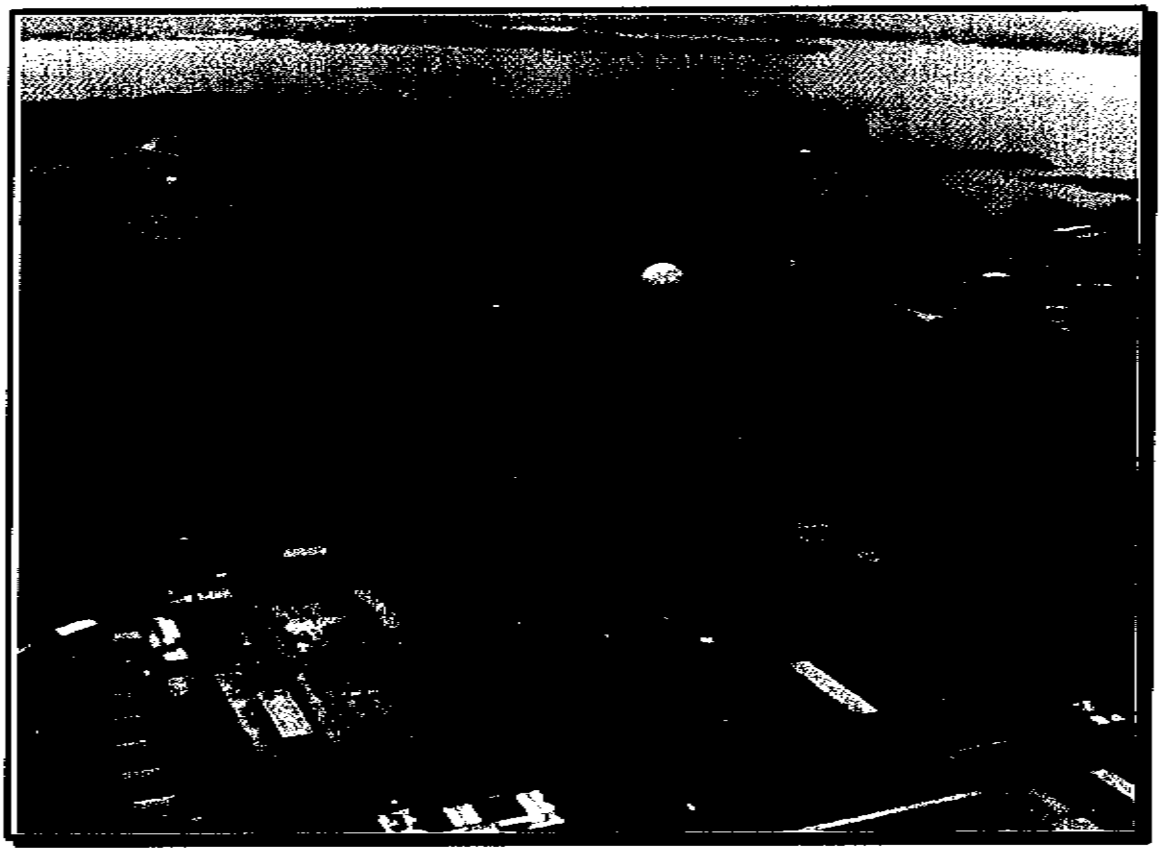
APPENDIX A

Soil Survey Report

Aberdeen Proving Ground



Soil Survey Report

October 1998

How to Use This Soil Survey

The **Detailed Soil Maps** can be useful in planning the use and management of small areas. To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet and turn to that sheet. Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units**, which lists the map units by symbol and name and shows the page where each map unit is described.

The **Contents** shows which table has data on a specific land use for each detailed soil map unit. Also see the **Contents** for sections of this publication that may address your specific needs.

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Foreword

This soil survey contains information that can be used in land-planning programs on Aberdeen Proving Ground. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Various regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. The information in this report is intended to identify soil properties that are used in making various decisions for land use or land treatment. Statements made in this report are intended to help the land users identify and reduce the effects of soil limitations that affect various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Soil Survey of Aberdeen Proving Ground, Maryland

Fieldwork by George P. Demas, Robert H. Ranson, Jr., and Mary Ann Levan, Natural Resources Conservation Service

Introduction by United States Army Garrison, Aberdeen Proving Ground

Cover photo provided by Aberdeen Test Center

Aberdeen Proving Ground, the Army's oldest active proving ground, was established on October 20, 1917, six months after the United States entered World War I, to provide the military a facility where design and testing of ordnance materiel could be carried out in close proximity to the Nation's industrial and shipping centers. The post officially opened on December 14, 1917, and the first gun was fired on January 2, 1918.

Aberdeen Proving Ground (APG) occupies more than 72,500 acres in Harford County, Maryland. Its northernmost point is marked by the confluence of the Susquehanna River and Chesapeake Bay. On the south it is bordered by the Gunpowder River.

The installation comprises two principal areas, separated by the Bush River. The northern area is known as the Aberdeen Area, and the southern area, formerly Edgewood Arsenal (established in November 1917 as a facility for the research, development, and testing of chemical weapons), is known as the Edgewood Area. The two areas were administratively combined in 1971. APG property not attached to the main installation includes the Churchill Test Site in Harford County and Carroll Island and Grace's Quarters in Baltimore County.

Aberdeen Proving Ground is home to more than 50 tenants and several satellite activities. Among the major tenants are the U.S. Army Test and Evaluation Command (APG's parent command), U.S. Army Ordnance Center and School, U.S. Army Aberdeen Test Center, U.S. Army Chemical and Biological Defense Command, U.S. Army Environmental Center, U.S. Army Center for Health Promotion and Preventive Medicine, Northeast Region Civilian Personnel Operations Center, U.S. Army Medical Research Institute for the Chemical Defense, Program Manager for Chemical Demilitarization, 203rd Military Intelligence Battalion, and major elements of the Army Research Laboratory.

As a center for Army materiel testing, laboratory research, and military training, the post is a key element in the Nation's defense. All tanks and wheeled vehicles which have served U.S. forces for the past 50 years have been tested for performance and durability at APG.

Army ordnance personnel have been trained at APG since 1918. The Army's ordnance training was consolidated at the proving ground during World War II, and today the U.S. Army Ordnance Center and School (OC&S) provides mechanical maintenance training for more than 20,000 U.S. and foreign personnel each year. OC&S also is regimental headquarters for the Army's Chief of Ordnance.

More than 7,600 civilians work at Aberdeen Proving Ground, and more than 4,500 military personnel are assigned there. In addition, there are nearly 3,000 contractor and private business employees working on the proving ground.

About 2,900 military family members live on the post, and 1,175 live off-post. The post supports more than 8,000 area military retirees and more than 12,500 retiree family members. It is Harford County's largest employer and one of the largest employers in the state of Maryland.

U.S. Army Garrison, Aberdeen Proving Ground, provides general, administrative, and logistical support to the post's tenants and satellite activities and is responsible for the management and operation of the entire installation.

Environmental stewardship is an essential component of all activity at APG. The installation and its tenants are actively involved in a wide variety of environmental compliance, pollution prevention, conservation, and restoration programs.

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas, their location, and a discussion of their suitability, limitations, and management for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted color, texture, size, and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from local and regional farm records and from local and regional field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in accurately locating boundaries.

This survey area was mapped at two levels of detail. At the more detailed level, map units are narrowly defined. Map unit boundaries were plotted and verified at closely spaced intervals. At the less detailed level, map units are broadly defined. Boundaries were plotted and verified at wider intervals. In the legend for the detailed soil maps, narrowly defined units are indicated by symbols in which the first letter is a capital and the second is lowercase. For broadly defined units, the first and second letters are capitals.

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of a better knowledge of soils, modifications in series concepts, soil taxonomic differences, variations in the intensity of mapping, variations in the extent of the soils in the survey areas, or the age of adjacent published soil surveys.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 1 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning wet, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; type of saturation; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Fluvaquents (*Fluv*, meaning flood plains, plus *aquent*, the suborder of the Entisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic subgroup is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other taxonomic class. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Fluvaquents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle size, mineral content, soil temperature regime, soil depth, and reaction. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is coarse-loamy, siliceous, acid, mesic Typic Fluvaquents.

SERIES. The series consists of soils within a family that have horizons similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. There can be some variation in the texture of the surface layer or of the substratum within a series.

Soil Series and Detailed Soil Map Units

In this section, arranged in alphabetical order, each soil series recognized in the survey area is described. Each description is followed by the detailed soil map units that are associated with the series.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual." Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" and in "Keys to Soil Taxonomy." Unless otherwise indicated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units delineated on the detailed maps represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the maps, can be used to determine the suitability and potential of a unit for specific uses. They also can be used to plan the management needed for those uses. More information about each map unit is given under the heading "Use and Management of the Soils."

A map unit delineation on a map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some "included" areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, inclusions. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, inclusions. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. A few included areas may not have been observed, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Beltsville silt loam, 2 to 5 percent slopes, is a phase of the Beltsville series in the survey area.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Mattapex-Udorthents-Urban land complex, 0 to 2 percent slopes, is a complex in the survey area.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Romney and Elkton soils, cratered, is an undifferentiated group in the survey area.

Table 2 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils or miscellaneous areas.

Beltsville Series

The Beltsville series consist of very deep, slowly permeable and very slowly permeable, moderately well drained soils. These soils formed in loamy alluvial and marine sediments. They are on level to gently rolling uplands of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 10 percent.

