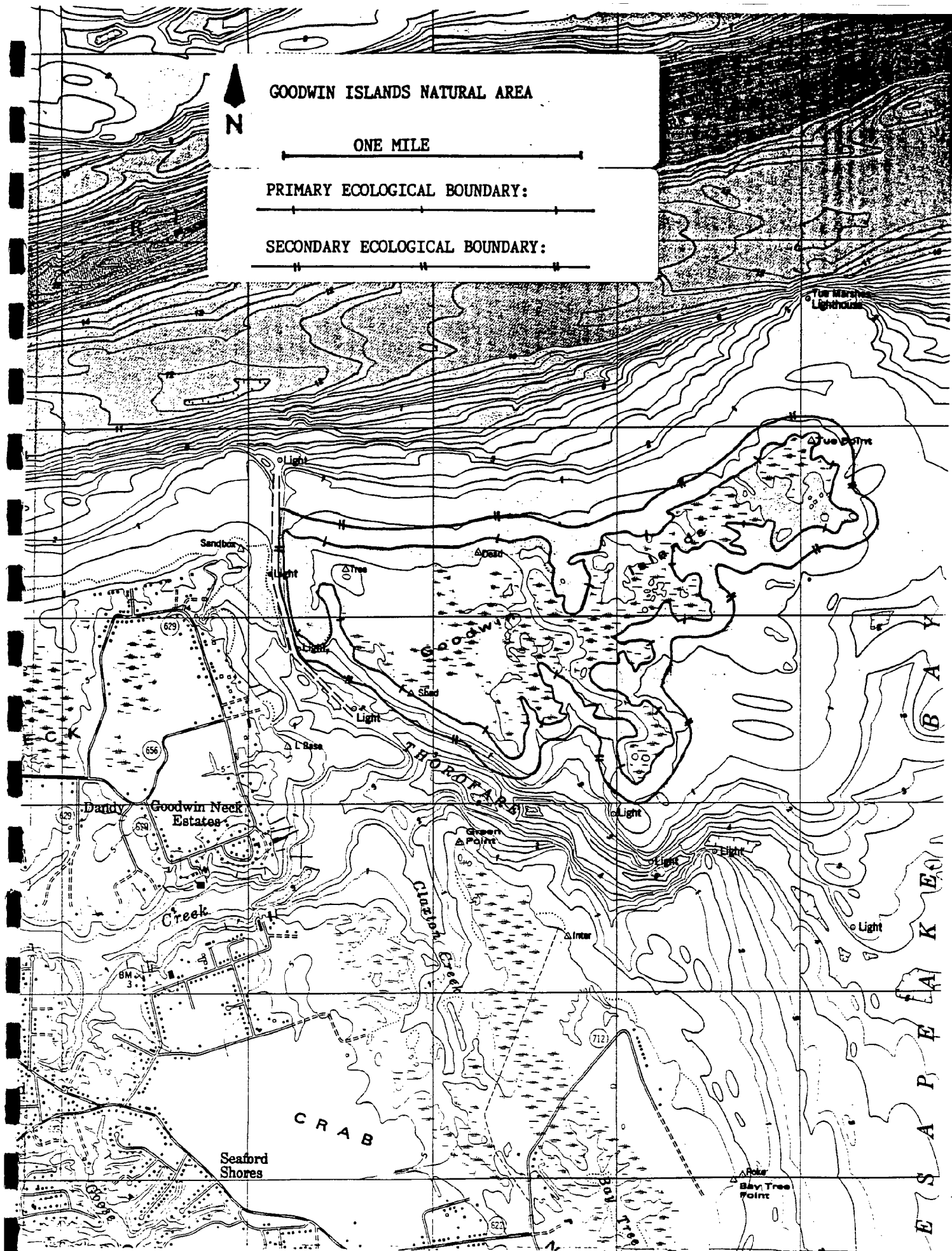
RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: The Goodwin Islands are a part of the National Estuarine Research Reserve which is owned and managed by the Virginia Institute of Marine Sciences. Recreational access is not recommended on these islands, however, the islands use as a wetlands education area and research laboratory should be encouraged.

GOODWIN ISLANDS NATURAL AREA

ONE MILE

PRIMARY ECOLOGICAL BOUNDARY:

SECONDARY ECOLOGICAL BOUNDARY:



GRAYLIN WOODS

SIZE: 20 acres

BIODIVERSITY RANK: B5

LOCATION: James City County
Norge quadrangles

GENERAL DESCRIPTION: This natural area includes the bottomland swamps and adjacent ravine slopes around Mill Creek near its intersection with Route 5. The bottomland is dominated by green ash and red maple with a dense understory of spicebush. The slopes bordering the swamp are forested with American beech and loblolly pine with an understory of American holly. The bottomland soils are Johnston complex, while the soils of the slopes consist of Emporia complex.

Timber management has been the most influential land use of past years. Currently, the natural area is totally surrounded by residential development and utility corridors.

Graylin Woods Natural Area supports a population of a rare plant species.

NATURAL HERITAGE RESOURCES: A medium sized population of the **hoary skullcap** occurs at Graylin Woods Natural Area. Though the population is currently in good condition, the surrounding development limits its habitat.

The hoary skullcap is a herbaceous plant of the mint family that is extremely rare in Virginia. The species is known to occur at only four sites in the Commonwealth, although it is much more common in other parts of its range, primarily the mid-Atlantic and mid-western states. Hoary skullcaps grow up to three feet tall and bear blue flowers in the summer. In addition to threats to its habitat, hoary skullcap must also contend with damage from trampling, deer browsing, and collecting.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary encompasses the known locations of the hoary skullcap in the natural area as well as adjacent unoccupied habitat from the swamp margin upslope to the residential development and from a pipeline corridor south to the highway.

SECONDARY ECOLOGICAL BOUNDARY: The purpose of the secondary boundary is to provide a buffer zone which will protect the water quality and habitat structure in the primary boundary. Ideally, the secondary boundary would run 100 feet past the top of the slope where the rare plants are found. Existing development precludes this guideline, however, and the secondary boundary runs only to the edge of the residential development upslope of the natural heritage resource. The buffer zone also extends to the opposite swamp margin to prevent alteration of the skullcap habitat from clearing of adjacent lands.

OWNERSHIP AND ZONING: A portion of the natural area is owned by James City County and houses a water and sewage pump station. The remainder of the natural area is in private ownership by either development companies or by individual lot owners.

The natural area is currently zoned general residential.

PRIMARY ACREAGE: 7 acres

SECONDARY ACREAGE: 13 acres

PROTECTION RECOMMENDATIONS: Mill Creek, its associated bottomlands, and 100 feet of surrounding upland are designated as Resource Protection Area under the James City County Chesapeake Bay Preservation Ordinance. About half of the land within the primary boundary, including the known plant locations fall within the Resource Protection Area. The Bay ordinance restricts most types of physical development from within Resource Protection Areas. The bottomland swamps of the site receive some protection from the Federal Clean Water Act which regulates the alteration of wetlands.

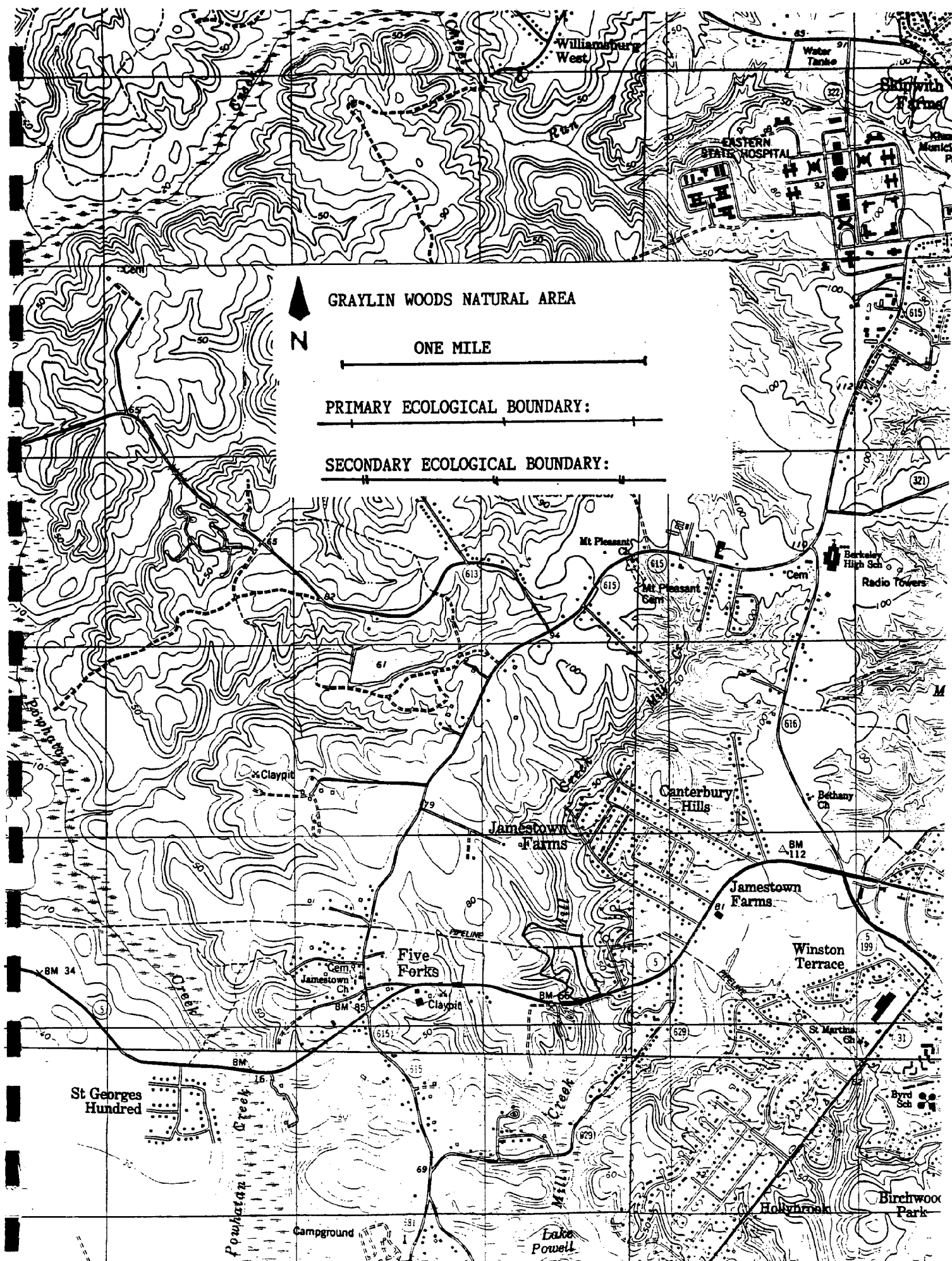
A public awareness and environmental education program should be instituted for the owners of property within the natural area. Once positive relationships have been established with the property owners, placement of Graylin Woods on the Virginia Registry of Natural Areas could be pursued. A local conservation group would be best suited for the landowner contact and education efforts; Department of Conservation and Recreation staff can provide technical support as needed and help with the registry of the site.

STEWARDSHIP RECOMMENDATIONS: Land-disturbing activities, such as timber harvest or development, should be restricted from within the natural area. Properly constructed trails for recreational use by the surrounding residents can be established between the primary and secondary boundaries, but should be restricted from within the primary boundary.

The hoary skullcap population should be monitored for size and condition periodically. At least one visit during the normal fruiting season for the species will be required to accurately estimate numbers of individuals and amount of reproduction.

Although the rare plant habitat is relatively free of problem species at this time, the surrounding utility corridors and backyards provide sources of invasive plant species such as millet grass and Japanese honeysuckle. Browsing by white-tail deer can also threaten hoary skullcap populations. Evidence of problem species should be monitored during the annual visits to the site. If an invasive plant species or aggressive animal species is determined to be threatening the viability of the natural heritage resource, the problem species should be controlled or suppressed using environmentally sensitive techniques.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: Since this area is already managed as greenspace within a subdivision, an educational kiosk or other focus on the site could be encouraged. The possibility of providing a trail from Route 5 to this area should be investigated. This may be an opportunity to focus on natural heritage resources located along the scenic byway.



GRICE'S RUN

SIZE: 160 acres

BIODIVERSITY RANK: B5

LOCATION: James City County
Yorktown and Hog Island quadrangles

GENERAL DESCRIPTION: Grice's Run Natural Area includes a series of ravines and steep slopes around a small stream, Grice's Run. Except for the open marsh in the southern part of the natural area, the site is forested with mixed hardwoods and pines. Soils in the marsh are Bohicket muck, while the soils of the remainder of the natural area consist of Emporia complex or Craven-Uchee complex, both a series of highly erodible fine sandy loams.

Historically, the natural area has been used for agriculture, timber harvest, and possibly grazing of domestic livestock. Currently, timber management is the predominant land use within the natural area. West of the natural area, lands are managed for timber resources, farmed for crops and pasture, and a historical site is operated as a tourist attraction. A major highway and moderate to heavy residential development lay north of the site, the James River and a large industrial plant are south of the natural area. Lands east of Grice's Run have recently been cleared and are being developed into a business park.

Grice's Run Natural Area harbors a small exemplary natural community.

NATURAL HERITAGE RESOURCES: Some of the slopes surrounding Grice's Run include a small, but exemplary, **southern mixed hardwood forest**. American beech, white oak, and southern sugar maple dominate the forest canopy. The understory is dominated by American holly in most places. The herbaceous layer is well-developed in some parts of the exemplary forest; shadow witch orchid, a plant which is uncommon in Virginia, can be found frequently on the forested slopes. Although the exemplary southern mixed hardwood forest at Grice's Run Natural Area is not virgin growth, it does have the old growth qualities such as many large maturing trees, complex stratification, diverse species composition and age structure, and substantial amounts of standing and fallen dead wood. Southern mixed hardwood forests are common natural community types, but the old growth characteristics of the Grice's Run forest make it a significant natural heritage resource.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary at Grice's Run includes the extent of the exemplary natural community. Because most of the forests on the level areas have been disturbed, the exemplary forest is primarily limited to the slopes around Grice's Run and its marsh.