The Beltsville soils are similar in drainage to Mattapex and Woodstown soils and are commonly associated with Romney and Fallsington soils. These associated soils do not have a fragipan. The Beltsville soils have more sand and less silt in the solum than the Mattapex series. Romney and Fallsington soils are on the lower or more level landforms and are more poorly drained than the Beltsville soils.

Typical pedon of Beltsville silt loam, 0 to 2 percent slopes; Edgewood Area of Aberdeen Proving Ground, on a low bluff at the edge of "C Field," approximately 150 feet northwest of Wilson Point.

A1—0 to 3 inches; dark grayish brown (10YR 4/2) silt loam; weak medium granular structure; very friable; many roots throughout; very strongly acid; clear smooth boundary.

A2—3 to 7 inches; brown (10YR 5/3) silt loam; weak fine granular structure; very friable; many roots throughout; very strongly acid; clear smooth boundary.

BE—7 to 11 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; very friable; many roots throughout; very strongly acid; clear smooth boundary.

Bt—11 to 19 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; slightly brittle, firm; slightly sticky, slightly plastic; common roots throughout; common fine distinct pale brown (10YR 6/3) and common fine faint yellowish brown (10YR 5/8) masses of iron accumulation; very strongly acid; clear smooth boundary.

Btx1—19 to 29 inches; variegated matrix of approximately 60 percent yellowish brown (10YR 5/6), 30 percent strong brown (7.5YR 4/6), and 10 percent light gray (10YR 7/2) silt loam; moderate medium platy structure parting to strong coarse prismatic; brittle, very firm; slightly sticky, slightly plastic; few roots on vertical faces of peds; common fine distinct light gray (10YR 7/2) iron depletions; very strongly acid; clear smooth boundary.

Btx2—29 to 45 inches; light olive brown (2.5Y 5/4) silt loam; strong very coarse prismatic structure parting to moderate medium platy; very firm; slightly sticky, slightly plastic; common fine distinct reddish yellow (7.5YR 6/8) hard nodules; common fine and very fine roots on faces of peds; thick dark brown (7.5YR 4/4) clay skins on faces of peds; common fine distinct gray (10YR 6/1) iron depletions; very strongly acid; clear smooth boundary.

Cg—45 to 60 inches; light brownish gray (2.5Y 6/2) silty clay loam; firm; slightly sticky, plastic; many fine prominent strong brown (7.5YR 5/6) and many medium prominent brown (7.5YR 5/4) masses of iron accumulation; very strongly acid.

The thickness of the solum ranges from 40 to 60 inches. A fragipan is at a depth of 12 to 34 inches. In unlimed areas reaction ranges from strongly acid to extremely acid throughout the profile.

The A or Ap horizon has hue of 10YR, value of 2 to 7, and chroma of 1 to 6. Value of 2, 3, or 4 and chroma of 1 or 2 generally occur only in thin, undisturbed surface horizons. The horizon is silt loam or loam.

The E horizon typically occurs only where the soil has not been disturbed. It has colors and textures similar to those of the BE horizon.

The BE horizon, if it occurs, has hue of 7.5YR to 2.5Y, value of 5 or 6, and chroma of 4 to 8. It is silt loam or silty clay loam.

The Bt horizon has hue of 7.5YR or 2.5Y, value of 5 or 6, and chroma of 4 to 8. It is silt loam or sandy clay loam.

The Btx horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 3 to 6. In many pedons it is variegated and has some iron depletions with low chroma. It is silt loam, silty clay loam, or loam and can be clay loam in subhorizons. The structure is strong very coarse prismatic.

The C horizon generally has hue of 10YR or 2.5Y, value of 4 to 7, and chroma of 2 to 4. In some pedons it has variegations of colors. It is stratified with textures ranging from sandy loam to clay loam.

BeA—Beltsville silt loam, 0 to 2 percent slopes

Composition

Beltsville soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats
Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Perched
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

BeB—Beltsville silt loam, 2 to 5 percent slopes

Composition

Beltsville soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats and knolls
Slope: 2 to 5 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Perched
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

BeC—Beltsville silt loam, 5 to 10 percent slopes

Composition

Beltsville soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland side slopes
Slope: 5 to 10 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Perched
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

BU—Beltsville-Udorthents-Urban land complex, 0 to 5 percent slopes

Composition

Beltsville soil and similar soils: 35 percent
Udorthents and similar soils: 35 percent
Urban land: 20 percent
Inclusions (unnamed soils): 10 percent

Setting

Landform: Upland flats
Slope: 0 to 5 percent

Component Description

Beltsville

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Perched
Available water capacity: Moderate

Udorthents

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Urban land

Urban land consists of areas where more than 80 percent of the surface is covered by asphalt, concrete, buildings, or other impervious surfaces. These areas include parking lots, shopping areas, airports, and building and housing complexes.

A typical soil description of the Beltsville soil is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Chicone Series

The Chicone series consists of very deep, moderately permeable, very poorly drained soils. These soils formed in loamy fluvial sediments overlying highly decomposed organic material. They are on wide flood plains of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Chicone soils occur on flood plains with Puckum, Lenape, and Indiantown soils. Indiantown soils have a sandy substratum and a thick organic-rich surface layer. They are at the slightly higher elevations. Puckum and Lenape soils are organic. They are in the slightly lower landscape positions.

Typical pedon of Chicone silt loam; on a smooth 1 percent slope on a wooded flood plain. (Colors are for moist soil.)

A—0 to 3 inches; very dark brown (10YR 2/2) silt loam; weak fine granular structure; friable; slightly sticky; many very fine and fine and common medium roots; common very fine and fine pores; strongly acid; clear wavy boundary.
Cg1—3 to 15 inches; dark brown (7.5YR 3/2) silt loam; massive; friable; slightly sticky; common very fine and fine roots; few very fine and fine pores; common fine prominent strong brown (7.5YR 4/6) masses of iron accumulation; strongly acid; gradual wavy boundary.
Cg2—15 to 24 inches; black (N 2/0) silt loam; massive; firm; slightly sticky, slightly plastic; common very fine roots; few very fine pores; strongly acid; clear wavy boundary.
Oa—24 to 65 inches; black (10YR 2/1) sapric material; fiber content is one-tenth of the soil volume after rubbing; 20 percent, by weight, mineral soil material; strongly acid.

The thickness of the mineral surface layer ranges from 16 to 40 inches. The thickness of the organic deposits ranges from 16 to 45 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR or 7.5YR, value of 2 to 4, and chroma of 1 to 3. Where value is less than 3.5, the horizon is less than 10 inches thick. The horizon is mucky silt loam, mucky loam, or silt loam.

The Cg horizon has hue of 10YR or 7.5YR, value of 2 to 5, and chroma of 0 to 4. It is silt loam or mucky silt loam. In some pedons it has thin layers of sandy loam or loam.

The Oa horizon has hue of 5YR to 10YR, value of 2 or 3, and chroma of 0 or 1. It is sapric or hemic material that is 16 inches to more than 40 inches thick. The fiber content after rubbing ranges from one-tenth to one-half of the soil volume. The content of mineral material, by weight, ranges from 20 to 40 percent. In some pedons the organic material is underlain by stratified sandy or loamy sediments.

Ch—Chicone silt loam

Composition

Chicone soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Flood plains
Slope: 0 to 2 percent

Component Description

Surface layer texture: Mucky silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Silty alluvial sediments over organic deposits
Flooding: Occasional
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Very high

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Codorus Series

The Codorus series consists of very deep, moderately permeable, moderately well drained and somewhat poorly drained soils. These soils formed in recently deposited alluvial sediments weathered from mostly metamorphic and crystalline rocks. They are on flood plains and very low-lying uplands, which are subject to overwash by wind tides, of the Mid-Atlantic Coastal Plain. Slopes are smooth and nearly level and range from 0 to 3 percent.

The Codorus soils are commonly adjacent to Mattapex, Woodstown, Romney, Puckum, and Lenape soils. Mattapex, Woodstown, and Romney soils are on uplands. They have a clay content in the subsoil that increases as depth increases. Mattapex and Romney soils have less sand and more silt in the subsoil than the Codorus soils. Puckum and Lenape soils are in adjacent tidal areas. They are organic soils and have thick, dark organic deposits.

Typical pedon of Codorus loam; on a smooth 1 percent slope on a wooded flood plain. (Colors are for moist soil.)

Ap—0 to 9 inches; dark brown (10YR 4/3) loam; weak fine granular structure; friable; nonsticky, nonplastic; 5 percent rock fragments; strongly acid; abrupt smooth boundary.

Bw1—9 to 18 inches; dark yellowish brown (10YR 4/4) loam; weak fine subangular blocky structure; friable; slightly sticky, nonplastic; 5 percent rock fragments; strongly acid; clear wavy boundary.

Bw2—18 to 30 inches; brown (10YR 5/3) loam; weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; many mica flakes; common fine faint light brownish gray (10YR 6/2) iron depletions and common fine distinct strong brown (7.5YR 5/6) masses of iron accumulation; strongly acid; gradual smooth boundary.

C1—30 to 54 inches; light yellowish brown (10YR 6/4) loam; massive; friable; slightly sticky, slightly plastic; many mica flakes; common medium faint light brownish gray (10YR 6/2) iron depletions and common medium distinct brown (7.5YR 5/4) masses of iron accumulation; strongly acid; clear smooth boundary.

C2—54 to 65 inches; light yellowish brown (10YR 6/4) loam that is stratified with sand and gravel; massive; friable; nonsticky, nonplastic; 40 percent rock fragments in individual strata; common faint brownish gray (10YR 6/2) iron depletions; strongly acid.

The thickness of the solum ranges from 30 to 60 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR, value of 3 to 6, and chroma of 2 or 3. It is loam or silt loam in the fine-earth fraction.

The B horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 3 or 4. It is loam, silt loam, or silty clay loam in the fine-earth fraction. Iron depletions with chroma of 2 or less are within a depth of 24 inches.

The C horizon has hue of 7.5YR to 2.5Y, value of 3 to 5, and chroma of 2 to 4. It is loam, silt loam, or silty clay loam in the fine-earth fraction. In some pedons it has layers of stratified sand and gravel below a depth of 40 inches.

Cd—Codorus loam

Composition

Codorus soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Flood plains
Slope: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy alluvial sediments
Flooding: Occasional
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Corsica Series

The Corsica series consists of very deep, very poorly drained, moderately permeable soils. These soils formed in loamy alluvial sediments overlying stratified fluvial sediments. They are in upland swales and depressions of the Mid-Atlantic Coastal Plain. Slopes are smooth and nearly level and range from 0 to 3 percent.

The Corsica soils are similar to Pone and Kentuck soils and are commonly adjacent to Fallsington, Romney, Mattapex, and Woodstown soils. Kentuck soils have less sand and more silt in the subsoil than the Corsica soils. Pone soils have less clay in the subsoil than the Corsica soils. Fallsington soils do not have a thick organic-rich surface layer. They are in the higher landscape positions. Romney soils are somewhat poorly drained. They have less sand and more silt in the subsoil than the Corsica soils. Woodstown and Mattapex soils are better drained than the Corsica soils and occur on adjacent uplands.

Typical pedon of Corsica loam; on a 1 percent slope in a wooded area. (Colors are for moist soil.)

Oi—0 to 2 inches; undecomposed and partially decomposed leaves and twigs from loblolly pine, sweetgum, and oak.

A—2 to 12 inches; black (10YR 2/1) loam; weak fine granular structure; very friable; slightly sticky, slightly plastic; common fine and medium and few coarse roots throughout; few very fine tubular pores; very strongly acid; clear smooth boundary.

BEg—12 to 18 inches; light brownish gray (2.5Y 6/2) loam; weak fine subangular blocky structure; very friable; slightly sticky, slightly plastic; few fine and medium and very few coarse roots; few very fine tubular pores; few medium distinct light olive brown (2.5Y 5/4) masses of iron accumulation; very strongly acid; clear smooth boundary.

Btg1—18 to 31 inches; light gray (2.5Y 7/2) sandy clay loam; moderate medium subangular blocky structure; friable; slightly sticky, plastic; common fine and very fine roots; few fine and medium tubular pores; common prominent dark gray (10YR 4/1) clay films on faces of peds; common medium distinct light yellowish brown (2.5Y 6/4) and few medium prominent strong brown (7.5YR 5/8) masses of iron accumulation; very strongly acid; clear smooth boundary.

Btg2—31 to 40 inches; light gray (2.5Y 7/2) sandy loam; moderate medium subangular blocky structure; friable; slightly sticky, slightly plastic; common fine and very fine roots; few fine and medium tubular pores; common prominent dark gray (10YR 4/1) clay films on faces of peds; common medium distinct light yellowish brown (2.5Y 6/4) and few medium prominent strong brown (7.5YR 5/8) masses of iron accumulation; very strongly acid; clear smooth boundary. (combined thickness of the Btg horizons is 10 to 34 inches)

BCg—40 to 48 inches; gray (10YR 6/1) sandy loam; weak coarse subangular blocky structure; friable; slightly sticky, nonplastic; few fine and very fine roots; common very fine and fine tubular pores; few medium distinct light yellowish brown (10YR 6/4) masses of iron accumulation; very strongly acid; clear wavy boundary.

Cg1—48 to 64 inches; stratified light gray (10YR 7/1) clay loam and strong brown (7.5YR 5/6) loamy sand; massive; friable; slightly sticky, slightly plastic; few fine and very fine roots; common very fine tubular pores; very strongly acid; clear wavy boundary.

Cg2—64 to 72 inches; gray (5Y 6/1) clay loam; massive; friable; slightly sticky, plastic; few fine and very fine tubular pores; few fine prominent strong brown (7.5YR 5/6) masses of iron accumulation; strongly acid.

The thickness of the solum ranges from 30 to 55 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR to 5Y or is neutral in hue, has value of 2 or 3, and has chroma of 0 to 2. It is mucky loam or mucky silt loam. It may have redoximorphic features.

The Eg or BEg horizon, if it occurs, has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 or 2. It is loam, silt loam, fine sandy loam, or sandy loam. Masses of iron accumulation have hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 4 or 6.

The Btg horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 1 or 2. It is typically clay loam, sandy clay loam, or loam but can be sandy loam, silt loam, or silty clay loam in part of the argillic horizon. Masses of iron accumulation have hue of 7.5YR to 2.5Y, value of 4 to 7, and chroma of 4 to 8. Iron depletions, if they occur, have hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 1 or 2.

The BCg horizon, if it occurs, has hue of 7.5YR to 2.5Y, value of 6 or 7, and chroma of 1 or 2. It is typically sandy loam or sandy clay loam but can be loam, clay loam, loamy sand, or the gravelly analogues of these textures. The content of rock fragments ranges from 0 to 30 percent. The horizon has redoximorphic features.

The Cg or C horizon has hue of 10YR to 5Y or is neutral in hue, has value of 5 to 8, and has chroma of 0 to 3. It is commonly stratified and has textures ranging from sand to clay loam and including their gravelly analogues. The content of rock fragments ranges from 0 to 30 percent. The horizon has redoximorphic features.

An Ab horizon occurs in some pedons below a depth of 60 inches.

Co—Corsica loam

Composition

Corsica soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Depressions and swales
Slope: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Loamy alluvial sediments
Flooding: None
Kind of water table: Apparent
Ponding: Brief
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Elkton Series

The Elkton series consist of very deep, slowly permeable, poorly drained soils. These soils formed in silty aeolian sediments and the underlying loamy alluvial and marine sediments. They are on upland and lowland flats and in depressions of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 2 percent.

The Elkton soils are similar to Othello and Fallsington soils and are commonly adjacent to Romney soils. They have more clay in the subsoil than Othello soils and have less sand and more silt in the subsoil than the Fallsington soils. Romney soils are on the somewhat higher landforms. They do not have the gray surface layer that is typical of the Elkton soils. They also have more sand and less silt in the subsurface layers than the Elkton soils.

Typical pedon of Elkton silt loam; Aberdeen Area of Aberdeen Proving Ground, 0.6 mile southeast of the intersection of Phillips Field Road and Phillips Field Loop, 1,000 feet east of Phillips Field Loop in hardwood stand of red maple and sweetgum.

Oi—2 inches to 0; partially decomposed woody organic matter.

A—0 to 4 inches; very dark gray (5Y 3/1) silt loam; weak fine granular structure; very friable; slightly sticky, slightly plastic; very strongly acid; abrupt smooth boundary.

BEg—4 to 14 inches; gray (5Y 6/1) silt loam; moderate medium subangular blocky structure; friable; slightly sticky, slightly plastic; common medium distinct strong brown (7.5YR 4/6) masses of iron accumulation; very strongly acid; clear wavy boundary.

Btg1—14 to 25 inches; gray (5Y 6/1) silty clay loam; strong medium subangular blocky structure; friable; sticky, plastic; common medium distinct strong brown (7.5YR 4/6) masses of iron accumulation; very strongly acid; clear wavy boundary.

Btg2—25 to 40 inches; dark gray (N 4/0) and gray (N 5/0) silt loam; common medium prominent strong brown (7.5YR 4/6) masses of iron accumulation; very strongly acid; clear smooth boundary.

2BCg—40 to 60 inches; gray (5Y 6/1) fine sandy loam; massive; friable; slightly sticky, slightly plastic; very strongly acid.

The thickness of the solum ranges from 40 to more than 60 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 0 to 3. It is silt loam, mucky silt loam, or loam.

The Eg horizon typically occurs only where the soil has not been disturbed. It has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is silt loam or loam.

The Btg horizon has hue of 10YR to 5GY, value of 4 to 7, and chroma of 0 to 2. It is silt loam or silty clay loam.

The 2BCg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 0 or 2. It is fine sandy loam or sandy clay loam.

The 2Cg horizon, if it occurs, is at depths of more than 40 inches. It has colors similar to those of the BCg horizon. It is fine sand or loamy fine sand.

Ek—Elkton silt loam

Composition

Elkton soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and shallow depressions
Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Fallsington Series

The Fallsington series consists of very deep, moderately permeable, poorly drained soils. These soils formed in loamy alluvial and marine sediments. They are on upland and lowland flats and in shallow depressions of the Mid-Atlantic Coastal Plain. Slopes are smooth and nearly level and range from 0 to 2 percent.

The Fallsington soils are similar to Othello and Elkton soils and are commonly adjacent to Corsica, Pone, Romney, and Woodstown soils. The Fallsington soils have more sand and less silt in the subsoil than Othello and Elkton soils. Corsica and Pone soils have a thick organic-rich surface layer. They occur in the lower landscape positions. Pone soils have less clay in the subsoil than the Fallsington soils. Romney soils are somewhat poorly drained. They have less sand and more silt in the subsoil than the Fallsington soils. Woodstown soils are better drained than the Fallsington soils and occur on adjacent uplands.

Typical pedon of Fallsington sandy loam; in a cultivated area. (Colors are for moist soil.)

Ap—0 to 10 inches; dark gray (10YR 4/1) sandy loam; moderate coarse granular structure; friable; nonsticky, nonplastic; many fine roots; 2 percent gravel; moderately acid; abrupt smooth boundary.