SECONDARY ECOLOGICAL BOUNDARY: The purpose of the secondary boundary is to provide a buffer zone around the exemplary forest. The secondary boundary generally follows the primary boundary at a distance of 100 feet on level land. Maintaining a 100 foot woodland buffer around the exemplary southern mixed hardwood forest will help insure the continued integrity of this natural community. Among the benefits provided by the buffer to the exemplary natural community are the following: (1) preventing increased light beyond the edges of the forest, (2) reducing the likelihood for invasion of aggressive "weedy" species into the forest, (3) protecting soils within the forest from erosion, and (4) decreasing the possibility of wind-throw of trees within the forest.

The secondary boundary also includes the bottomlands and marsh along Grice's Run and the slopes opposite the exemplary forest. This measure protects the natural heritage resource from habitat alteration due to impoundment of the stream or clearing of adjacent lands.

OWNERSHIP AND ZONING: Grice's Run Natural Area is entirely within private ownership. Most of the site is owned by a large private foundation. The remainder is owned by an industrial corporation.

Most of the natural area is zoned residential. A small portion is zoned for agriculture or industry.

PRIMARY ACREAGE: 60 acres

SECONDARY ACREAGE: 100 acres

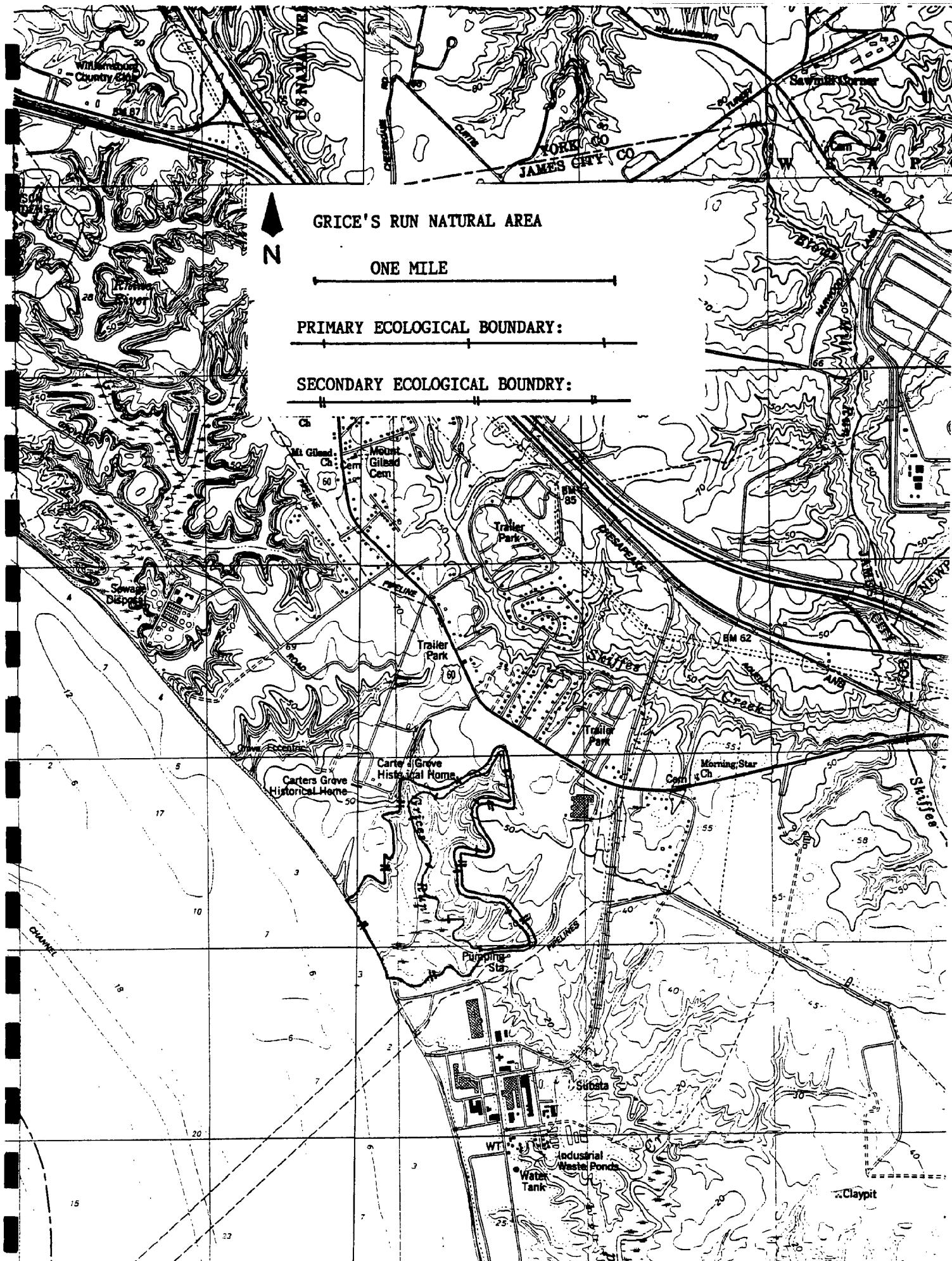
PROTECTION RECOMMENDATIONS: The marsh associated with Grice's Run and 100 feet of upland around it have been designated as Resource Protection Area by the James City County Chesapeake Bay Preservation Ordinance. Most forms of development are restricted from within the Resource Protection Area. The bottomlands in natural area may receive some protection from the Federal Clean Water Act depending upon what wetland delineation guidelines are used. The Clean Water Act regulates the alteration of wetlands. The tidal marsh portion of the natural area also receives protection from the Federal Clean Water Act and from similar state and local tidal wetland laws applying to tidal wetlands. The exemplary forest itself has no existing protection whatsoever.

The two landowners should be approached regarding placement of the site onto the Virginia Registry of Natural Areas. Negotiation of management agreements with these landholders regarding land-use within the natural area is desirable.

STEWARDSHIP RECOMMENDATIONS: Land-disturbing activities, such as timber harvest, impoundment of watercourses, off-road vehicles, and physical development, should be restricted from within the natural area. Some recreational uses such as hiking and nature

observation are compatible within the natural area. Details of appropriate land uses within the natural area should be established within the management agreements with the landowners.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: This site is located near a historic site which is open to the public. The area serves as a visual buffer for the historic site. The property may be appropriate for use as equestrian and hiking trails. The area is also a key component to providing open space and possibly a wildlife corridor between developed lands.



HOG NECK CREEK

SIZE: 630 acres

BIODIVERSITY RANK: B5

LOCATION: James City County
Norge, Brandon, Walkers, and Toano quadrangles

GENERAL DESCRIPTION: Three tidal creeks and the surrounding marshes form the core of Hog Neck Creek Natural Area. All three creeks are tributaries to the Chickahominy River. The marshes are dominated by wild rice, arrow arum, and pickerelweed. The uplands surrounding the marsh contain mixed pine-hardwood forest, young planted pine forest, and recent clearcuts.

Soils in the marshes are Levy silty clay, a poorly drained, acidic, regularly inundated soil type typical of the marshes of the Chickahominy River. Soils of the bluffs surrounding the marshes consist of Emporia complex, a series of deep, well-drained, loamy soils which are highly susceptible to erosion. Most of the soils beyond the bluffs within the natural area are of the Crave-Uchee complex, a set of sandy clay loams and loamy fine sands which are also highly erodible. The remainder of the upland soils in the natural area consist of various silt loams and fine sandy loams.

Hunting and fishing are the principle historic and current uses of the marshes and creeks. The surrounding uplands are managed for their timber resources.

Hog Neck Creek Natural Area contains an exemplary natural community and a population of a rare plant species.

NATURAL HERITAGE RESOURCES: Hog Neck Creek supports a moderate size **tidal freshwater marsh** in excellent condition. Tidal freshwater marshes are rare to uncommon natural communities occur in the narrow range where estuarine salinities are very low but the rivers and creeks are still tidal.

Healthy tidal freshwater marshes and creeks furnish many ecological benefits. Marshes enhance water quality, help contain floodwaters, buffer against shoreline erosion, produce large amounts of nutrients and energy, and provide habitats for a vast array of vertebrates and invertebrates. Tidal freshwater creeks rich in submerged aquatic vegetation provide spawning and nursery areas for fish and other aquatic animals.

Hog Neck Creek Natural Area supports a fair population of the **yellow cowlily**. Yellow cowlily is an aquatic plant in the water-lily family. Yellow cowlilys are rooted in creek and river bottoms and their elongated leaves float at the water's surface. The showy yellowish to green flowers bloom through the spring and summer. Yellow cowlily often grows in deep, mid-channel waters. In addition to being sensitive to degradation of water quality

and disturbance of the hydrologic regime, the plant's habit of growing in open water makes it very vulnerable to direct damage from boat traffic.

Yellow cowlily is rare throughout its range, the coastal regions of Virginia, North Carolina, and South Carolina, and extremely rare in Virginia. The subspecies occurs at only seven sites in the Commonwealth, all of which are in three counties along the tidal portion of the Chickahominy River. The population at Hog Neck Creek is small, but occurs in good habitat.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary at this site encompasses the freshwater marsh as well as the associated tidal creeks and sections of the Chickahominy River in which the yellow cowlily grows.

SECONDARY ECOLOGICAL BOUNDARY: The purpose of the secondary boundary around the marsh is to provide a buffer which will protect the water quality and hydrologic regime of the marsh and its creeks. There has been an enormous amount of research regarding the appropriate width of wetland buffering strips. Widths ranging from 50 feet to 330 feet have been recommended based on the various data. The only point the immense body of literature on the subject has emphasized is that there is really no single equation for buffer strip width that applies to every situation. Given the high erodibility of the soil types surrounding the wetlands and the extreme sensitivity and significance of the natural heritage resources, 330 feet is the most appropriate width for the forested buffer strip for the wetlands of this natural area. A 330 feet buffer strip was also designed around swamps and perennial and intermittent streams which feed into the marsh. Since those tributaries communicate directly with the core area, their water quality is also a concern for protection. Where the height-of-land (drainage divide) occurs closer than 330 feet to the edge of the wetlands or water course, the secondary boundary runs along the drainage divide. The secondary boundary was also extended 330 feet past the primary boundary into the Chickahominy River where the river is adjacent to the marsh for stewardship reasons.

The yellow cowlily habitat is also protected by the secondary boundary around the marsh and creeks.

OWNERSHIP AND ZONING: Except for open water, Hog Neck Creek Natural Area is entirely within private ownership and includes parts of four tracts. Areas of open water are considered "waters of the state."

The entire natural area is zoned general agricultural.

PRIMARY ACREAGE: 310 acres

SECONDARY ACREAGE: 320 acres

PROTECTION RECOMMENDATIONS: The freshwater marsh and its creeks and channels are afforded some protection by the Federal Clean Water Act and similar state and local tidal wetland laws and the James City County Chesapeake Bay Preservation Ordinance. The Clean Water Act regulates alteration of wetlands. The Chesapeake Bay Ordinance provides a 100 foot buffer around the edge of wetlands and watercourses of the Bay; most types of development are restricted from within the 100 foot buffer zone.

Because laws and their interpretation can change, additional protection should be secured for the site. Natural Area Registry with the private land-holders of the natural area would most appropriate for this site. A management agreement should accompany the registry for those tracts upon which intensive forestry practices occur.

STEWARDSHIP RECOMMENDATIONS: Land uses which would degrade water quality or disturb the hydrologic regime of the marsh, such as physical development, ditching, wastewater discharge, and road and utility construction, should be restricted from within the natural area. The buffer strip between the primary and secondary boundary should remain forested except that some types of environmentally sensitive timber harvest may be compatible in some sections of the buffer zone. Hunting and fishing are generally compatible uses inside the primary and secondary boundaries.

Hog Neck Creek Natural Area is subject to a moderate amount of motorized boat traffic. The establishment of a research program to determine the effects, if any, of motorboat traffic in this and the other Chickahominy River natural areas is recommended. Appropriate actions for the preservation of the tidal marsh and creek ecosystems should be instituted based on the results of the study.

Yellow cowlily colonies in Hog Neck Creek Natural Area often show signs of damage from motorboats passing through them. Steps to help abate motorboat damage to the yellow cowlily populations would greatly enhance their long-term viability. Preventative measures could include posting of educational signs at area marinas and possibly in or near yellow cowlily colonies themselves. The signs could provide a description of the plant, explain its sensitivity and significance, and request boaters to voluntarily avoid navigating through cowlily colonies.