Btg1—10 to 20 inches; gray (10YR 6/1) sandy clay loam; weak very coarse prismatic structure parting to moderate subangular blocky; friable; slightly sticky, slightly plastic; common fine roots; common thin clay films on faces of peds and in pores; common medium prominent yellowish brown (10YR 5/6) masses of iron accumulation; extremely acid; clear smooth boundary.

Btg2—20 to 32 inches; gray (10YR 6/1) sandy clay loam; weak very coarse prismatic structure parting to moderate medium subangular blocky; friable; sticky, slightly plastic; common fine roots on faces of peds; common thick clay films on faces of peds; common coarse prominent yellowish brown (10YR 5/6) masses of iron accumulation; extremely acid; clear wavy boundary.

BCg—32 to 40 inches; light gray (10YR 7/1) loamy sand; weak very coarse subangular blocky structure; loose; nonsticky, nonplastic; very few thin clay films on faces of peds; common medium distinct yellowish brown (10YR 5/6) masses of iron accumulation and gray (10YR 5/1) iron depletions; very strongly acid; clear wavy boundary.

2Cg—40 to 46 inches; light gray (10YR 7/1) sandy clay loam; weak moderate subangular blocky structure; firm; slightly sticky, slightly plastic; few fine distinct yellowish brown (10YR 5/6) masses of iron accumulation; very strongly acid; clear wavy boundary.

3Cg—46 to 62 inches; light gray (10YR 7/2) sand; single grain; loose; nonsticky, nonplastic; very strongly acid.

The thickness of the solum ranges from 24 to 40 inches. The content of coarse fragments, mostly round to subrounded gravel, ranges from 0 to 10 percent in individual horizons. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR to 5Y, value of 2 to 6, and chroma of 1 to 3. Values of 2 and 3 occur only in thin, upper A horizons. The horizon is loam, sandy loam, or fine sandy loam.

The B horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 0 to 4. Values of 3 and 4 occur only below a depth of 30 inches. The horizon is sandy clay loam, loam, or sandy loam and has an average of 18 to 27 percent clay.

The C horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 0 to 4. It is loamy sand, sand, or sandy loam. It can be stratified.

Fa—Fallsington sandy loam

Composition

Fallsington soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and shallow depressions
Slope: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Hambrook Series

The Hambrook series consists of very deep, moderately permeable, well drained soils. These soils formed in loamy alluvial and marine sediments. They are on level to gently rolling uplands of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 60 percent.

The Hambrook soils are similar to Nassawango soils and are commonly adjacent to Mattapex, Woodstown, and Beltsville soils. Nassawango soils have less sand and more silt in the subsoil than the Hambrook soils. The Hambrook soils are better drained than Woodstown, Mattapex, and Beltsville soils. Beltsville soils have a fragipan.

Typical pedon of Hambrook sandy loam, 0 to 2 percent slopes; Spesutie Island Area of Aberdeen Proving Ground, in an open field.

Ap—0 to 7 inches; dark brown (10YR 4/3) sandy loam; moderate medium granular structure; friable; nonsticky, nonplastic; neutral; abrupt smooth boundary.

A—7 to 14 inches; brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; friable; nonsticky, nonplastic; neutral; clear wavy boundary.

Bt1—14 to 21 inches; yellowish brown (10YR 5/8) sandy clay loam; weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; strongly acid; gradual wavy boundary.

Bt2—21 to 28 inches; strong brown (7.5YR 5/6) sandy loam; weak medium granular structure; friable; slightly sticky, slightly plastic; strongly acid; gradual wavy boundary.

C1—28 to 43 inches; strong brown (7.5YR 5/6) loamy sand; massive; very friable; extremely acid; clear smooth boundary.

C2—43 to 60 inches; yellowish brown (10YR 5/6) sand; massive; common medium distinct pale brown (10YR 6/3) iron depletions and few medium prominent strong brown (7.5YR 5/8) masses of iron accumulation; extremely acid.

The thickness of the solum ranges from 21 to 48 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A or Ap horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. It is sandy loam or loam.

The E horizon typically occurs only where the soil has not been disturbed. It has colors and textures similar to those of the BE horizon.

The BE horizon, if it occurs, has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. It is sandy loam or loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 5 to 8. It is sandy loam, sandy clay loam, or loam.

The BC horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 6 to 8. It is loamy sand or sandy loam.

The C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 1 to 6. It is loamy sand or sandy loam. Iron depletions and masses of iron accumulation commonly occur in most pedons in the lower part of the horizon.

HbA—Hambrook sandy loam, 0 to 2 percent slopes

Composition

Hambrook soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats
Slope: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

HbB—Hambrook sandy loam, 2 to 5 percent slopes

Composition

Hambrook soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats and knolls
Slope: 2 to 5 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

HbC—Hambrook sandy loam, 5 to 10 percent slopes

Composition

Hambrook soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland side slopes
Slope: 5 to 10 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

HbE—Hambrook sandy loam, 10 to 60 percent slopes

Composition

Hambrook soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Escarpments
Slope: 10 to 60 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

HU—Hambrook-Udorthents-Urban land complex, 0 to 10 percent slopes

Composition

Hambrook soil and similar soils: 50 percent
Udorthents and similar soils: 25 percent
Urban land: 15 percent
Inclusions (unnamed soils): 10 percent

Setting

Landform: Upland flats
Slope: Hambrook and Udorthents—0 to 10 percent; Urban land—0 to 5 percent

Component Description

Hambrook

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Udorthents

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Urban land

Urban land consists of areas where more than 80 percent of the surface is covered by asphalt, concrete, buildings, or other impervious surfaces. These areas include parking lots, shopping areas, airports, and building and housing complexes.

A typical soil description of the Hambrook soil is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Indiantown Series

The Indiantown series consist of very deep, moderately permeable, very poorly drained soils. These soils formed in loamy fluvial sediments overlying sandy alluvial and marine sediments. They are on narrow low-gradient flood plains of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Indiantown soils are similar to Longmarsh soils and are on flood plains associated with Longmarsh, Zekiah, Lenape, and Puckum soils. The organic surface material of the Indiantown soils is thicker than that of the Longmarsh soils. The Indiantown soils have a thicker organic-rich surface layer than the associated soils. Zekiah soils can be intermingled with Indiantown soils or can occur at the higher reaches of the flood plain. Longmarsh soils are generally at the lower reaches of the flood plain. Lenape and Puckum soils are organic soils and occur in tidal areas at the lower reaches of the flood plain.

Typical pedon of Indiantown mucky silt loam; on a smooth 1 percent slope on a wooded flood plain.

A1—0 to 13 inches; very dark brown (10YR 2/2) mucky silt loam; weak fine granular structure; friable; slightly sticky, slightly plastic; many very fine and fine roots; very strongly acid; abrupt wavy boundary.

A2—13 to 25 inches; black (10YR 2/1) mucky loam; massive; friable; slightly sticky, slightly plastic; common very fine and fine roots; very strongly acid; abrupt wavy boundary.

Cg1—25 to 41 inches; grayish brown (10YR 5/2) loamy sand; common coarse black (10YR 2/1) organic stains; massive; few very fine roots; extremely acid; abrupt wavy boundary.

Cg2—41 to 51 inches; dark grayish brown (2.5Y 4/2) loamy sand; common medium very dark gray (10YR 3/1) organic stains; massive; very strongly acid; clear wavy boundary.

Cg3—51 to 72 inches; dark grayish brown (2.5Y 4/2) sand; single grain; loose; few medium very dark gray (10YR 3/1) organic stains; few medium prominent dark yellowish brown (10YR 4/4) masses of iron accumulation; extremely acid.

The content of organic matter ranges from 5 to 18 percent in the A horizon. It is variable in the substratum, ranging from 1 to 10 percent. Reaction ranges from extremely acid to strongly acid throughout the profile. Salinities are less than 2 millimhos.

The A horizon has hue of 7.5YR to 2.5Y or is neutral in hue, has value of 2 or 3, and has chroma of 0 to 2. It is mucky silt loam, mucky loam, silt loam, or loam.

The Cg horizon has hue of 10YR to 5B, value of 3 to 7, and chroma of 1 to 3. It is loam, sandy loam, loamy sand, or sand.

A 2Cg horizon that has properties similar to those of the Cg horizon can be identified in places where the deposited material has originated from areas where a silt mantle dominates the surrounding uplands. A discontinuity may occur in these soils.

In—Indiantown mucky silt loam

Composition

Indiantown soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Flood plains
Slope: 0 to 1 percent

Component Description

Surface layer texture: Mucky silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Loamy alluvial sediments
Flooding: Frequent
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Kentuck Series

The Kentuck series consists of very deep, slowly permeable, very poorly drained soils. These soils formed in woody organic deposits overlying unconsolidated eolian, alluvial, or marine sediments. They are on low-lying uplands, in depressions, and on flood plains of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Kentuck soils are similar to Corsica soils and are commonly adjacent to Othello, Elkton, and Romney soils. Corsica soils have more sand and less silt in the subsoil than the Kentuck soils. Othello and

Elkton soils do not have a dark organic-rich surface layer. They are in the slightly higher landscape positions. Romney soils are better drained than the Kentuck soils and occur on low-lying uplands.

Typical pedon of Kentuck silt loam; on a smooth 1 percent slope in an area of woodland. (Colors are for moist soil.)

Oi/Oe—0 to 3 inches; undecomposed and moderately decomposed leaves and twigs; clear smooth boundary.