The tidal freshwater marsh should be monitored periodically. Several permanent sampling plots should be established in random locations in the marsh (pending a management agreement with the landowner). In each sampling plot, species composition and relative abundances should be measured at least once every five years during the late growing season. Soil composition factors should also be recorded on these visits. Such a biological monitoring program will not only provide insight as to the structure and function of this exemplary wetland community, but also sound early warnings to adverse changes in the ecology of

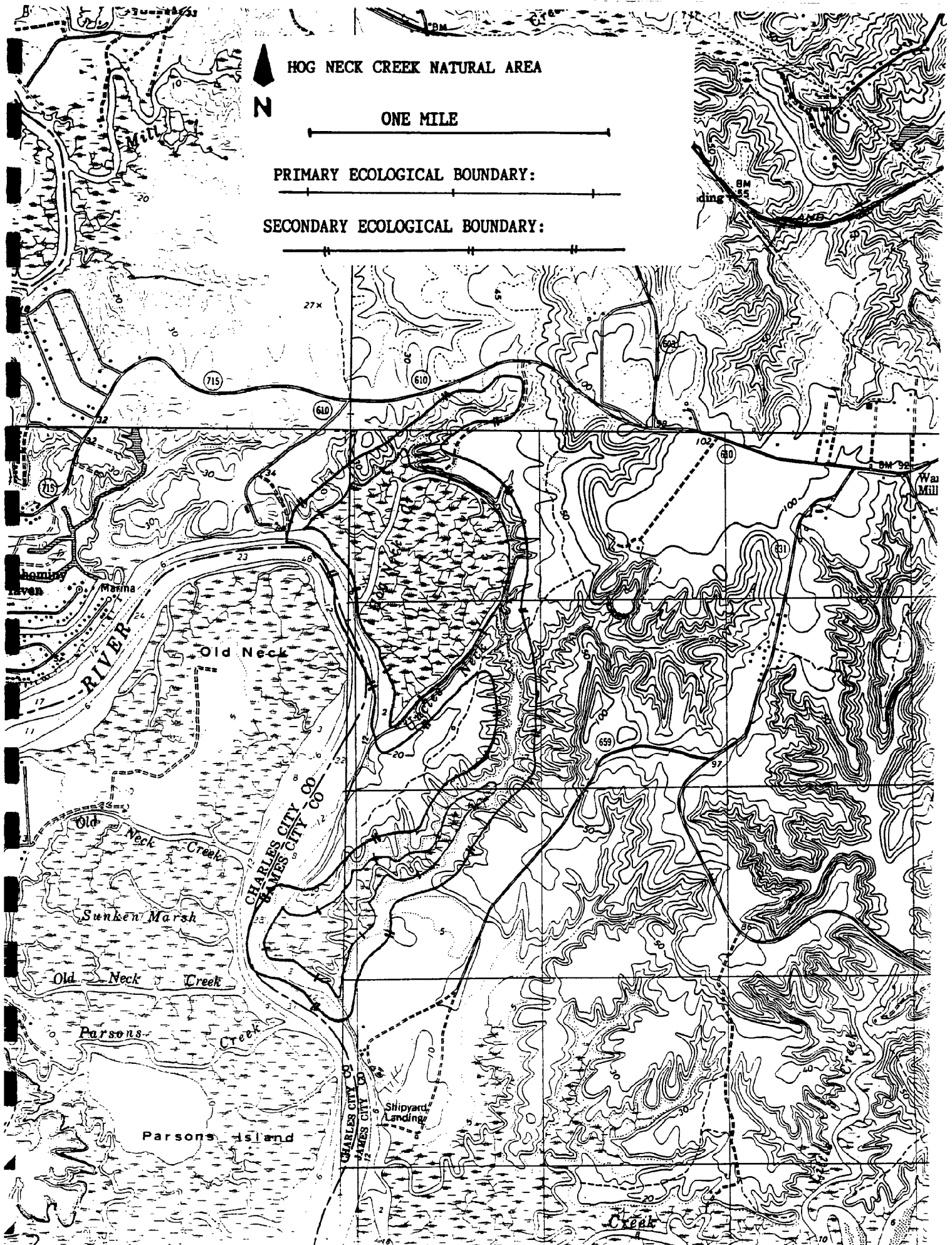
the marsh from such threats as invasive species, hydrologic disturbance, or water pollution.

The rare plant population should also be monitored periodically. A single visit during the fruiting season of the species should be sufficient to document the status of the population.

Searches for potentially invasive problem species should also be conducted during the biological monitoring visits. If an invasive species, such as common reedgrass, is determined to be threatening the viability of the marsh or the rare plant population, the problem species should be controlled or suppressed using environmentally safe techniques.

Department of Conservation and Recreation staff scientists are available to assist with the design and implementation of the biological monitoring program.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: This area is located near Shipyard Landing. Some education could be oriented from the water to this area. For example, a boat accessed observation platform at or near the natural area could promote an awareness of natural heritage resources and encourage the protection of the site.



HOG NECK CREEK NATURAL AREA

N

ONE MILE

PRIMARY ECOLOGICAL BOUNDARY:

SECONDARY ECOLOGICAL BOUNDARY:

RIVER

Old Neck

Sunken Marsh

Old Neck Creek

Parsons Creek

Parsons Island

CHARLES CITY CO.
JAMES CITY CO.

Shipyard
Landing

Creek

Wau
Mill

KENTUCKY FARMS

SIZE: 130 acres

BIODIVERSITY RANK: B5

LOCATION: York County
Poquoson West quadrangle

GENERAL DESCRIPTION: Kentucky Farms Natural Area consists of a nearly level site in southern York County forested by mixed pines and hardwoods. Soils on the site consist mostly of silt loams such as Bethera silt loam and Peawick silt loam. The natural area harbors a fair occurrence of an uncommon natural community type.

Timber management and agriculture have been the principle historic land uses in the natural area. Currently, the site is managed for its timber resources. Surrounding land uses include farming, forestry, and operation of an airport.

NATURAL HERITAGE RESOURCES: Kentucky Farms Natural Area contains a small number of coastal plain sinkhole ponds similar to those found at the Grafton Ponds Natural Area to the north. The ponds are actually depression caused by the dissolving and sagging of underground marl (ancient shell) deposits. The ponds' hydrology is influenced by a combination of surface and ground water. Most ponds fill in the winter and spring, loose water through the late spring and summer, and are usually dry by the late summer or early autumn. Each pond has a unique hydrologic regime which may also vary from year to year. The type of vegetation found in and around each pond is influenced by its hydrologic regime. These unusual natural communities often harbor rare plant and animal species.

Fifteen to twenty small ponds occur in this natural area. Trees in and around the ponds are maturing, but have been heavily logged in the past.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary encompasses the ponds and forest habitat connecting groups of ponds.

SECONDARY ECOLOGICAL BOUNDARY: The secondary boundary includes a substantial amount of forest around the primary boundary. The purposes of the secondary boundary are to provide a buffer zone around the primary boundary for protection of surface and ground water quality and quantity and to connect the two separate primary areas with continuous forested habitat.

A corridor of forest habitat connecting Kentucky Farms Natural Area with Grafton Ponds Natural Area is also included in the preserve design. The purpose of the corridor is to provide for movement of plants and animals from one site to the other, thus greatly increasing the long-term genetic viability of populations at each site.

OWNERSHIP AND ZONING: Most of the Kentucky Farms Natural Area is owned by the City of Newport News as part of their public water supply. The eastern part of the natural area is owned by the adjacent airport. The site includes parts of three tracts.

About half of the site is zoned residential conservation and half limited industrial. The residential conservation designation allows agriculture, forestry, or limited residential development.

PRIMARY ACREAGE: 30 acres

SECONDARY ACREAGE: 100 acres

PROTECTION RECOMMENDATIONS: The seasonal ponds may receive some protection from the Federal Clean Water Act depending upon what wetland delineation technique is used. The Clean Water Act regulates the alteration of wetlands.

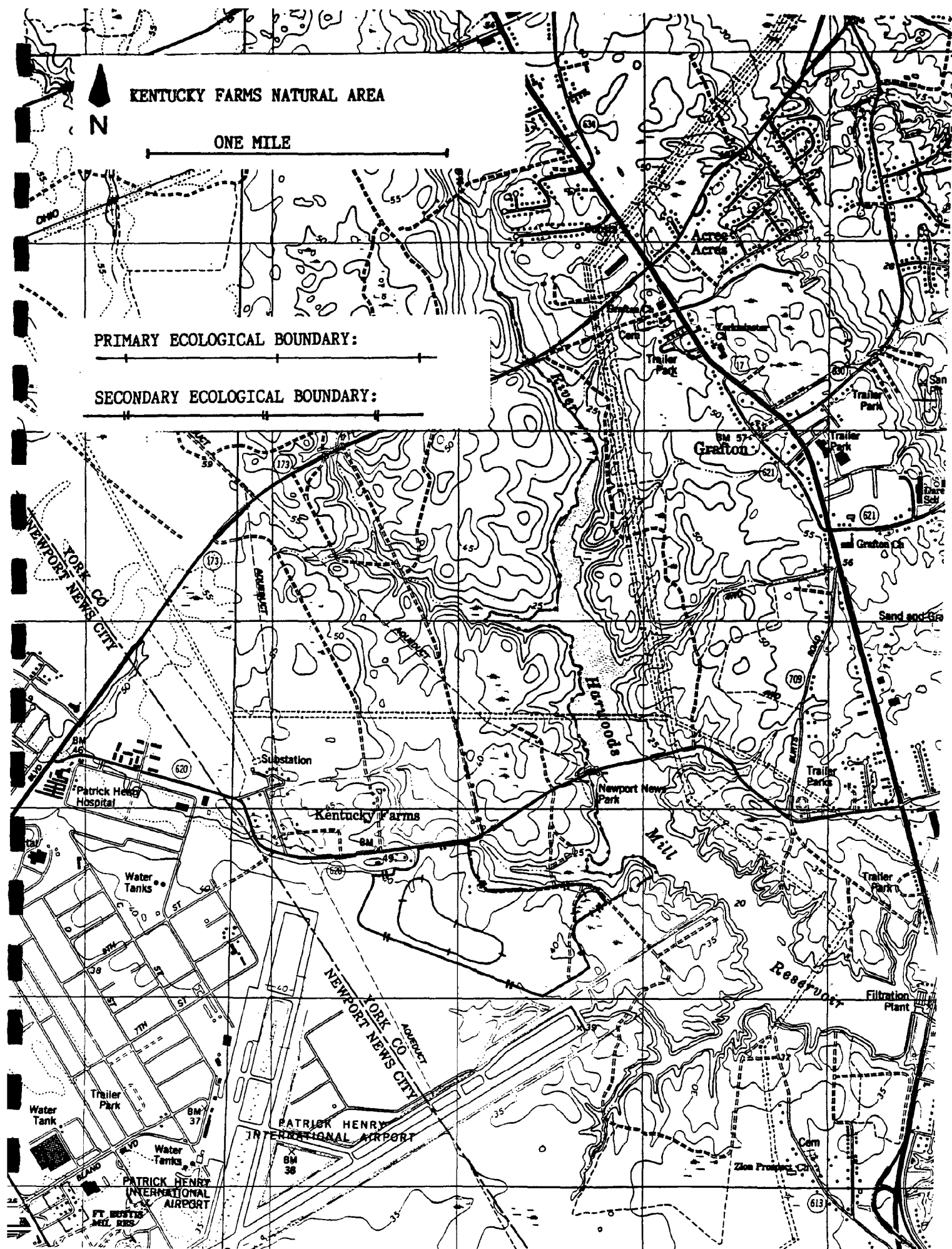
The Newport News Waterworks Department and the Peninsula Airport Commission should be approached regarding placement of this site on the Virginia Registry of Natural Areas. Management agreements in the form of Memoranda of Understanding should be negotiated among the Airport Commission, Newport News, York County, and the Department of Conservation and Recreation regarding the appropriate management of the natural area.

STEWARDSHIP RECOMMENDATIONS: Details as to compatible and incompatible land uses within the natural area should be established in the management agreements. Generally, the land within the primary boundaries and a 100 foot wide forested buffer zone around the primary boundaries should be left undisturbed. Forest management can continue between the forested buffer zone and secondary boundaries if measures are taken to protect the water quality and quantity of the seasonal ponds. Physical development such as buildings, roads, runways, and utilities should be restricted from within the natural area.

Additional inventory in and around the seasonal ponds may discover Mabee's salamander, a rare amphibian which occurs at other sites in the vicinity.

The seasonal ponds should be monitored periodically for their condition and threats.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: The property owned by the water works could be incorporated into a passive park area. Interpretive facilities could be placed near Harwoods Mill Park to provide information on the sinkhole ponds.



LACKEY PONDS

SIZE: 80 acres

BIODIVERSITY RANK: B5

LOCATION: York County
Yorktown quadrangle

GENERAL DESCRIPTION: Lackey Ponds Natural Area centers on a few seasonal ponds in a forested area just south of the community of Lackey. The ponds and surrounding forest support a very small population of a rare animal species. The forests consist of mixed hardwoods in the eastern half of the natural area and planted pines in the west. Soils in the natural area consist mostly of Slagle fine sandy loam with some Bethera silt loam occurring in the eastern part of the site.

The natural area was used for agriculture and forestry in years past. Current land use is timber management. The surrounding area is mostly forested with some residential development.

NATURAL HERITAGE RESOURCES: A rare amphibian, **Mabee's salamander**, has been documented at Lackey Ponds Natural Area through the capture of a single individual during a 1991 survey. Mabee's salamander is at the northern edge of its range in southeastern Virginia. The species' range is restricted; Mabee's salamanders occur only on the coastal plain of South Carolina, North Carolina, and Virginia. The salamander is known from six sites in Virginia, only four of which are confirmed reproductive populations. The species is listed as threatened under the Virginia Endangered Species Act. Mabee's salamanders are three to four inches long, dark gray or brown, and have light specks along their sides. In the family known as the mole salamanders, Mabee's salamanders spend most of their lives crawling through leaf litter or burrowing through soft ground in search of food (primarily ground-dwelling invertebrates). Individuals may range as far as 1000 feet from their breeding ponds, but the salamanders must return to the seasonal ponds to reproduce.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary contains the seasonal ponds of the site plus 1000 feet of adjacent mixed hardwood forest, except where development or pine plantations preclude such habitat.

SECONDARY ECOLOGICAL BOUNDARY: The secondary boundary encompasses an area upslope of the primary boundary to provide a buffer zone which will protect the surface and ground water quality and quantity. The secondary boundary also provides a 100 foot wide buffer zone around other parts of the primary boundary, where possible, to protect the woodland habitat from alteration caused by clearing of adjacent lands.

A corridor of forested habitat connecting Lackey Ponds Natural Area to Beaverdam Creek Natural Area is included in the preserve

design. The purpose of the corridor is to allow movement of species among conservation sites and thus greatly increase the viability of their otherwise fragmented populations.

OWNERSHIP AND ZONING: Approximately half of Lackey Ponds Natural Area is owned by the City of Newport News Waterworks Department. The remainder is in private ownership, including parts of four tracts. About half of the site is zoned residential conservation and half is zoned single family residential.

PRIMARY ACREAGE: 30 acres

SECONDARY ACREAGE: 50 acres

PROTECTION RECOMMENDATIONS: The seasonal ponds may receive some protection from the Federal Clean Water Act depending upon what wetland delineation technique is used. The Clean Water Act regulates the alteration of wetlands. Mabee's salamander receives protection from direct harm under the Virginia Endangered Species Act, but that legislation does not completely protect the species' habitat.

The Newport News Waterworks Department and the private owners should be approached regarding placement of this site on the Virginia Registry of Natural Areas. Appropriate management and land uses within the primary and secondary boundaries should be discussed.

STEWARDSHIP RECOMMENDATIONS: The land within the primary boundary and the 100 foot wide forested buffer zone around the primary boundary should be left undisturbed. Physical development such as buildings, roads, and utilities should be restricted from within the natural area. Forest management can continue within the secondary boundary beyond the 100 foot buffer strip if measures are taken to protect the water quality and quantity of the site.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: This area may provide an opportunity for connecting trails to the Newport News Park or extending trails to the pond sites.



NEW BETHEL CHURCH

SIZE: 230 acres

BIODIVERSITY RANK: B5

LOCATION: York County
Newport News North quadrangle

GENERAL DESCRIPTION: New Bethel Church Natural Area consists of a forested site on a low, level plain in southern York County. The forest includes mixed pines and hardwoods. Soils in the natural area include mostly Tomotly fine sandy loam with some areas of Nimmo fine sandy loam.

The principle historic land uses appear to have been forest management and agriculture. The natural area is currently subject to timber harvest and residential development. The natural area is surrounded by a large powerline corridor, light and medium-duty roads, rapidly growing residential developments, and a small marsh.

New Bethel Church Natural Area supports a good population of a rare plant species.

NATURAL HERITAGE RESOURCES: A population of Shumard's oak is found in New Bethel Church Natural Area. Though it is fairly common in some parts of its range which covers most of the southeastern and southcentral states, Shumard's oak is considered rare in Virginia because it occurs at less than ten sites and is limited to a distribution of four counties. Shumard's oak closely resembles scarlet oak in appearance and the acorns are sometimes needed to discern the species from each other. Besides destruction from logging, Shumard's oak is also vulnerable alteration of its habitat.

Although the species has been found scattered about the vicinity, the natural area boundaries encompass only the trees in a relatively undisturbed and unfragmented woodland habitat which supports many mature individuals as well as many seedlings. The area is threatened by logging and residential development.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary encompasses an unbroken, unfragmented, relatively old block of woodland habitat which supports the a large number of the oldest Shumard's oaks of the vicinity and forms the most easily protected unit of land. The primary boundary includes the known mature trees plus additional surrounding habitat for recruitment of seedlings into the population.

SECONDARY ECOLOGICAL BOUNDARY: Ideally, the secondary boundary would delineate a forested buffer zone to protect the habitat contained within the primary boundary. Because of existing development surrounding the Shumard's oak habitat, however, a

forested buffer zone is not possible. In this case, the secondary boundary is entirely coincident with the primary.

OWNERSHIP AND ZONING: New Bethel Church Natural Area is entirely within private ownership and the ownership pattern is complicated. Parts of several large tracts are included within the natural area, but these tracts are being quickly subdivided into residential lots.

The entire site is zoned single family residential.

PRIMARY ACREAGE: 230 acres

SECONDARY ACREAGE: 0 acres

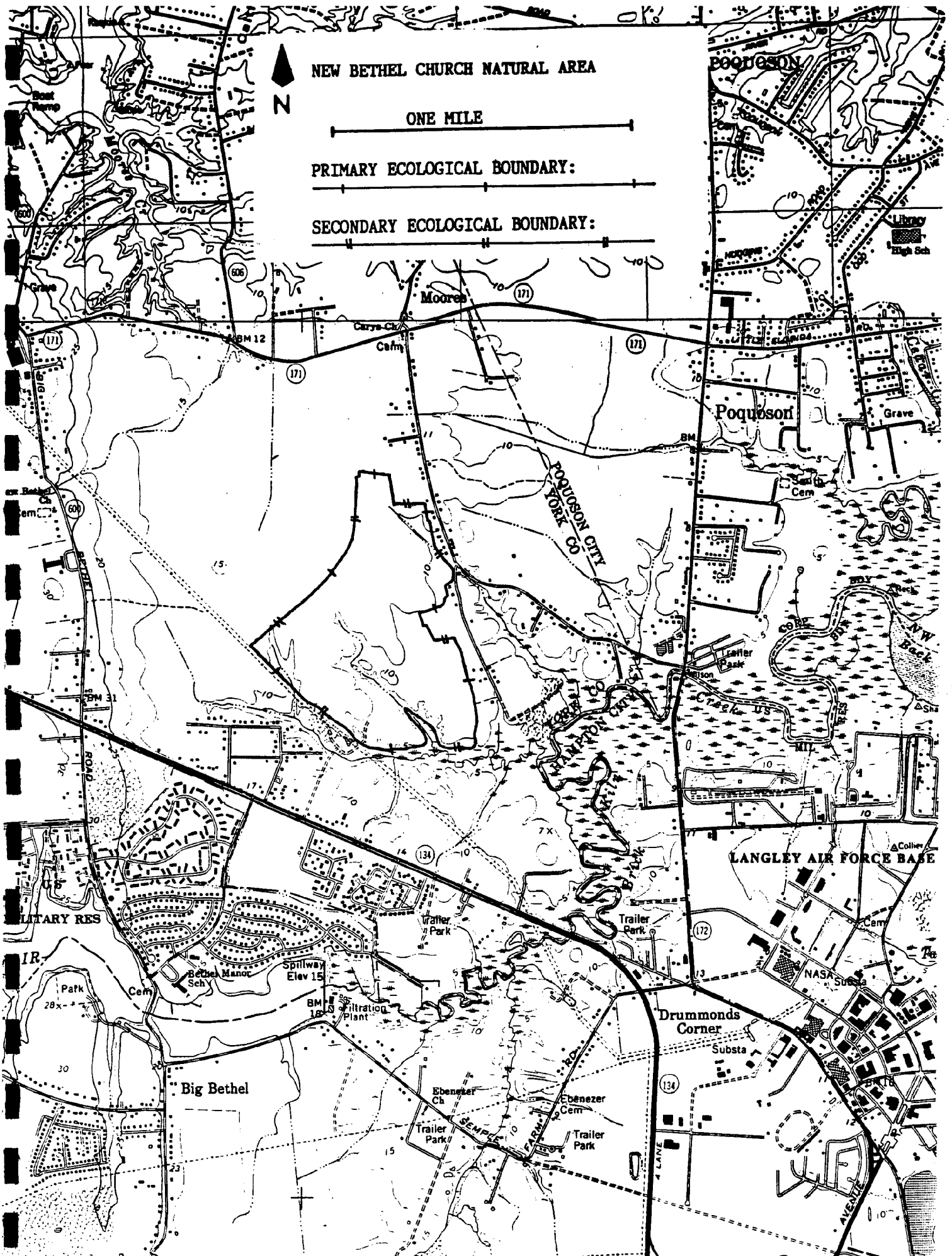
PROTECTION RECOMMENDATIONS: Shumard's oak has no existing protection. Some trees occur in wet areas of the site which may receive limited protection under the Federal Clean Water Act depending upon which wetlands delineation guidelines are used. The Clean Water Act regulates the alteration of wetlands.

Specific protection recommendations will depend on the results of additional inventory. A landowner contact and education program and addition of the site to the Virginia Registry of Natural Areas will probably be recommended.

STEWARDSHIP RECOMMENDATIONS: Additional inventory is needed for Shumard's oak at New Bethel Church Natural Area. With more complete population information, a more refined preserve design can be formulated and more specific protection and stewardship recommendations can be offered.

At least until further inventory is completed, the lands within the existing primary and secondary boundaries should be left undisturbed; land clearing and construction of roads, utilities, and buildings within the existing natural area boundaries should be discouraged.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: The areas designated within the ecological boundaries could be incorporated into greenspace for planned communities. The open space areas will ensure visual interest in the communities and help to preserve biodiversity.



QUEEN'S CREEK

SIZE: 2360 acres

BIODIVERSITY RANK: B5

LOCATION: York County and City of Williamsburg
Williamsburg and Clay Bank quadrangles

GENERAL DESCRIPTION: This natural area centers on Queen's Creek, a tidal tributary of the York River, and harbors several regionally significant habitats. Marshes line the creek and salinities decrease as one moves upstream. Most of the surrounding lands are forested, but an airstrip and some residential development occur near the lower part of the creek. Soils of the marsh are Bohicket muck, while the soils of the slopes surrounding the marsh consist of Emporia complex or Craven-Uchee complex, both a series of well-drained, highly erodible fine sandy loams. The soils of the adjacent level uplands consist predominantly of Emporia fine sandy loam.

Historically, the natural area and vicinity have been used for fishing, hunting, timber management, and military training. Those historic uses continue today to some degree and are augmented by recreational boating and residential development.

NATURAL HERITAGE RESOURCES: Queen's Creek Natural Area contains good examples of **tidal freshwater and brackish marshes**. The marsh of the natural area is medium-sized and in good condition. Though the marshes at the mouth of Queen Creek are decidedly brackish, salinities and tidal influence decrease gradually as one moves upstream. Marsh vegetation follows the same pattern, starting with typical brackish water species near the mouth or the creek such as saltmarsh cordgrass. Big cordgrass replaces saltmarsh cordgrass as the dominant species in the middle sections of the marsh. Scattered individuals of freshwater marsh species are seen among the big cordgrass. The upper marsh harbors typical freshwater marsh species such as cattails and wild rice.

Healthy marshes and tidal creeks furnish many ecological benefits. Marshes enhance water quality, help contain storm and flood waters, buffer against shoreline erosion, produce large amounts of nutrients and energy, and provide habitats for a vast array of vertebrates and invertebrates. Tidal creeks rich in submerged aquatic vegetation provide spawning and nursery areas for fish and other aquatic animals. High quality marshes and creeks are essential to the health and productivity of the Chesapeake Bay. Additionally, the proximity of this marsh to urban areas, the existing access at bridge crossings and a local park, and the salinity and vegetation gradient would make the marsh of Queen Creek an excellent outdoor classroom.

Some of the uplands surrounding Queen's Creek include good examples of **southern mixed hardwood forest**. American beech,

white oak, and tuliptree dominate the forest canopy. The understory is dominated by American holly and flowering dogwood in most places. These southern mixed hardwood forests are beginning to show old growth qualities such as many large maturing trees, complex stratification, diverse species composition and age structure, and substantial amounts of standing and fallen dead wood. If left undisturbed, these forests will develop into significant natural communities with time.

PRIMARY ECOLOGICAL BOUNDARY: The primary boundary encompasses the tidal creek and its associated marshes. Also included in the primary boundary are the significant forests.

SECONDARY ECOLOGICAL BOUNDARY: The secondary boundary generally follows the primary boundary at a distance of 100 feet. The secondary boundary also surrounds all swamps and streams feeding into Queen Creek. Because they communicate directly with Queen Creek, the tributaries are also a concern for protection.

The purpose of the secondary boundary is to provide a buffer zone between the areas within the primary boundary and adjacent land uses. The primary purpose of the buffer around the marsh is to protect the water quality and hydrologic regime of the marsh and its creeks. The buffer zone around the forest habitats prevent increased light into the forest, reduce the likelihood of invasion by aggressive "weedy" species, protect the soils from erosion, and decrease the possibility of wind-throw of trees.

OWNERSHIP AND ZONING: Approximately two-thirds of the natural area is in public ownership by York County (New Quarter Park), the City of Williamsburg (Waller Mill Reservoir and Park), the National Park Service (Colonial National Historic Park), and the US Department of Defense (Camp Peary Naval Reservation and US Naval Supply Center). The remaining private land in the natural area includes parts of 19 tracts and one subdivision.

Almost all of the natural area lies within York County; a small part of the marsh and its buffer zone are within the Williamsburg city limits.

Parts of the natural area within the City of Williamsburg are currently zoned for residential development. Most of the York County tracts are zoned residential conservation with the remainder zoned as rural residential or single family residential. Parts of the natural area under federal jurisdiction (Camp Peary and Colonial Parkway) are not subject to local land use regulations.

PRIMARY ACREAGE: 1700 acres

SECONDARY ACREAGE: 660 acres

PROTECTION RECOMMENDATIONS: The marsh habitats and their buffer zones receive protection from the Williamsburg and York County

Chesapeake Bay Preservation Ordinances. Areas within the primary and secondary boundary associated with the marsh and not on federal land have been designated as Resource Protection Areas by the Bay Ordinances. Most types of physical development are prohibited from within Resource Protection Areas. The marsh also receives some protection from the Federal Clean Water Act and state and local tidal wetland laws (especially the York County Tidal Wetlands Ordinance) which regulate the alteration of tidal wetlands.