A—3 to 13 inches; black (10YR 2/1) silt loam; strong fine granular structure; very friable; slightly sticky, slightly plastic; many very fine and fine and common medium and coarse roots; many very fine and fine and common medium irregular pores; 10 percent organic matter; extremely acid; clear wavy boundary.

Eg—13 to 24 inches; light brownish gray (2.5Y 6/2) silt loam; weak medium subangular blocky structure; very friable; slightly sticky, plastic; common very fine and fine and few medium roots; many very fine, common fine, and few medium tubular pores; common medium prominent brownish yellow (10YR 6/6) masses of iron accumulation and common medium distinct white (10YR 8/1) iron depletions; very strongly acid; clear wavy boundary.

Btg1—24 to 37 inches; light brownish gray (10YR 6/2) silt loam; moderate medium subangular blocky structure; friable; sticky, plastic; common very fine and fine and few medium roots; many very fine, common fine, and few medium tubular pores; common faint clay films on faces of peds; common fine prominent strong brown (7.5YR 5/8) masses of iron accumulation and common medium distinct white (10YR 8/1) iron depletions; very strongly acid; gradual wavy boundary.

Btg2—37 to 45 inches; grayish brown (2.5Y 5/2) silty clay loam; moderate medium subangular blocky structure; firm; sticky, plastic; few very fine and fine roots; common very fine and fine tubular pores; common distinct clay films on faces of peds; common fine prominent reddish yellow (7.5YR 6/8) masses of iron accumulation and few medium distinct white (10YR 8/1) iron depletions; very strongly acid; gradual wavy boundary.

2BCg—45 to 56 inches; grayish brown (10YR 5/2) fine sandy loam; massive; very friable; slightly sticky; few very fine and fine roots; many very fine tubular pores; very few fine distinct white (10YR 8/1) iron depletions; strongly acid; gradual wavy boundary.

2Cg—56 to 70 inches; light gray (10YR 7/1) fine sand; single grain; loose; few very fine roots; very strongly acid.

The thickness of the solum ranges from 30 to 56 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1 or 2. It is mucky silt loam.

The Eg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is silt loam.

The Btg horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 1 or 2. It is silt loam or silty clay loam.

Some pedons have a 2Btg horizon. This horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 or 2. It is very fine sandy loam, loam, or clay loam.

The 2BCg horizon has hue of 10YR to 5Y, value of 4 to 6, and chroma of 1 or 2. It is sandy loam or fine sandy loam.

The 2Cg horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 1 to 4. It is sand, fine sand, or loamy sand that has pockets of finer material.

Kn—Kentuck silt loam

Composition

Kentuck soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Lowland flats and shallow depressions
Slope: 0 to 1 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Ponding: Brief
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Klej Series

The Klej series consists of very deep, moderately well drained and somewhat poorly drained soils. These soils are rapidly permeable and very rapidly permeable in the solum and moderately permeable to very slowly permeable in the substratum. They formed in sandy unconsolidated sediments. They occur on flood plains and very low-lying uplands, which are subject to overwash by wind tides, of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 2 percent.

The Klej soils are commonly adjacent to Romney, Woodstown, Puckum, and Lenape soils. Romney and Woodstown are on uplands. They have a clay content in the subsoil that increases as depth increases. They have less sand and more silt in the subsoil than the Klej soils. Puckum and Lenape are in adjacent tidal areas. They have very dark, thick organic deposits.

Typical pedon of Klej loamy sand; on a smooth 1 percent slope on a wooded flood plain. (Colors are for moist soil.)

A1—0 to 2 inches; grayish brown (2.5Y 5/2) loamy sand; very weak medium granular structure; very friable; common roots; very strongly acid; clear wavy boundary.

A2—2 to 9 inches; light brownish gray (2.5Y 6/2) loamy sand; very weak medium granular structure; very friable; common roots; very strongly acid; clear wavy boundary.

Bw1—9 to 19 inches; olive yellow (2.5Y 6/6) loamy sand; single grain; loose; many roots; sand grains coated with silt; extremely acid; gradual irregular boundary.

Bw2—19 to 39 inches; olive yellow (2.5Y 6/6) loamy sand; single grain; loose; few roots; some coated sand grains; common medium distinct light brownish gray (2.5Y 6/2) iron depletions; extremely acid; gradual irregular boundary.

Cg1—39 to 47 inches; light brownish gray (2.5Y 6/2) grading to gray (5Y 6/1) sand; single grain; loose; very few roots; common medium prominent brownish yellow (10YR 6/6) masses of iron accumulation; extremely acid; abrupt smooth boundary.

2Cg2—47 to 65 inches; light gray (2.5Y 7/2) sandy loam; massive; friable; sticky, slightly plastic; common coarse prominent light yellowish brown (10YR 6/4) masses of iron accumulation; extremely acid.

The thickness of the solum ranges from 30 to 60 inches. Reaction ranges from extremely acid to strongly acid in unlimed areas.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 1 to 4. It is loamy sand, fine sand, or loamy fine sand.

The Bw horizon has hue of 7.5YR to 5Y, value of 5 or 6, and chroma of 4 to 6. The lower part of the horizon has iron depletions. The fine-earth texture is loamy sand or loamy fine sand in the upper part of the horizon and ranges from loamy fine sand to sand in the lower part.

The Cg1 horizon is neutral in hue or has hue of 10YR to 5Y, has value of 5 to 7, and has chroma of 0 to 6. It is loamy sand, sand, or fine sand in the fine-earth fraction.

The 2Cg2 horizon is neutral in hue or has hue of 10YR to 5Y, has value of 5 to 7, and has chroma of 0 to 4. It ranges from sandy loam to clay.

Kj—Klej loamy sand

Composition

Klej soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and shallow depressions
Slope: 0 to 2 percent

Component Description

Surface layer texture: Loamy sand
Depth class: Very deep (more than 60 inches)
Dominant parent material: Sandy eolian deposits over fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Low

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Lenape Series

The Lenape series consists of deep, moderately permeable, very poorly drained soils. These soils formed in organic deposits overlying loamy estuarine or marine deposits having a high *n* value. They formed in closed depressions, on flood plains, and in freshwater, tidally flooded swamps of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Lenape soils are similar to Manahawkin soils and occur adjacent to Manahawkin, Puckum, Indiantown, and Chicone soils. Manahawkin soils are underlain by sand. Puckum soils have an organic layer that is thicker than that of the Lenape soils. Indiantown soils have an organic layer that is thinner than that of the Lenape soils. They typically occur in the higher areas on the flood plain. Chicone soils are mineral soils and do not have a thick organic surface layer. They are in landscape positions similar to those of the Lenape soils.

Typical pedon of Lenape mucky peat; on a smooth 1 percent slope in an estuarine tidal marsh. (Colors are for moist, rubbed soil.)

Oe1—0 to 4 inches; dark brown (7.5YR 3/2) mucky peat (hemic soil material); 60 percent fiber unrubbed, 30 percent fiber rubbed; 10 percent blackened leaves and twigs; few fine and medium roots; 45 percent organic material; very strongly acid; clear wavy boundary.

Oe2—4 to 8 inches; very dark grayish brown (10YR 3/2) mucky peat (hemic soil material); 45 percent fiber unrubbed, 18 percent fiber rubbed; few fine and medium roots; 50 percent organic material; extremely acid; clear smooth boundary.

Oa—8 to 26 inches; very dark brown (10YR 2/2) muck (sapric soil material); 20 percent fiber unrubbed, 5 percent fiber rubbed; few fine roots; 70 percent organic material; extremely acid; gradual wavy boundary.

Cg1—26 to 34 inches; very dark gray (10YR 3/1) loam; massive; friable; slightly sticky, slightly plastic; *n* value greater than 1.0, material flows easily between fingers when squeezed; 5 percent organic soil material; very strongly acid; clear smooth boundary.

Cg2—34 to 60 inches; dark greenish gray (5GY 4/1) silty clay loam; massive; firm; slightly sticky, plastic; *n* value greater than 1.0, material flows easily between fingers when squeezed; strongly acid.

2Cg3—60 to 72 inches; gray (10YR 6/1) and light gray (10YR 7/1) sand; single grain; loose; very strongly acid.

The thickness of the organic deposits ranges from 16 to 51 inches. Conductivity of the saturation extract is less than 4 millimhos per centimeter throughout the profile. Reaction ranges from extremely acid to strongly acid. In the mineral soil horizons, the *n* value is typically greater than 0.7 but ranges to less than 0.7.

The surface tier is neutral in hue or has hue of 7.5YR or 10YR, has value of 2 to 4, and has chroma of 1 to 3. It is hemic and fibric soil material. The fiber content after rubbing is more than one-third of the soil volume. The mineral content, by weight, ranges from 20 to 60 percent.

The subsurface tier is neutral in hue or has hue of 5YR to 10YR, has value of 2 to 4, and has chroma of 1 to 4. It is typically sapric soil material but ranges from hemic to sapric. The fiber content after rubbing ranges from one-tenth to one-third of the soil volume. The mineral content, by weight, ranges from 25 to 75 percent.

The Cg horizon is neutral in hue or has hue of 10YR to 5GY, has value of 2 to 4, and has chroma of 0 to 2. It is loam, silt loam, or silty clay loam. In some pedons thin sandy mineral layers are stratified within the horizon.

The 2Cg horizon has hue of 2.5Y to 5GY, value of 3 to 7, and chroma of 0 to 2. It is loamy sand, sand, or loamy fine sand. In some pedons, the upper boundary of the 2C horizon is below a depth of 72 inches.