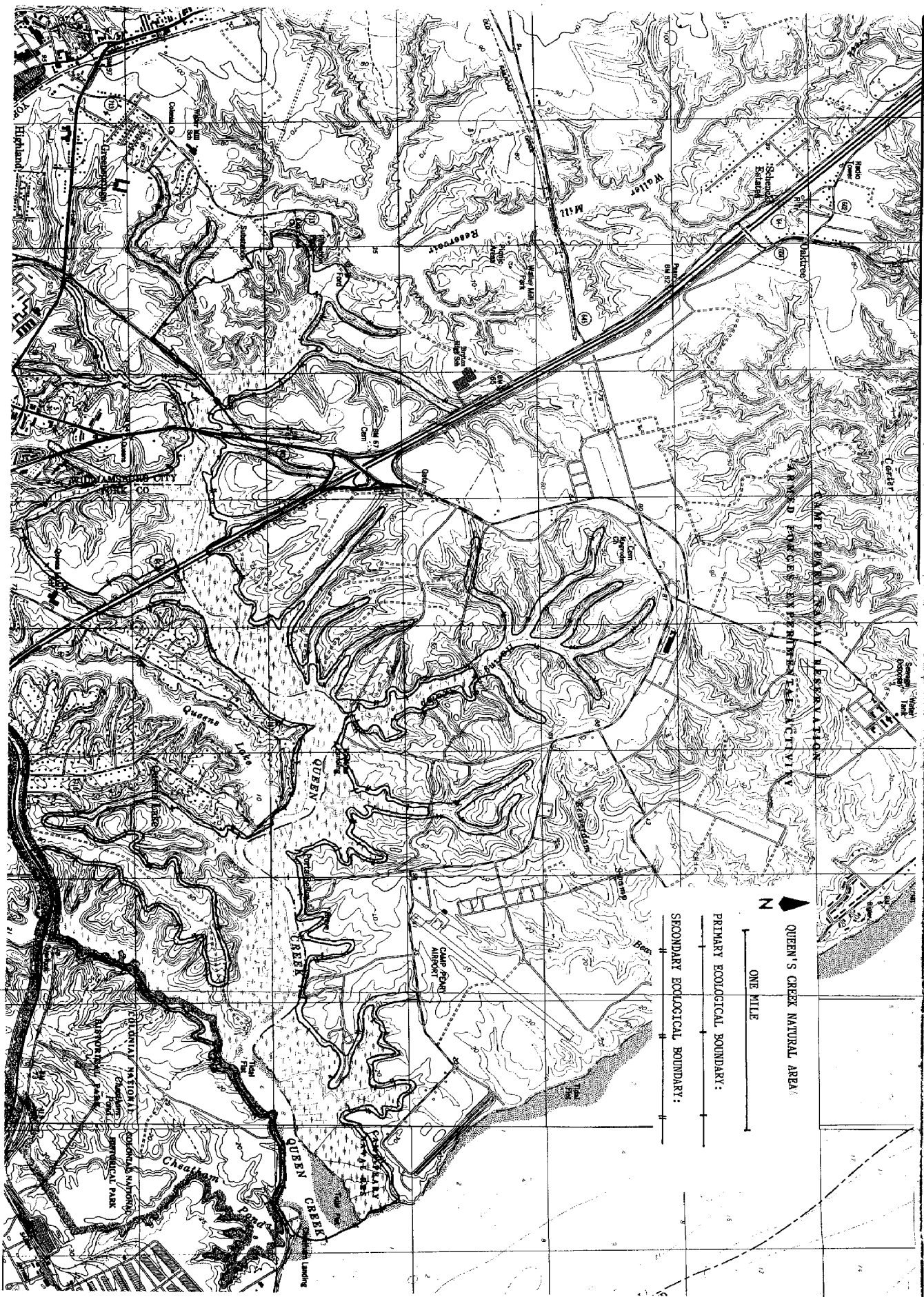
The marsh is fairly well protected by existing legislation, but the forest habitats have little protection. A small portion of the significant forests may fall under Resource Protection Area Designation. Given the regional significance of the natural area and its potential benefits to area residents, it is recommended that the York County pursue protection of the exemplary forests. Key tracts of the natural area should be added to the Virginia Registry of Natural Areas. Rezoning of the parts of the natural area associated with the exemplary southern mixed hardwood forests to a more conservation oriented designation should be considered. The managers of the Camp Peary and Colonial Parkway should also be approached regarding compatible management of the portion of the site which occurs on federal land.

STEWARDSHIP RECOMMENDATIONS: Land-disturbing activities such as timber harvest, physical development, and ditching should be restricted from within the natural area. Scientific research and environmental education within the natural area are encouraged.

Queen Creek Natural Area requires no additional natural heritage inventory, ecological management, or biological monitoring.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: The development of an interpretive canoe trail which focuses on the progression of a stream from freshwater to saltwater could be established within this natural area. Route 143 could function as the put in and New Quarter Park as the take out for canoes.

Queens Lake School could provide an additional opportunity for interpretive and educational exhibits. The woodland area adjacent to the school may provide some of these opportunities.



QUEEN'S CREEK NATURAL AREA
ONE MILE

PRIMARY ECOLOGICAL BOUNDARY:

SECONDARY ECOLOGICAL BOUNDARY:

UPPER CRAB NECK

SIZE: 840 acres

BIODIVERSITY RANK: B5

LOCATION: York County
Poquoson West quadrangle

GENERAL DESCRIPTION: Upper Crab Neck Natural Area consists of a large forested site on a low, level plain in eastern York County. The forest is dominated variously with stands of older oaks, stands of mixed hardwoods, and stands of mixed pines and hardwoods. The predominant soil type is Tomotley fine sandy loam.

Past land use on the site is forestry and possibly agriculture. It appears the site has been left undisturbed for some time. The natural area is completely surrounded by major roads, residences, light industry, and a very large powerline. A major petroleum refinery lays just north of the site.

Upper Crab Neck harbors a significant natural community and a small population of a rare plant species.

NATURAL HERITAGE RESOURCES: Upper Crab Neck contains a example of a **southern mixed hardwood forest**. Although much of the site has been heavily disturbed by logging and ditching in the past, several patches of older, maturing growth are scattered in the natural area and many of the remaining forest stands are beginning to recover from past disturbances. The highest quality stands are dominated by large, old oak trees, mostly cherrybark oak, swamp chestnut oak, white oak, and willow oak. American holly and red maple are common in the understory and are often accompanied by red bay and flowering dogwood. The herbaceous layer is well-developed in these older stands and scattered standing dead trees can be found. In the more disturbed areas loblolly pine and tuliptree become more dominant.

Although the southern mixed hardwood forest at Upper Crab Neck Natural Area is not virgin growth, some stands do have old growth qualities such as many large maturing trees, complex stratification, diverse species composition and age structure, and substantial amounts of standing and fallen dead wood. These old growth characteristics make the forest a significant natural heritage resource.

A very small population of **Carolina boltonia** is known from the southern edge of the natural area. *Carolina boltonia*, a member of the composite family, is very rare throughout its range which includes the piedmont and coastal plain from Virginia south to South Carolina. The species is also considered very rare in the Commonwealth; it is known from less than twelve sites in eight Virginia counties.

Carolina boltonias are tall (up to six feet) herbaceous perennial plants with many branches, sparse compound leaves, and yellow and white composite flowers. The plants normally grow in full sun in moist or wet soils. A single boltonia was discovered growing at the edge of a small stream at Upper Crab Neck in 1990. Two additional plants were discovered in the same vicinity in 1992. All of the plants were flowering.

PRIMARY ECOLOGICAL BOUNDARY: The primary ecological boundary encompasses all of the significant woodland and includes the rare plant habitat.

SECONDARY ECOLOGICAL BOUNDARY: Ideally, the secondary boundary would form a forested buffer zone around the primary boundary in this situation. Because the primary boundary is surrounded by major roads and development, a buffer zone is not possible. The secondary boundary at this natural area is entirely coincident with the primary boundary.

OWNERSHIP AND ZONING: Most of the natural area is owned by a single corporate landholder. Some of the natural area includes parts of several private tracts, especially along the periphery of the site.

Approximately three-fourths of the natural area is zoned general industrial with the remainder of the land within the natural area boundaries zoned limited industrial or single family residential.

PRIMARY ACREAGE: 840 acres

SECONDARY ACREAGE: 0 acres

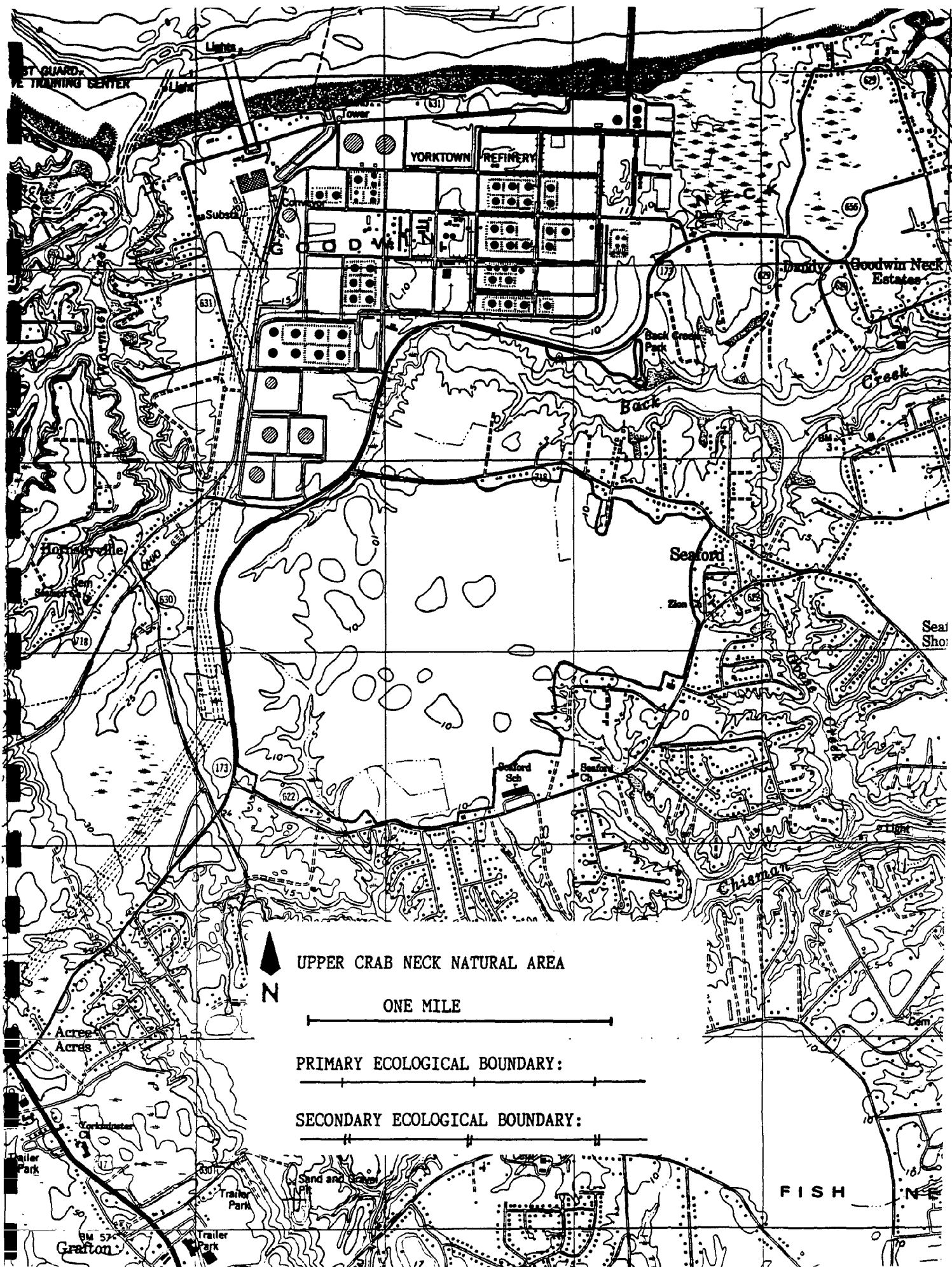
PROTECTION RECOMMENDATIONS: Upper Crab Neck Natural Area has no known existing protection.

The property owners should be contacted and advised as to the significance of the site. Placement of the site on the Virginia Registry of Natural Areas is recommended. Once positive relations have been established with the landholders, the negotiation of management agreements to protect the natural heritage resources of the site may be possible.

STEWARDSHIP RECOMMENDATIONS: The land within the natural area boundary should not be subjected to further land-disturbing activities such as timber harvest, ditching, or physical development. Hiking, nature observation, and environmental education are activities compatible with the natural heritage resources of the site.

Additional inventory should be conducted in Upper Crab Neck Natural Area. Inventory efforts should focus on finding any additional Carolina boltonia sites which may exist at the site. Known boltonia plants should be monitored periodically.

RECREATIONAL, SCENIC, AND EDUCATIONAL CONSIDERATIONS: The corporate landowner could be convinced to offer use of this site as open space to benefit the local community. Trails and interpretive exhibits could be established.



BIBLIOGRAPHY

Following is a listing of many of the written resources drawn upon during the course of this project. Also included are some general references regarding biodiversity and land protection tools. Additional information regarding conservation planning can be obtained by contacting the Virginia Department of Conservation and Recreation's Division of Natural Heritage.

Adams, L.W., and L.E. Dove. 1989. Wildlife Reserves and Corridors in the Urban Environment. National Institute for Urban Wildlife, Columbia, MD. 91 pp.

Andrew, J.M., and J.A. Mosher. 1982. Bald eagle nest site selection and nesting habitat in Maryland. Journal of Wildlife Management 46:382-390.

Bent, A.C. 1937. Life Histories of North American Birds. Dover Publications, New York, NY. 19 volumes.

Berger, J.J. 1990. Environmental Restoration. Island Press, Washington, DC. 398 pp.

Brennenman, R.L., and S.M. Bates, eds. 1984. Land-Saving Action. Island Press, Covelo, CA. 249 pp.

Brown, M.T., J.M. Schaefer, and K. Brandt. 1990. Buffer Zones for Water, Wetlands, and Wildlife in East Central Florida. CFW Publication #89-07, Florida Agricultural Experiment Stations Journal Series No. T-00061.

Buckley, P.A., and F.G. Buckley. 1976. Guidelines for the Protection and Management of Colonially Nesting Waterbirds. U.S. National Park Service, Boston, MA. 54 pp.

Calver, J.L., and C.R.B. Hobbs, Jr. 1963. Geologic Map of Virginia. Department of Conservation and Economic Development, Division of Mineral Resources (now Dept. of Mines, Minerals, and Energy), Charlottesville, VA.

Cooper, J.R., J.W. Gilliam, R.B. Daniels, and W.P. Robarge. 1987. Riparian areas as filters for agricultural sediment. Soil Science Society of America Journal.