Le—Lenape mucky peat

Composition

Lenape soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Swamps, flood plains, and depressions
Slope: 0 to 1 percent

Component Description

Surface layer texture: Mucky peat
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic deposits over loamy fluviomarine sediments
Flooding: Frequent
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Very high

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Longmarsh Series

The Longmarsh series consists of very deep, moderately permeable, very poorly drained soils. These soils formed in loamy fluvial sediments overlying sandy alluvial and marine sediments. They are on narrow low-gradient flood plains of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Longmarsh soils are similar to Pone and Indiantown soils and are associated with Indiantown, Zekiah, and Fallsington soils. Pone soils have a subsurface horizon of clay accumulation. They occur on the higher landforms. The Longmarsh soils have a thicker organic-rich surface layer than the associated soils. Zekiah soils can be intermingled with the Longmarsh soils or can occur at the higher reaches of the flood plain. The Longmarsh soils are generally on reaches of the flood plain lower than those of Indiantown soils. Fallsington soils occur on adjacent uplands.

Typical pedon of Longmarsh sandy loam; on a smooth 1 percent slope on a wooded flood plain. (Colors are for moist soil.)

Oi—0 to 0.5 inch; undecomposed leaves and twigs.

Oe—0.5 to 1 inch; partially decomposed organic materials.

A1—1 to 7 inches; black (10YR 2/1) sandy loam; weak medium subangular blocky structure parting to weak medium granular; very friable; nonsticky, slightly plastic; many very fine to coarse roots throughout; few fine discontinuous tubular pores; very strongly acid; gradual smooth boundary.

A2—7 to 19 inches; very dark gray (7.5YR 3/1) sandy loam; weak coarse subangular blocky structure; very friable; nonsticky, slightly plastic; many very fine to coarse roots throughout; few fine discontinuous tubular pores; moderately acid; clear smooth boundary.

Cg1—19 to 34 inches; grayish brown (2.5Y 5/2) fine sandy loam; massive; firm; nonsticky, slightly plastic; common very fine and fine roots throughout; common coarse distinct dark grayish brown (10YR 4/2) iron depletions; moderately acid; gradual smooth boundary.

Cg2—34 to 54 inches; light gray (2.5Y 7/2) loamy sand; massive; loose; nonsticky, nonplastic; 2 percent fine mixed gravel; moderately acid; gradual smooth boundary.

Cg3—54 to 66 inches; 60 percent light brownish gray (2.5Y 6/2) and 40 percent grayish brown (2.5Y 5/2) loamy sand; massive; loose; nonsticky, nonplastic; moderately acid.

The content of organic matter ranges from 5 to 18 percent in the A horizon. In the substratum it is variable and ranges from 1 to 10 percent. The content of coarse fragments of mixed rounded gravel ranges from 0 to 20 percent in the A horizon and from 0 to 40 percent in the substratum.

The A horizon has hue of 7.5YR to 5Y or is neutral in hue, has value of 2 to 4, and has chroma of 0 to 2. It is typically mucky sandy loam, mucky loam, sandy loam, or loam but has textures ranging to sand, loamy sand, silt loam, and fine sandy loam.

The Cg horizon has hue of 10YR to 5Y, value of 3 to 8, and chroma of 1 or 2. It is commonly loamy sand or coarse sand but may include sand, loamy coarse sand, sandy loam, fine sandy loam, and their gravelly analogues. Redoximorphic features have hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 2 to 6.

The C horizon, if it occurs, has hue of 7.5YR to 5Y, value of 4 to 6, and chroma of 3 to 6. It occurs in a reduced environment despite the high chromas. It is clay loam, loamy sand, or sand. It may have redoximorphic features.

Lo—Longmarsh sandy loam

Composition

Longmarsh soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Flood plains
Slope: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep
Drainage class: Very poorly drained
Dominant parent material: Loamy alluvial sediments
Flooding: Frequent
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Low

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Manahawkin Series

The Manahawkin series consists of deep, very poorly drained soils. These soils are moderately slowly permeable to moderately rapidly permeable in the organic horizons and moderately rapidly permeable in the mineral material. They formed in organic deposits over sandy mineral material. They occur in freshwater swamps and back swamps near tidal channels of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Manahawkin soils are similar to Lenape soils and occur adjacent to Lenape, Puckum, and Chicone soils. Lenape soils are underlain by loamy sediments. Chicone soils are in landscape positions similar to those of the Manahawkin soils. They are mineral soils and do not have a thick surface layer of organic material. Puckum soils have an organic layer that is thicker than that of the Manahawkin soils.

Typical pedon of Manahawkin muck; on a nearly level lowland flat in a forested area. (Description is for soil that was wet throughout.)

Oa1—0 to 8 inches; black (5YR 2/1) broken face and rubbed muck; 10 percent fiber unrubbed, less than 2 percent fiber rubbed; moderate medium granular structure; mat of many fine roots; identifiable material is primarily herbaceous with a trace of woody fragments; 85 percent organic matter; extremely acid; clear wavy boundary.

Oa2—8 to 20 inches; black (5YR 2/1) broken face and rubbed muck; 5 percent fiber unrubbed, less than 2 percent fiber rubbed; many fine roots; 95 percent organic matter; 2 percent soft woody fragments which break down when rubbed; very strongly acid; gradual wavy boundary.

Oa3—20 to 30 inches; black (5YR 2/1) broken face and rubbed muck (broken face color was slightly redder and lighter than rubbed color but did not differ a whole unit); 15 percent fiber unrubbed, less than 2 percent fiber rubbed; weak medium granular structure; common fine and medium roots; 95 percent organic matter; 10 percent soft woody fragments as much as 1 inch in diameter which break down when rubbed; very strongly acid; gradual wavy boundary.

Oa4—30 to 39 inches; black (5YR 2/1) broken face and rubbed muck (broken face color is slightly redder and lighter than rubbed color but did not differ a whole unit); 10 percent fiber unrubbed, less than 2 percent fiber rubbed; massive; few roots; 90 percent organic matter; 30 percent woody fragments as much as 2 inches in diameter which break down when rubbed; very strongly acid; abrupt smooth boundary.

2C1—39 to 46 inches; gray (10YR 5/1) sand; single grain; loose; strongly acid; abrupt smooth boundary.

2C2—46 to 60 inches; gray (10YR 6/1) gravelly sand; single grain; loose; 20 percent fine quartzose pebbles; very strongly acid.

The thickness of the organic deposits ranges from 16 to 51 inches. The mineral content of the organic layers ranges from 5 to 80 percent. The organic layers consist of sapric material, but some pedons have subhorizons of hemic material as much as 10 inches thick. The 2C horizon contains as much as 50 percent pebbles. In some pedons the organic horizons have as much as 50 percent woody fragments consisting of twigs, branches, or logs ranging in size from 1/8 inch to 20 inches in diameter. Most woody fragments break down completely when rubbed. Reaction is extremely acid or very strongly acid in the surface tier and very strongly acid or strongly acid in the lower tiers and in the mineral substratum.

The surface tier is neutral in hue or has hue of 10YR to 5Y, has value of 2 or 3, and has chroma of 0 or 1. It is typically sapric soil material but in some pedons is hemic soil material or contains layers of hemic soil material. It has granular structure or is massive.

The organic part of the subsurface and bottom tiers is neutral in hue or has hue of 10YR to 5Y, has value of 2 or 3, and has chroma of 0 to 2. Broken face and rubbed colors are similar but may differ one or two units in value or chroma or in both. These tiers are dominantly sapric soil material but in some pedons contain layers of hemic soil material as much as 10 inches thick. They have granular structure or are massive.

The 2C horizon is neutral in hue or has hue of 7.5YR or 10YR, has value of 2 to 5, and has chroma of 0 or 1. It is sand, fine sand, loamy sand, or the gravelly analogues of these textures.

Ma—Manahawkin muck

Composition

Manahawkin soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Swamps and flood plains
Slope: 0 to 2 percent

Component Description

Surface layer texture: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic deposits over loamy fluviomarine sediments
Flooding: Frequent
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Very high

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Mattapex Series

The Mattapex series consists of very deep, moderately well drained soils. These soils are moderately permeable in the subsoil and moderately rapidly permeable and rapidly permeable in the substratum. They formed in silty aeolian sediments and the underlying loamy alluvial and marine sediments. They are on uplands, in shallow depressions, and in swales of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 10 percent.

The Mattapex soils are similar to Beltsville and Woodstown soils and are commonly adjacent to Nassawango, Hambrook, and Romney soils. Beltsville and Woodstown soils have less silt and more sand in the subsoil than the Mattapex soils. Beltsville soils have a fragipan. Nassawango and Hambrook soils are better drained than the Mattapex soils. The Mattapex soils are better drained than the Romney soils, which occur on adjacent low-lying or somewhat depressional uplands.

Typical pedon of Mattapex silt loam, 0 to 2 percent slopes; Aberdeen Area of Aberdeen Proving Ground, 2,500 feet northwest of the intersection of Route 715 and Aberdeen Road, 100 feet northeast of Aberdeen Road, in an open wooded area.

Ap—0 to 8 inches; brown (10YR 5/3) silt loam; weak medium granular structure; friable; slightly sticky, slightly plastic; neutral; abrupt smooth boundary.

Bt1—8 to 21 inches; light yellowish brown (2.5Y 6/4) silt loam; weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; common medium distinct strong brown (7.5YR 5/8) masses of iron accumulation and few medium distinct light olive gray (5Y 6/2) iron depletions; strongly acid; clear wavy boundary.

Bt2—21 to 40 inches; light yellowish brown (2.5Y 6/4) silt loam; moderate medium subangular blocky structure; friable; sticky, plastic; common medium distinct strong brown (7.5YR 5/8) masses of iron accumulation and few medium distinct light olive gray (5Y 6/2) iron depletions; strongly acid; clear wavy boundary.

2C1—40 to 47 inches; brown (10YR 5/3) fine sandy loam; moderate medium subangular blocky structure; friable; sticky, plastic; common medium distinct strong brown (7.5YR 5/8) masses of iron accumulation and few medium distinct light olive gray (5Y 6/2) iron depletions; extremely acid; gradual irregular boundary.

2C2—47 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam; moderate medium subangular blocky structure; friable; sticky, plastic; common medium distinct strong brown (7.5YR 5/6) and common medium faint yellowish brown (10YR 5/4) masses of iron accumulation; extremely acid.

The thickness of the solum ranges from 24 to 42 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 10YR, value of 3 to 5, and chroma of 3 or 4. It is silt loam or loam.

The E horizon typically occurs only where the soil has not been disturbed. It has colors and textures similar to those of the BE horizon.

The BE horizon, if it occurs, has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. It is silt loam or loam.

The Bt horizon has hue of 7.5YR, 10YR, or 2.5Y, value of 4 to 6, and chroma of 4 to 7. It has few to many, faint to prominent masses of iron accumulation and iron depletions. It is silt loam or silty clay loam.

The 2BC horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 3 to 6. It has few to many, faint to prominent masses of iron accumulation. It is fine sandy loam or sandy clay loam.

The 2C horizon has hue of 7.5YR to 2.5Y, value of 4 to 6, and chroma of 3 to 8. It has few to many, faint to prominent masses of iron accumulation. It ranges from sand to fine sandy loam and includes the gravelly analogues of these textures. The content of rock fragments or gravel ranges from 0 to 20 percent.

MpA—Mattapex silt loam, 0 to 2 percent slopes

Composition

Mattapex soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats
Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

MpB—Mattapex silt loam, 2 to 5 percent slopes

Composition

Mattapex soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats and knolls
Slope: 2 to 5 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

MpC—Mattapex silt loam, 5 to 10 percent slopes

Composition

Mattapex soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland side slopes
Slope: 5 to 10 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

MU—Mattapex-Udorthents-Urban land complex, 0 to 2 percent slopes

Composition

Mattapex soil and similar soils: 50 percent
Udorthents: 25 percent
Urban land: 10 percent
Inclusions (unnamed soils): 10 percent

Setting

Landform: Upland flats and knolls
Slope: Mattapex and Udorthents—0 to 2 percent; Urban land—0 to 5 percent

Component Description

Mattapex

Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

Udorthents

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Urban land

Urban land consists of areas where more than 80 percent of the surface is covered by asphalt, concrete, buildings, or other impervious surfaces. These areas include parking lots, shopping areas, airports, and building and housing complexes.

A typical soil description of the Mattapex soil is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

MwA—Mattapex silt loam, cratered

Composition

Mattapex soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats
Slope: 0 to 2 percent

Note:
- This map unit consists of areas where ordnance has exploded, resulting in the formation of craters.

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Nassawango Series

The Nassawango series consists of very deep, well drained soils. These soils are moderately permeable in the subsoil and moderately rapidly permeable and rapidly permeable in the substratum. They formed in silty sediments overlying loamy alluvial and marine sediments. They are on level to gently rolling uplands of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 10 percent.

The Nassawango soils are similar to Hambrook soils and are commonly adjacent to Mattapex, Beltsville, and Woodstown soils. Hambrook and Beltsville soils have less silt and more sand in the subsoil than the Nassawango soils. The Nassawango soils are better drained than Mattapex, Woodstown, and Beltsville soils. Beltsville soils have a fragipan.

Typical pedon of Nassawango silt loam, 0 to 2 percent slopes; Spesutie Island Area of Aberdeen Proving Ground, in an open field.

Ap—0 to 11 inches; yellowish brown (10YR 5/4) loam; weak fine granular structure; friable; slightly sticky, slightly plastic; neutral; abrupt smooth boundary.
E—11 to 24 inches; dark yellowish brown (10YR 4/4) loam; weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; neutral; clear smooth boundary.
Bt1—24 to 36 inches; dark yellowish brown (10YR 4/4)

silt loam; weak medium subangular blocky structure; slightly sticky, slightly plastic; slightly acid; clear smooth boundary.

Bt2—36 to 47 inches; brown (10YR 4/3) silty clay loam; moderate medium subangular blocky structure; sticky, slightly plastic; common medium distinct strong brown (7.5YR 4/6) soft masses of iron accumulation; slightly acid; clear smooth boundary.

2C—47 to 60 inches; yellowish brown (10YR 5/4) fine sandy loam and sandy clay loam; massive; few medium distinct yellowish red (5YR 4/6) soft masses of iron accumulation and few medium distinct light brownish gray (2.5Y 6/2) iron depletions; moderately acid.

The thickness of the solum ranges from 30 to 50 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A or Ap horizon has hue of 10YR, value of 3 to 5, and chroma of 3 to 5. It is silt loam or loam.

The E horizon typically occurs only where the soil has not been disturbed. It has colors and textures similar to those of the BE horizon.

The BE horizon, if it occurs, has hue of 10YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam or loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 6. It is silt loam or silty clay loam.

The BC horizon has hue of 10YR, value of 5 or 6, and chroma of 4 to 6. It is silt loam.

The 2C horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 6. Iron depletions and soft masses of iron accumulation are common at the base of the horizon in most pedons. The horizon ranges from sand to fine sandy loam and in many pedons is stratified with thin layers of finer or coarser textured sediments. The content of rock fragments or gravel ranges from 0 to 20 percent.

NnA—Nassawango silt loam, 0 to 2 percent slopes

Composition

Nassawango soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats
Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Perched
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

NnB—Nassawango silt loam, 2 to 5 percent slopes

Composition

Nassawango soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats and knolls
Slope: 2 to 5 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Perched
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

NnC—Nassawango silt loam, 5 to 10 percent slopes

Composition

Nassawango soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland side slopes
Slope: 0 to 5 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Perched
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Othello Series

The Othello series consists of very deep, moderately slowly permeable, poorly drained soils. These soils formed in loess (silty) sediments overlying sandy alluvial and marine sediments. They are on broad upland and lowland flats and in shallow depressions of the Mid-Atlantic Coastal Plain. Slopes are smooth and nearly level and range from 0 to 2 percent.

The Othello soils are similar to Fallsington and Elkton soils and are commonly adjacent to Pone, Corsica, Romney, and Mattapex soils. Fallsington soils have less silt and more sand in the subsoil than the Othello soils. Elkton soils have more clay in the subsoil than the Othello soils. Corsica and Pone soils have a thick organic-rich surface layer. They occur in the lower landscape positions. Romney and Mattapex soils are better drained than the Othello soils and occur on adjacent uplands.

Typical pedon of Othello silt loam; in a cultivated area. (Colors are for moist soil.)

Ap—0 to 9 inches; dark grayish brown (2.5Y 4/2) silt loam; very weak fine and medium granular structure; friable; slightly sticky, slightly plastic; many roots; moderately acid; abrupt smooth boundary.

Btg1—9 to 18 inches; light olive gray (5Y 6/2) silty clay loam; weak fine and medium blocky and subangular blocky structure; firm; sticky, slightly plastic; common roots; common dark grayish brown (2.5Y 5/2) clay films on faces of peds; few medium faint light gray (5Y 7/1) iron depletions and common medium prominent yellowish brown (10YR 5/6) masses of iron accumulation; very strongly acid; clear to abrupt smooth boundary.

Btg2—18 to 29 inches; gray (5Y 6/1) silty clay loam; moderate medium subangular blocky structure; friable; slightly sticky, slightly plastic; few roots; many light olive gray (5Y 5/2) clay films on faces of peds; common coarse prominent yellowish brown (10YR 5/6) and few medium prominent strong brown (7.5YR 5/6) masses of iron accumulation; very strongly acid; clear to abrupt smooth boundary.

2Cg1—29 to 34 inches; gray (N 5/0) sandy loam; massive; friable; slightly sticky, slightly plastic; common medium prominent strong brown (7.5YR 5/6) masses of iron accumulation; extremely acid; gradual smooth boundary.

2Cg2—34 to 60 inches; light gray (N 7/0) loamy sand; single grain; loose; common coarse yellowish brown (10YR 5/6) streaks and splotches; extremely acid.

The thickness of the solum ranges from 24 to 40 inches. In unlimed areas reaction is strongly acid or very strongly acid in the A horizon and extremely acid to strongly acid in the B and C horizons. The depth to unconforming, coarse textured sediments is less than 40 inches.

The A horizon has hue of 10YR to 5Y, value of 3 to 7, and chroma of 0 to 2. It is silt loam, fine sandy loam, or silty clay loam.

The Btg horizon has hue of 10YR to 5Y, value of 5 to 7, and chroma of 0 to 2. Redoximorphic features have hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 1 to 8. The horizon is silt loam or silty clay loam and has 18 to 35 percent clay in the particle-size control section. The BCg horizon, if it occurs, is sandy clay loam, loam, or sandy loam.

The 2Cg horizon has hue of 10YR to 5Y or is neutral in hue, has value of 5 to 7, and has chroma of 0 to 2. It is loamy sand, sandy loam, or sandy clay loam. It can contain as much as 10 percent fine rounded gravel.