Diamond, J.M. 1975. The island dilemma: lessons of modern biogeographic studies for the design of natural preserves. Biological Conservation 7:129-146.

Diehl, J., and T.S. Barrett. 1988. The Conservation Easement Handbook. The Land Trust Alliance, Alexandria, VA. 269 pp.

Dillaha, T.A., J.H. Sherrare, D. Lee. 1986. Long term effectiveness and maintenance of vegetative filter strips. Bulletin 153, Virginia Water Resources Research Center.

- Dillaha, T.A., J.H. Sherrard, D. Lee, S. Mostaghim, and V.O. Shanholtz. 1988. Evaluation of vegetative filter strips as a best management practice for feedlots. *Journal of Water Pollution Control Federation* 60:1231-1238.
- Dixon, J.A., and P.B. Sherman. 1990. *Economics of Protected Areas*. Island Press, Washington, DC. 234 pp.
- Fernald, M.L. 1950. *Gray's Manual of Botany*. Dioscorides Press, OR. 1632 pp.
- Gleason, H.A. 1952. *Illustrated Flora of the Northeastern United States and Adjacent Canada*. Hafner Press, New York, NY. 3 volumes.
- Harvill, A.M., Jr., T.R. Bradley, C.E. Stevens. T.F. Wiebolt, D.M.E. Ware, D.W. Ogle, G.W. Ramsey, and G.P. Fleming. 1992. *Atlas of the Virginia Flora, Third Edition*. Virginia Botanical Associates, Burkeville, VA. 144 pp.
- Hodges, R.L., P.B. Sabo, D. McCloy, and C.K. Staples. 1985. *Soil Survey of James City and York Counties and the City of Williamsburg, Virginia*. U.S.D.A. Soil Conservation Service. 137 pp.
- Hoose, P.M. 1981. *Building an Ark, Tools for the Preservation of Natural Diversity through Land Protection*. Island Press, Covelo, CA. 221 pp.
- Jaffee, N.B. 1980. Nest site selection and foraging behavior of the bald eagle in Virginia. M.A. thesis, College of William and Mary, Williamsburg, VA. 113 pp.
- Johnson, G.H., and C.R. Berquist, Jr. 1989. *Geology and Mineral Resources of the Brandon and Norge Quadrangles, Virginia*. Dept. of Mines, Minerals, and Energy, Charlottesville, VA.
- Klein, R.D. 1992. *The Effects of Boating Activity and Related Facilities upon Tidal Creeks in Maryland*. Community and Environmental Defense Services, Maryland Line, MD. 25 pp.
- Knight, S. K., and R.L. Knight. 1984. Responses of wintering bald eagles to boating activity. *Journal of Wildlife Management* 48:999-1004.
- Mathisen, J.E. 1968. Effects of human disturbance on nesting bald eagles. *Journal of Wildlife Management* 32:1-6.
- McGarigal, K. 1988. Human-eagle interactions on the lower Columbia River, Oregon. M.S. thesis. Oregon State University, Corvallis, OR. 115 pp.
- Mitsch, W.J., and J.G. Gosselink. 1986. *Wetlands*. Van Nostrand Reinhold Company, New York, NY. 539 pp.

- Norton, B.G. 1987. Why Preserve Natural Variety? Princeton University Press. 281 pp.
- Noss, R.F. 1987. Protecting natural areas in fragmented landscapes. *Natural Areas Journal* 7(1):2-13.
- Pennak, R.W. 1989. Fresh-water Invertebrates of the United States, Third Edition. John Wiley and Sons, Inc., New York, NY. 628 pp.
- Radford, A.E., H.E. Ahles, and C.R. Bell. 1968. Manual of the Vascular Flora of the Carolinas. University of North Carolina Press, Chapel Hill, NC. 1183 pp.
- Rawinski, T.J. 1990. A Classification of Virginia's Indigenous Biotic Communities: Phase 1 - Upper Levels of the Hierarchy. Unpubl. Report. Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. 11 pp.
- Roman, C.T., and R.E. Good. 1985. buffer Delineation Model for New Jersey Pinelands Wetlands. Rutgers Center for Coastal and Environmental Studies, Division of Pinelands Research.
- Shafer, C.L. 1990. Nature Reserves. Smithsonian Institution Press, Washington, DC. 189 pp.
- Soule, M.E. 1987. Viable Populations for Conservation. Cambridge University Press, Cambridge, UK. 189 pp.
- Soule, M.E., and D. Simberloff. 1986. What do genetics and ecology tell us about the design of nature reserves? *Biological Conservation* 35:19-40.
- Terwilliger, K., coordinator. 1991. Virginia's Endangered Species: Proceedings of a Symposium. McDonald and Woodward Publishing Company, Blacksburg, VA. 672 pp.
- White, C.P. 1989. Chesapeake Bay, Nature of the Estuary, a Field Guide. Tidewater Publishers, Centreville, MD. 212 pp.
- Weigmann, D.L., and C.J. Kroehler. Threats to Virginia's Groundwater. Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University, Blacksburg, VA. 44 pp.
- Williams, R.D. 1990. Vegetative filter Strips and surface Water Quality. Unpublished report of USDA-ARS Water quality and Watershed Research Laboratory.
- Wright, L.D., and S.P. Hubbell. 1983. Stochastic extinction and reserve size: a focal species approach. *Oikos* 41:466-476.
- Zabawa, C. 1981. The role of boat wakes in shore erosion in Anne Arundel County, Maryland. Maryland Coast Report 5:1-4. Maryland Department of Natural Resources, Annapolis, MD.

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APPENDIX A

LOCAL OPTIONS FOR CONSERVING NATURAL AREAS

by Shepard Moon
Virginia Council on the Environment

LOCAL OPTIONS FOR CONSERVING NATURAL AREAS

Virginia Council on the Environment

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This report was prepared by staff of the Virginia Council on the Environment at the request of the Department of Conservation and Recreation. It is a general guide to the land management options available to local governments in Virginia for conserving natural areas. The report is for use in conjunction with the Division of Natural Heritage report, Conservation Planning for the Natural Areas of the Lower Peninsula, which contains detailed information on identified natural areas in James City and York Counties, and the City of Williamsburg. The Natural Heritage report is the final product of a multi-year effort to survey and promote protection for important natural areas in the subject localities. The Natural Heritage survey was conducted at the request of local officials. The concepts presented here are applicable throughout Virginia and can be used for natural area conservation planning in any state locality.

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LOCAL OPTIONS FOR CONSERVING NATURAL AREAS

I. Introduction

This report describes options available to Virginia localities for conserving natural areas identified through a natural heritage resource inventory. Natural heritage resources are "the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest" (Virginia Natural Area Preserves Act, *Virginia Code* §10.1-209 et seq.). Natural areas are determined based on an inventory, conducted by the Department of Conservation and Recreation's Division of Natural Heritage, which systematically identifies natural heritage resources and the land area necessary to protect them.

Natural areas are increasingly threatened by the cumulative effects of human activities which alter the natural environment. Habitat disturbance, fragmentation, or destruction is occurring as a result of encroaching urban development as well as logging, agriculture, and surface mining. The conservation techniques described in this report can be used in various combinations to prevent the loss of important natural areas and provide a comprehensive local natural areas protection program.

In describing natural area boundaries, staff scientists from the Division of Natural Heritage consider a number of factors including;

- the extent of current and potential habitat for important biological communities,
- species migration corridors, and
- buffer requirements to maintain surface and ground water quality and quantity within the site, and exclude or control problem species.

Using these guidelines, a preserve design is prepared for each natural area which generally consists of two zones: a core reserve, and a buffer zone. Each zone has its own special planning considerations. In general, the core reserve requires the highest level of protection. A buffer zone around the core protects it from outside threats and encroachments. This buffer may still be used in a low intensity manner if appropriate performance standards are applied. The specific requirements of each

zone may vary from site to site, based on the characteristics and needs of the resources found there.

The primary goal of a local natural areas program is to conserve natural heritage resources. Other benefits of preserving these natural areas include providing habitat for other, more common species, as well as providing opportunities for recreation, education and research. In order to better integrate natural area conservation into the local decision process, complementary goals should be to protect these resources in ways that do not impose unfair restrictions on private property, and that serve as an asset for local economic and community development efforts.

Most efforts to date to conserve natural heritage resources have focused either on state and federal regulations or traditional non-regulatory options such as acquisition or easements. These most commonly used methods are discussed in the next two sections of this report. There is also, however, a growing trend toward increased local government involvement in natural area conservation. An enhanced local role can fill the gaps where federal and state programs are unable to limit habitat loss from land development and other activities which fall under the purview of local programs. Information on the location of natural areas can assist localities in planning for community development and implementing local land management programs. These options for managing development are also discussed later in this report.

A key principle for a successful local natural areas program is to integrate natural heritage resource conservation into the planning and land management process in a way that considers local circumstances and accommodates community development. There is no single approach for natural area conservation that is appropriate for all localities. An appropriate program is determined by local conditions such as population density, anticipated growth, the extent and value of natural areas, public awareness of the issue, and the general vision the community has for its future. Each strategy has advantages and disadvantages in different situations and for different localities. Certain local governments will choose to emphasize one approach over another. The most effective local programs, however, will likely consist of a combination of strategies and management techniques. These issues will be discussed in the last section entitled "developing a natural areas conservation program".

II. State and Federal Regulations

State and federal mandates play an important role in conserving natural heritage resources. Some, such as state and federal endangered species laws, are directed specifically at protecting these resources. Others are focused on managing significant lands such as wetlands, beaches, or Chesapeake Bay Preservation Areas which may contain natural heritage resources or be closely tied to the well being of these resources. Still others, such as the National Environmental Policy Act and Virginia's Environmental Impact Review Process are designed to identify and manage the effects of proposed public facilities, including impacts to natural heritage resources. Taken together, these mandates can provide an important component of a comprehensive natural area conservation program.

State and Federal Laws Protecting Rare Plants and Animals

Virginia's natural heritage includes a number of species which are listed or proposed for inclusion on the state or federal endangered or threatened species lists. Several protection measures are afforded to listed endangered and threatened species such as systematic surveys, preparation and implementation of recovery plans, permit review, land acquisition and other species conservation actions.

Virginia has two laws designed to protect endangered species. The Virginia Endangered Species Act (*Virginia Code* §29.1-230 et seq.) was passed in 1972 and is administered by the Department of Game and Inland Fisheries. This legislation prohibits the taking, transportation, sale, etc. of endangered and threatened animal species, except by permit. Virginia's Endangered Plant and Insect Act (*Virginia Code* §3.1-1020 et seq.) was passed by the General Assembly in 1979 in order to extend protection and management to endangered and threatened species of plants and insects. This act is administered by the Department of Agriculture and Consumer Services and prohibits the taking or possession of listed species except from a person's own land or by permit.

The U.S. Fish and Wildlife Service administers the federal Endangered Species Act, which was passed in 1973. The Fish and Wildlife Service's regulations promulgated pursuant to this act prohibit the taking of any endangered species including significant modification or degradation of their habitat. Cooperative agreements for the implementation and enforcement of provisions of the federal Endangered Species Act have been signed by the U.S. Fish and Wildlife Service with

the Department of Game and Inland Fisheries and the Department of Agriculture and Consumer Services.

Environmental Impact Review

Environmental review affords an important opportunity to provide early comments on the potential impacts to natural heritage resources from proposed federal and state development projects. Projects proposed, funded, or permitted by a federal agency may require some level of environmental review under the National Environmental Policy Act (NEPA). Under this act, any federal agency proposing, funding, or granting a permit for an activity which could affect a threatened or endangered species must consult with the U.S. Fish and Wildlife Service. The rules governing the federal environmental impact process require that federal agencies contact affected state and local governments in preparing and reviewing federal documents. The Council on the Environment is the coordinating agency for the Commonwealth of Virginia for federal environmental documents, with the exception of road projects.

The Commonwealth of Virginia also requires an environmental review of major state-funded projects. The Virginia Environmental Quality Act (*Virginia Code* §10.1 - 1200 et seq.) requires that any state agency or institution proposing to construct facilities costing more than \$100,000 must prepare an environmental impact report and submit it to the Council on the Environment. If there is a possibility that natural heritage resources will be affected by a state project, the Division of Natural Heritage will be asked to comment. The impacts to natural heritage resources must be described in the environmental impact report along with measures to avoid or minimize these impacts. Following a review of the project, the Council provides comments to the Governor prior to authorization for project funding. Unlike the federal NEPA, state legislation does not require state agencies to prepare an environmental impact report before issuing permits to private parties.

Certain agencies and organizations submit permit applications and project notices directly to the Division of Natural Heritage in response to various mandates beyond the coordinated review programs described above. These include the Virginia Department of Transportation, the Virginia Marine Resources Commission, the State Water Control Board, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service and other permitting and regulatory agencies, along with some private concerns. Again, the objective of this review is to protect natural heritage resources

by avoiding or minimizing impacts to the resources. The Division of Natural Heritage reviews these proposals and makes recommendations to assist in planning efforts.

State and Federal Regulation of Significant Areas

State and federal regulations apply to certain classes of environmentally significant areas which may contain or be closely linked to natural heritage resources. These include wetlands, dunes, beaches, and Chesapeake Bay Preservation Areas. These areas provide rich habitats and often have a higher than average likelihood of supporting rare species. Although natural heritage conservation may not be the sole or primary purpose for protecting these areas, applicable regulations can form an important component of a comprehensive local natural areas program.

Wetlands, both tidal and non-tidal, have a number of important physical and biological functions, including providing important habitat for many rare and endangered species. Nationally, almost 35 percent of protected animal species are found in wetlands, although wetlands cover only about 5 percent of the nation's land area. In Virginia, over 50 percent of our rare, threatened, or endangered plant species are found in wetlands.

State law regulates the use of tidal wetlands in Virginia (*Virginia Code* §28.2-1300 et seq.). This law is administered cooperatively by local wetlands boards and the Virginia Marine Resources Commission. A permit from the local wetlands board is required prior to starting construction, dredging, or filling a tidal wetland. Permits are to be issued only if the proposed activity would not violate the intent and standards of the law and the benefits of the activity exceed its detriment. One of the standards listed in the law is that "wetlands of primary ecological significance shall not be altered so that the ecological systems in the wetlands are unreasonably disturbed."

Non-tidal wetlands are regulated under Section 404 of the Clean Water Act (1977), administered by the U.S. Army Corps of Engineers. The Act prohibits disposal of dredged material or placement of fill material into "waters of the United States," which are interpreted by the Environmental Protection Agency to include most non-tidal wetlands. Section 401 of the Act gives states the authority to review the 404 permit applications (as well as other federal water permits or license requests), and to certify accordance with state water quality standards and policies. As a result of 1989 Virginia legislation, the state has strengthened its 401 certification program through the issuance of a Virginia Water Protection Permit.

Beaches and coastal primary sand dunes in Virginia are regulated by *Virginia Code* §28.2-1400 et seq. This law is administered in similar fashion to the wetlands law and requires a permit for any dune or beach disturbing activity above the mean high water mark. Beaches below the mean high water mark are regulated by the wetlands law.

The Chesapeake Bay Preservation Act (*Virginia Code* §10.1-2100 et seq.), although enacted to protect water quality, has provisions which can help conserve natural heritage resources. The Chesapeake Bay Preservation Area Designation and Management Regulations are administered by the Chesapeake Bay Local Assistance Department and implemented by local governments in the Tidewater region of Virginia. The regulations require local governments to designate tidal and contiguous non-tidal wetlands, tidal shores, and at least a 100 foot buffer as Resource Protection Areas. Development or alteration of these areas is, in most cases, prohibited. Adjacent lands which may affect water quality are designated as Resource Management Areas. Land uses in these areas must meet specific water quality protection criteria.

The regulations that apply to each of these environmentally significant areas can be instrumental in protecting natural heritage resources. It is important to recognize, however, that these programs were not designed solely to conserve natural heritage resources. In some cases, the regulations may permit activities which are detrimental to these resources. For example, non-tidal wetlands such as bottomland hardwood areas may be logged under current regulations, thus severely altering the ecosystem. This does not mean that the regulations have no value for habitat protection, but rather that it may be necessary in some cases to use other management techniques in addition to the applicable regulations.

III. Non-regulatory Options

The state and federal regulatory programs described above may afford protection against some of the threats to natural areas. More than likely, however, they will not by themselves provide sufficient conservation measures to fully protect a natural area. In order to provide comprehensive natural area conservation, other protection techniques need to be used as well. An integral part of a comprehensive natural area conservation program will be effective partnerships among the various parties having influence over activities that affect the target resources. Landowners,

businesses, developers, environmental groups and citizens in general need to be included in this partnership along with local and state government. This section describes some techniques that can be used for building partnerships to conserve natural areas through non-regulatory means.

Acquisition

Fee simple acquisition is one of the oldest and most direct strategies for conserving natural areas. Natural areas can be acquired by the federal, state, or local governments, or by private concerns. Funds to acquire these areas can also come from some combination of these groups. There are hundreds of natural areas in need of protection in Virginia. Because funds are limited and land is expensive, only a small percentage of the most biologically important natural areas can be protected through outright acquisition by the state and federal governments or by private conservation organizations. Still, acquisition can play an important role in local natural area conservation and can be particularly effective if local governments, businesses, and conservation groups take an active role in acquiring important properties.

In some cases land acquisition may be the only realistic option for preserving significant natural areas. For instance where parcels lie entirely within an important natural area, conservation might require a difficult compromise between habitat preservation and reasonable use of the land. Where the owner is interested in altering land in ways detrimental to the natural heritage resources, some form of acquisition may be the most appropriate preservation technique. The property could be acquired by the local government, a private environmental group, or a coalition of interests including businesses and private citizens.

There are a number of options, and combinations of options, available for acquiring and maintaining important natural areas. The simplest option is for the local government to purchase property with either general funds or through a local bond issue. This option, of course, requires strong support from local citizens. Local government funds can also be used as "seed money" to attract contributions from businesses, citizen groups and private individuals, or to be used as a match for other grants. Funds may also be available on a competitive basis from the state or federal governments and national conservation organizations. In addition to fee simple purchase of property, these funds could also be used to protect natural heritage resources by leasing land. This technique can be a more cost effective use of funds if

the property owner is interested in such arrangements.

Acquisition of important natural areas can provide a core from which to build a more comprehensive open space network. It may also encourage nearby property owners to preserve their land through other techniques such as those discussed below.

Conservation Easements

Conservation easements are legally enforceable agreements between a landowner and a government agency or conservation organization that place restrictions on the present and future use of land. State agencies and local governments can hold easements, or property, under the provisions of the Open Space Land Act (*Virginia Code* § 10.1-1700 et seq.). The Virginia Outdoors Foundation, which was created to accept and hold gifts of open space land, also accepts easements (*Virginia Code* § 10.1-1800 et seq.). Non-profit conservation organizations can hold conservation easements under the provisions of the Virginia Conservation Easement Act (*Virginia Code* § 10.1-1009 et seq.). An easement can run for a term of years or can be a perpetual easement to be observed by the present and future owners of the land. Easements are attractive for both the conservation-minded landowner as well as the agency or conservation organization. The restrictive terms of the easement are entirely negotiable between the parties involved. The present and future landowners continue to enjoy many uses of the property while the agency or conservation organization achieves their conservation goals for the site. There are also financial benefits for the donor of the easement such as a possible reduced assessment for real estate purposes, a charitable deduction for state and federal income tax purposes, and reduction of federal estate taxes and Virginia inheritance taxes.

Dedication of Natural Area Preserves

The Virginia Natural Area Preserves Act authorizes the Department of Conservation and Recreation to accept the dedication of qualified natural areas into the Virginia Natural Area Preserves System. Natural area dedication is the strongest form of protection that can be afforded a natural area. It involves recording a legally binding agreement which states the conservation purpose of a property and grants a conservation interest to the Department. The terms of a dedication agreement can be similar to those of a conservation easement and should state intentions for the use of the property, its management, development, and possible public uses. The dedication

agreement is recorded with the deed of the property and is perpetual. The Natural Area Preserves Act allows any private landowner, state agency, or other public body (other than federal) to dedicate their lands as natural area preserves. Private landowners may dedicate their property as a natural area preserve and still maintain ownership and all rights to sell or otherwise transfer title to the property. In addition to the satisfaction of preserving important natural resources, the same financial benefits offered the donor of a conservation easement are available to a private landowner who dedicates land as a natural area preserve.

Natural Areas Registry and Management Agreements

The Virginia Natural Area Preserves Act also authorizes the Department of Conservation and Recreation to maintain a state registry of voluntarily protected natural areas. The Division of Natural Heritage is initiating a registry program for voluntary conservation of publicly and privately owned natural areas. Natural Area registry agreements will be sought on private, state, and federal lands. Participating landowners receive a plaque that recognizes the significance of the property and its placement on the Department's Natural Area Registry. In return, the landowner offers voluntary protection for their property and agrees to notify the Department of Conservation and Recreation of any intent for ownership to change hands, as well as the condition of the natural heritage resources on the land. In return for this voluntary protection, a landowner receives the personal satisfaction of knowing that they have contributed to a statewide natural area conservation effort. Landowners also receive advice and assistance with site and species management and monitoring, and other assistance from the Department of Conservation and Recreation relating to natural area conservation.

A management agreement is a contract between the landowner of a natural area and an agency or conservation organization to achieve specific conservation objectives. Management agreements are designed to clearly state the desires of the landowner and the conservation group in regard to the conservation intent for the site and the duration of the agreement. These agreements can be used to conserve natural areas on either publicly or privately owned land. A natural area management agreement may be an effective conservation option alone, or may be used in conjunction with some other technique such as natural areas registry.

Tax Incentives

Under the "Land Use Assessment Law" (*Virginia Code* §58.1-3230 et seq.) a locality may, at its own option, adopt a program of preferential assessment for lands devoted to agriculture, horticulture, forestry, and open space uses. In localities which adopt this program, real estate which meets qualification standards formulated by the State Land Evaluation Advisory Committee is assessed by local officials according to its "use value" as opposed to its fair market value. Such assessments promote the conservation of open space by ameliorating pressures which might otherwise force a property's conversion to more intensive use.

The Agricultural and Forestal Districts Act (*Virginia Code* §15.1-1506 et seq.) allows farm or timberland owners to voluntarily form agricultural or forestal districts. These are areas in which landowners declare their intention to maintain their land in agricultural or timber harvesting for a period of five to eight years. Although the primary goal of this legislation is to preserve the economic production aspects of these lands, the act also states that the areas will serve to "conserve and protect agricultural and forestal lands as valued natural and ecological resources which provide essential open spaces for clean air sheds, watershed protection, wildlife habitat, as well as for aesthetic purposes." In return for entering into a district agreement, landowners receive certain financial incentives and protection from development pressures. Landowners in an agricultural or forestal district are automatically eligible for use-value assessments for property taxes. Limitations are placed on the expenditure of public funds for infrastructure expansion in districts as well as restrictions on the acquisition of land through eminent domain. Local governments rezoning parcels next to agricultural and forestal districts must also consider the existence of these districts in their decision making.

Although agricultural and forestal districts do not prohibit all activities which may be detrimental to natural areas, they can help reduce development pressures and provide some buffering from development. In this respect, these districts would be most valuable when combined with some form of acquisition, such as conservation easements, for the most important natural areas within a district.

IV. Managing Development

Non-regulatory protection options, used in combination with state and federal regulations, can provide a strong core for a local natural area conservation program. But these regulations and agreements, although valuable components, do not by themselves represent a comprehensive natural areas program and probably cannot protect all of the natural areas in a locality. State and federal regulations will not apply to all of the land within most natural areas. Non-regulatory protection options are limited by available funds and by the wishes of current landowners. In order to supplement these strategies and develop a more extensive system of protected natural areas, local governments should use their land management authority to harness the development pressures threatening natural areas. Development proposals can then actually be used to conserve these areas. To accomplish this objective, a strong natural area conservation component in the comprehensive plan is essential. The plan can provide a blueprint for natural area conservation which can be implemented through several different flexible zoning techniques. This section describes these planning and land management mechanisms which are available to localities for conserving natural areas by managing development.

Comprehensive Planning

All localities in Virginia are required to adopt a comprehensive plan. Comprehensive planning provides a means for anticipating and influencing changes occurring within a community. Comprehensive plans include information on existing conditions, community goals and objectives, and strategies for attaining the community's vision for its future. Conserving natural areas should be an integral part of this vision.

With regard to natural areas, deciding how to best display the occurrence of rare species populations is a matter of some debate. A natural areas inventory will provide detailed information on natural area boundaries, as well as a description of the natural heritage resources within the area and their location and management requirements. The debate occurs over how much detail should be given in comprehensive plans available to the public. There is some concern that including details on species location may invite harm to those species from collectors or by landowners wishing to remove what they may see as an obstacle to achieving their goals for their property. On the other hand, limiting the level of detail to very general location information also limits the usefulness of the information for planning purposes. Some have argued that very general location information is sufficient and

that precise location data should be reserved for local staff review of development proposals. This strategy has limitations, however, because it does not encourage developers to consider sensitive resources as they design developments. Each locality must decide how to best balance these risks and opportunities.

There is no debate, however, over the value of developing strong comprehensive plan goals and objectives for conserving natural areas. The comprehensive plan can be a powerful tool for coordinating a comprehensive natural area conservation program. A goal is an end towards which community actions are aimed. An objective is a measurable activity to be accomplished in pursuit of that goal. The final part of the natural area planning process is to develop conservation strategies. Strategies are specific proposals for accomplishing an objective. Strategies to employ for attaining natural area conservation objectives should include the non-regulatory and development management options described in this report. These strategies, when added to applicable state and federal regulations, form a well balanced and comprehensive natural area conservation program.

One planning strategy for natural area conservation is to incorporate natural areas into a comprehensive open space plan. Open space planning involves identifying open spaces and recommending strategies to conserve these areas through various land management techniques. An open space plan may address conservation of many important community features, including natural areas, historic sites and districts, scenic routes and rivers along with their adjacent "viewsheds", national, state or local parks and forests, other environmentally sensitive areas such as wetlands and steep slopes, groundwater recharge areas, and public reservoir watersheds. In addition to their primary purposes, these areas may provide opportunities for recreation and education. Open space planning can also help guide growth and result in a more orderly community.

The cultural and recreational value of open space can be amplified by connecting various resources through a system of greenways. Greenways are linear corridors of private and public lands and waters providing access to open space and other recreational resources. These corridors can also be used to connect rural open spaces with more urbanized areas. Often abandoned rail lines, utility right-of-ways, scenic routes, rivers, and stream floodplains are used as greenways. If greenways contain a sufficient amount of undisturbed vegetation, they may also add to the habitat value of the natural areas they connect by providing a natural corridor between them. Habitat corridors among natural areas provide avenues of movement for species and help keep populations genetically healthy.

To help incorporate the concepts of natural areas, open space, and greenways into the planning process, various natural and cultural resources can be assembled into a single data base. Although not a necessity, a computerized geographic information system (GIS) can make it easier to manage such a data base. A GIS can be useful in land management decisions such as rezoning requests by providing a quick reference on the natural resources that will be affected by a particular decision.

The combined benefits of open spaces and greenways make it easier to justify conservation of significant resources in the face of expanding suburban growth. In addition to conserving valued natural and cultural resources, they provide a valuable community asset which contributes to a higher quality of life. As a community asset, these areas can have the added benefit of enhancing local economic development and tourism efforts. To achieve these many benefits, however, the strategies identified in the comprehensive plan must be implemented through local land management authority such as zoning.

Conventional Zoning

State law enables localities to use their zoning authority to protect open spaces (*Virginia Code* §15.1-486), and to provide for the preservation of "lands of significance for the protection of the natural environment" (*Virginia Code* §15.1-489). State law also cites conservation of natural resources as one of the matters to be considered in drawing and applying zoning ordinances and districts (*Virginia Code* §15.1-490).

Conventional zoning can be used for natural area conservation, however it has some limitations. In general, conventional zoning by itself does not offer the flexibility needed to protect natural areas while allowing reasonable use of private property. Conventional zoning typically only classifies land uses and regulates development density. It does not provide the flexibility to conserve sensitive natural areas while allowing appropriate development in other, more suitable portions of a tract. Classifying large tracts of land for natural area preservation would require strict limits on development and may prohibit most uses of land within that zone.

Limiting development to very low densities through large lot zoning also presents problems. Although the number of dwelling units may be an appropriately low intensity for protection of the natural area, no actual protection is afforded to living resources since they are subject to the will of individual property owners. Large

lot zoning may actually cause more rapid loss of natural areas because more land is required to meet the demand for development.

Flexible Zoning

Other more flexible zoning techniques are available for conserving natural areas. These include overlay zones, cluster and planned unit development provisions, and conditional zoning. These techniques can be used in conjunction with conventional zoning and incorporate guidelines for preserving natural areas and open space into the development review process. They can encourage sensitive site design which conserves natural areas without sacrificing other objectives. Each of these techniques can be used to provide more flexibility because they offer an opportunity for negotiation regarding site design.

Overlay zones are special districts that are placed "on top of" portions of other conventional zoning districts. The development standards for the overlay zone are then added to the standards of the original zones. Overlay zones can be used to outline natural areas or land designated for open space preservation. Within this zone, developments can be required to provide a certain percentage of open space or meet certain design standards which increase the viability of natural areas. Overlay zones can also include provisions for density bonuses for clustering development and preserving open space.

Cluster development encompasses many techniques that allow moderate to high density development in exchange for conservation of open space and natural areas. Clustering is an excellent way to preserve open space by minimizing the amount of land needed for development. Development costs are usually lower because fewer streets are needed and water and sewer systems can be made more compact. By concentrating development on the most suitable portion of a tract, open space, including natural areas elsewhere on the tract, can be preserved.

A planned unit development, or PUD, is a form of clustering, but is generally larger and can include non-residential land uses. Planned unit development regulations set an average development density for large tracts and then permit higher density and cluster development on selected portions of the tract. The more intensely developed areas are off-set by areas with little or no development. Clustering of both residential and non-residential uses can be done within a PUD, thus yielding benefits to the developer while conserving open space and natural areas. Many PUD

regulations appear as floating zones which are not designated on a zoning map. This allows more flexibility for the community to reserve judgement on placement of such large developments until a request is received.

Conditional zoning is a procedure that allows localities to accept conditions proffered (voluntarily offered) by an applicant for a rezoning. Proffered conditions are commitments, not required by the zoning ordinance, to limit how the property is to be used or to provide facilities to meet the needs of the area being rezoned. Under conditional zoning, developers could proffer to leave important natural areas undeveloped and assure the protection and management of these areas. Other measures to protect natural areas could also be proffered such as stormwater management facilities to protect the water quality of sensitive aquatic habitats, or water dependent terrestrial species and communities.

The purpose of conditional zoning is to add flexibility to the way zoning is practiced. It allows applicants to proffer conditions that make the proposed rezoning more acceptable to the community. Conditional zoning enabling legislation (*Virginia Code* §15.1-491.1 et seq.) requires that proffers must relate to the rezoning and conform with the comprehensive plan. Upon approval, conditions become legally binding on the property and are enforced by the zoning administrator.

Transfer, Purchase and Lease of Development Rights

Another mechanism which holds promise for the future is the transfer, purchase or leasing of development rights. Current state law does not allow the transfer of development rights between parcels of land, however a number of efforts have been made to promote this legislation. Where such systems have been used in other states, owners of designated open space have been assigned development rights according to a formula based on the amount of land owned in the area where development is to be restricted. Landowners in these designated areas may not develop their land, but may transfer, sell or lease the development rights while keeping the land itself. Once the development rights are gone, the land may be used only for limited purposes such as open space conservation, agriculture or forestry and is taxed accordingly.

The development rights removed from these "sending" properties can then be used to increase allowable density on other more suitable properties. In some cases, the community itself may obtain development rights from property owners in order to restrict growth while, at the same time, providing compensation to those property

owners. Advocates of the use of development rights see them as the most effective and equitable way yet devised to conserve open space in areas experiencing rapid growth. Although the transfer of development rights alone does not assure habitat protection, it can be used in combination with other non-regulatory techniques such as easements to conserve natural areas while providing compensation to landowners.

V. Developing a Natural Areas Conservation Program

The various techniques described in this report present a broad spectrum of options for local governments to use for conserving natural areas. Beyond addressing natural area conservation in the local comprehensive plan, there is no one technique, or combination of techniques, that is best for all natural areas or all localities. A local strategy must consider a number of variables. This section describes these variables and their relation to conservation strategies.

Local governments must adopt strategies for individual natural areas that consider the characteristics of each site. An initial step should be to prioritize natural areas according to their natural values and risk of loss from development. The natural areas inventory provides information on the natural heritage value of each area. This information should be combined with details on other natural values such as opportunities for passive recreation, water quality maintenance, education, research, and linkages to other open space areas. The potential for development is determined by factors such as current land use designation and zoning, environmental constraints such as steep slopes or wetlands, access, available utilities, and proximity to urban growth areas. Natural areas with high natural values and high development potential should be given first priority.

Once natural areas have been prioritized, other factors such as ownership patterns and parcel size should be analyzed. It is important to determine the attitudes of the property owner, or owners, with regard to natural area conservation. Conservation minded owners may be willing to provide voluntary protection for the natural area. If so, representatives from a state agency such as the Department of Conservation and Recreation, or a private organization such as The Nature Conservancy may be able to provide technical assistance by working with the landowner to assure protection. If the landowner desires compensation for conserving the site, he may be interested in a below-market-value sale, or sale of a conservation easement on the property.

If owners are less conservation minded, other strategies will be necessary. An

important factor in this case is the location of the natural area in relation to individual parcels and owners. If the designated natural area, or portion of the natural area, constitutes only a small portion of the parcel in question there may be an opportunity to conserve the natural area while still allowing reasonable use of the remainder of the site. This could be accomplished through the flexible zoning techniques described above. If, however, the natural area constitutes a high percentage of the parcel, negotiation through flexible zoning may not be feasible. In this case, it may be difficult to conserve the natural area while allowing reasonable use of the site. Under these circumstances, the only option for protecting the natural area may be acquisition of either the property or a conservation easement at market rate.

In cases where some form of acquisition, whether at or below market value, is the only option available, localities should seek creative solutions for raising the necessary funds. Local funds, either from the general budget or from the sale of bonds, can be used as seed money to attract other resources. Although scarce, grant monies from the state or federal governments or private national conservation organizations may be available to provide matching funds. Local fundraising through private conservation groups or businesses could also be added into this effort.

Whatever strategy is used must be appropriate for local circumstances such as projected growth and community attitudes. Localities experiencing, or expecting, moderate to high growth can harness development pressure to conserve natural areas. Flexible zoning techniques can be used in these localities to protect natural areas as growth occurs. In this way, as land is developed, the more sensitive features of that land, such as natural areas, are permanently protected. In the face of rapid growth, citizens may also be more willing to commit public and private funds to resource protection. Although natural areas in growing communities may be the most threatened, these circumstances may offer more opportunities for resource conservation.

Highly urbanized areas and rural areas with little projected growth may require different strategies. In these cases, it may be difficult to use local land management authority to conserve natural areas because little growth is occurring. Highly urbanized areas may have few remaining natural areas, but because of their scarcity, these areas may be highly valued by citizens. Citizens in rural localities with little expected growth, on the other hand, may not be as willing to support conservation efforts because natural resources seem abundant and unthreatened. This does not mean, however, that actions to conserve natural areas through local land management

authority are inappropriate for localities that do not expect high growth. On the contrary, a natural area conservation strategy which includes comprehensive planning and flexible land management techniques is appropriate for any locality. This type of strategy is simply more likely to be effective in growing localities that have more opportunities to use this technique.

In conclusion, there are a number of options available for localities to use to conserve natural areas. The keys to protecting these areas are good information on the resources to be preserved, a strong natural area or open space component in the comprehensive plan, land management ordinances that provide adequate flexibility, and in particular, strong public involvement and support for natural area conservation.

APPENDIX B
SCIENTIFIC AND TECHNICAL NAMES

For convenience and readability, only common or colloquial names are used in the text. Following is an alphabetical listing of all species common names found in the report text along with their scientific names and an alphabetical listing of the common names of the natural communities with their technical names. Many common names of species are not standardized, so one may find that an unfamiliar common name is actually a synonym for a familiar species. Also note that some common names for natural community types are actually used to refer to several closely related technically defined biotic communities.

SPECIES NAMES

COMMON NAME

SCIENTIFIC NAME

American Beech	<u>Fagus grandifolia</u>
American holly	<u>Ilex opaca</u>
arrow arum	<u>Peltandra virginica</u>
Asiatic clam	<u>Corbicula fluminea</u>
bald cypress	<u>Taxodium distichum</u>
bald eagle	<u>Haliaeetus leucocephalus</u>
barking treefrog	<u>Hyla gratiosa</u>
beaver	<u>Castor canadensis</u>
beggar's ticks	<u>Bidens species</u>
big cordgrass	<u>Spartina cynosuroides</u>
black gum	<u>Nyssa sylvatica</u>
black needle rush	<u>Juncus roemerianus</u>
black walnut	<u>Juglans niger</u>
blueflag	<u>Iris versicolor</u>
broad-leaved arrowhead	<u>Sagittaria latifolia</u>
brown-headed cowbird	<u>Molothrus ater</u>
cardinal flower	<u>Lobelia cardinalis</u>
Carolina boltonia	<u>Boltonia caroliniana</u>
cattail	<u>Typha species</u>
cherrybark oak	<u>Quercus pagoda</u>
chestnut oak	<u>Quercus montana</u>
Collins' sedge	<u>Carex collinsii</u>
common paw paw	<u>Asimina trilobata</u>
common reedgrass	<u>Phragmites australis</u>
Cuthbert's turtlehead	<u>Chelone cuthbertii</u>
drooping bulrush	<u>Scirpus lineatus</u>
eastern pondmussel	<u>Ligumia nasuta</u>
false hop sedge	<u>Carex lupuliformis</u>
Florida adder's-mouth	<u>Malaxis spicata</u>
flowering dogwood	<u>Cornus florida</u>
glossy crayfish snake	<u>Regina regida</u>
great blue heron	<u>Ardea herodias</u>
great egret	<u>Casmerodius albus</u>
green ash	<u>Fraxinus pensylvanica</u>
gypsy moth	<u>Lymantria dispar</u>
Harper's fimbristylis	<u>Fimbristylis perpusilla</u>
hoary skullcap	<u>Scutellaria incana</u>
Japanese honeysuckle	<u>Lonicera japonica</u>
least bittern	<u>Ixobrychus exilis</u>

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loblolly pine
Mabee's salamander
marsh elder
marsh hibiscus
milletgrass
mountain camellia
mountain laurel
New Jersey rush
northern red oak
northern spring sideswimmer
pagoda dogwood
Parker's pipewort
pickerelweed
post oak
red bay
red maple
rice cutgrass
saltmarsh cordgrass
saltmeadow hay
sand post oak
scarlet oak
sensitive joint-vetch
shadow witch orchid
Shumard's oak
slender marsh pink
small whorled pogonia
southern blackhaw
southern red oak
southern sugar maple
southern twayblade
Spanish moss
spatterdock
spicebush
spikenard
star-nosed mole
swamp chestnut oak
swamp tupelo
sweet flag
sweet pine sap
sweetgum
tuliptree
Virginia least trillium

Virginia pine
water oak
white oak
white-tailed deer
wild rice
willow oak
yellow cowlily
zebra mussel

Pinus taeda
Ambystoma mabeei
Iva frutescens
Hibiscus moscheutos
Microstegium vimineum
Stewartia ovata
Kalmia latifolia
Juncus caesariensis
Quercus rubra
Gammarus pseudolimnaeus
Cornus alterniflora
Eriocaulon parkeri
Pontederia cordata
Quercus stellata
Persea borlonia
Acer rubrum
Leersia oryzoides
Spartina alterniflora
Spartina patens
Quercus margaretta
Quercus coccinea
Aeschynomone virginica
Ponthieva racemosa
Quercus shumardii
Sabatia campanulata
Isotria medeoloides
Viburnum rufidulum
Quercus falcata
Acer barbatum
Listera australis
Tillandsia usneoides
Nuphar luteum
Lindera benzoin
Aralia racemosa
Condylura cristata
Quercus michauxii
Nyssa aquatica
Acorus calamus
Monotropsis odorata
Liquidambar styraciflua
Liriodendron tulipifera
Trillium pusillum var.
virginianum
Pinus virginiana
Quercus nigra
Quercus alba
Odocoileus virginianus
Zizania aquatica
Quercus phellos
Nuphar luteum ssp. sagittifolia
Dreissena polymorpha

NATURAL COMMUNITIES

COMMON NAME

TECHNICAL NAME

coastal plain sinkhole pond
complex

oligotrophic seasonally flooded
palustrine forest
oligotrophic seasonally flooded
palustrine woodland
oligotrophic seasonally flooded
palustrine scrub
low herbaceous palustrine
wetland

marl ravine forest
southern mixed hardwood forest
tidal brackish marsh

moss/lichen palustrine wetland
permesotrophic forest
submesotrophic forest
tall herbaceous estuarine
wetland

tidal freshwater marsh

tall herbaceous palustrine
wetland

tidal saltmarsh

mid-height herbaceous
palustrine wetland
mid-height herbaceous estuarine
wetland

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