Ot—Othello silt loam

Composition

Othello soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and shallow depressions
Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Ponding: Brief
Available water capacity: High

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Pone Series

The Pone series consists of very deep, moderately rapidly permeable, very poorly drained soils. These soils formed in loamy alluvial sediments overlying stratified alluvial and marine sediments. They are on flood plains, in upland swales, and in depressions of the Mid-Atlantic Coastal Plain. Slopes are smooth and nearly level and range from 0 to 3 percent.

The Pone soils are similar to Corsica and Kentuck soils and are commonly adjacent to Fallsington, Romney, and Woodstown soils. Kentuck soils have less sand and more silt in the subsoil than the Pone soils. Corsica soils have more clay in the subsoil than the Pone soils. Fallsington soils do not have a thick organic-rich surface layer. They occur in the higher landscape positions. Romney soils are somewhat poorly drained. They have less sand and more silt in the subsoil than the Pone soils. Woodstown soils are better drained than the Pone soils and occur on adjacent uplands.

Typical pedon of Pone mucky loam; on a 1 percent slope in an area of woodland. (Colors are for moist soil.)

Oi/Oa—3 inches to 0; undecomposed and highly decomposed leaves, needles, and twigs; clear smooth boundary.

A1—0 to 6 inches; black (10YR 2/1) mucky loam; strong medium granular structure; friable; slightly sticky, slightly plastic; many very fine and fine, common medium, and few coarse roots; many very fine and fine and common medium irregular pores; 10 percent organic matter; extremely acid; gradual smooth boundary.

A2—6 to 14 inches; black (10YR 2/1) mucky loam; weak medium subangular blocky structure parting to weak fine granular; friable; slightly sticky, slightly plastic; many very fine, common fine and medium, and few coarse roots; many very fine and fine and common medium irregular pores; high organic matter content; strongly acid; gradual wavy boundary.

Btg—14 to 26 inches; grayish brown (10YR 5/2) sandy loam; weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; common coarse distinct very dark grayish brown (10YR 3/2) material from A horizon in vertical channels; many very fine, common fine, and few medium roots; many very fine, common fine, and few medium tubular pores; common prominent clay films on faces of peds and lining pores; very common medium distinct light gray (10YR 7/1) iron depletions; strongly acid; clear irregular boundary.

BC—26 to 37 inches; light gray (10YR 7/2) loamy sand; massive; very friable; common very fine and few fine roots; common very fine and fine and few medium tubular pores; 10 percent pockets of dark gray sandy clay loam in vertical channels; common coarse distinct grayish brown (2.5Y 5/2) iron depletions and few medium prominent yellowish brown (10YR 5/8) masses of iron accumulation; very strongly acid; clear irregular boundary.

Cg1—37 to 47 inches; gray (10YR 5/1) sand; massive; very friable; common very fine roots; stratified horizontal lines of light and dark gray sand less than 3 millimeters thick; many coarse prominent strong brown (7.5YR 5/8) masses of iron accumulation; very strongly acid; clear broken boundary.

2Cg2—47 to 69 inches; gray (5Y 6/1) silt loam;

massive; friable; slightly sticky, plastic; few very fine roots; many very fine tubular pores; common coarse distinct gray (10YR 5/1) iron depletions and common fine prominent strong brown (7.5YR 5/8) masses of iron accumulation; very strongly acid.

The thickness of the solum ranges from 26 to 40 inches. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 5YR to 5Y, value of 2 or 3, and chroma of 0 to 2. It is mucky sandy loam, mucky loam, sandy loam, or loam.

The Btg horizon has hue of 10YR to 5Y, value of 3 to 6, and chroma of 1 or 2. It is commonly sandy loam or loam but in some pedons includes thin layers of sandy clay loam.

The BC horizon has hue of 10YR to 5Y, value of 5 to 7, and chroma of 1 or 2. It is loamy sand or sandy loam.

The Cg horizon is neutral in hue or has hue of 10YR to 5Y, value of 5 to 8, and chroma of 1 or 2. It is sand or loamy sand.

The 2Cg horizon is neutral in hue or has hue of 10YR to 5Y, has value of 5 to 7, and has chroma of 0 to 3. It ranges from very fine sandy loam to silty clay loam.

The 2C horizon is commonly above a depth of 50 inches but occurs below that depth in some pedons. Some pedons have a buried A horizon below a depth of 60 inches. This horizon has a high content of organic matter.

Po—Pone mucky loam

Composition

Pone soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Low-lying uplands, depressions, and swales
Slope: 0 to 2 percent

Component Description

Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic deposits over fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Puckum Series

The Puckum series consists of very deep, moderately permeable, very poorly drained soils. These soils formed in thick, highly decomposed organic deposits derived from woody materials. They formed in freshwater swamps on flood plains of the Mid-Atlantic Coastal Plain. Slopes are 0 to 1 percent.

The Puckum soils are associated with Lenape, Manahawkin, and Chicone soils. Lenape soils are underlain by loamy mineral sediments at depths of 16 to 51 inches. Manahawkin soils are underlain by sandy sediments at depths of 16 to 51 inches. Chicone soils are mineral soils and do not have a thick surface layer of organic material. They occur in landscape positions similar to those of the Puckum soils.

Typical pedon of Puckum muck; on a smooth 1 percent slope in a wooded area. (Colors are for moist soil.)

Oa1—0 to 4 inches; very dark brown (10YR 2/2) muck (sapric soil material); fiber content is one-seventh of the soil volume after rubbing; 20 percent, by weight, mineral soil material; strongly acid; abrupt smooth boundary.

Oa2—4 to 20 inches; dark brown (7.5YR 3/2) muck (sapric soil material); fiber content is one-seventh of the soil volume after rubbing; 25 percent, by weight, mineral soil material; strongly acid; gradual wavy boundary.

Oa3—20 to 40 inches; dark brown (7.5YR 3/2) muck (sapric soil material); fiber content is one-seventh of the soil volume after rubbing; 30 percent, by weight, mineral soil material; material has a higher water content than the horizon above; strongly acid; gradual wavy boundary.

Oa4—40 to 57 inches; very dark brown (10YR 2/2) muck (sapric soil material); fiber content is one-seventh of the soil volume after rubbing; 40 percent, by weight, mineral soil material; 20 percent yellow (10YR 8/6) soft woody fragments 0.5 inch to 2 inches in diameter; strongly acid; gradual wavy boundary.

Oa5—57 to 65 inches; dark brown (7.5YR 3/2) muck (sapric soil material); fiber content is one-tenth of the soil volume after rubbing; 50 percent, by weight, mineral soil material; strongly acid; clear wavy boundary.

Oa6—65 to 80 inches; very dark brown (10YR 3/2) muck (sapric soil material); fiber content is one-tenth of the soil volume after rubbing; 60 percent, by weight, mineral soil material; strongly acid.

The thickness of the organic deposits ranges from 16 to 51 inches. Woody fragments occur in some part of the profile in most pedons, and their content ranges from 0 to 25 percent, by volume. The fragments consist of twigs, branches, logs, or stumps and are ½ inch to 12 inches in diameter. Woody fragments are firm but break under pressure. Conductivity of the saturation extract is less than 4 millimhos per centimeter throughout the profile. Reaction ranges from extremely acid to strongly acid.

The surface tier has hue of 5YR to 10YR, value of 2 or 3, and chroma of 1 to 4. It is hemic or sapric soil material. The fiber content after rubbing is less than one-half of the soil volume. The content of mineral material, by weight, ranges from 10 to 55 percent.

The subsurface and bottom tiers have hue of 5YR to 10YR, value of 2 to 4, and chroma of 1 to 4. They are dominantly sapric soil material but include some thin layers of hemic soil material. The fiber content after rubbing generally is less then one-quarter of the soil volume but averages less then one-sixth. The content of mineral material, by weight, ranges from 25 to 70 percent.

Some pedons contain thin strata of loamy or sandy mineral material.

Pk—Puckum muck

Composition

Puckum soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Swamps and flood plains
Slope: 0 to 2 percent

Component Description

Surface layer texture: Muck
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Dominant parent material: Organic woody deposits
Flooding: Frequent
Kind of water table: Apparent
Ponding: Brief
Available water capacity: Very high

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Romney Series

The Romney series consists of very deep, moderately slowly permeable, somewhat poorly drained soils. These soils formed in silty sediments overlying loamy marine and fluvial sediments. They are on low-lying uplands and in shallow depressions of the Mid-Atlantic Coastal Plain. Slopes are nearly level and range from 0 to 2 percent.

The Romney soils are commonly adjacent to Mattapex and Othello soils. Mattapex soils are in the slightly higher landscape positions or on the more convex landforms. They have gray iron depletions that are deeper in the solum than those of the Romney soils. Othello soils are lower on the landscape. They have gray iron depletions that are not as deep as those of the Romney soils.

Typical pedon of Romney silt loam; on a 1 percent slope, Aberdeen Area of Aberdeen Proving Ground, east of Phillips Field, 0.3 mile northeast of the intersection of Michaelsville Road and Aviation Arms Road, northwest side of Michaelsville Road, in an area of woods.

A—0 to 4 inches; very dark grayish brown (10YR 3/2) silt loam; weak medium granular structure; friable; few fine and medium roots; neutral; clear smooth boundary.

E—4 to 8 inches; gray (10YR 5/1) silt loam; moderate medium granular structure; friable; few fine and medium roots; few medium prominent yellowish brown (10YR 5/8) masses of iron accumulation; strongly acid; clear smooth boundary.

Bt—8 to 16 inches; 40 percent light yellowish brown (10YR 6/4), 30 percent yellowish brown (10YR 5/4), and 30 percent yellowish brown (10YR 5/6) silt loam; weak medium subangular blocky structure; friable; few light gray (10YR 7/1) iron depletions and few strong brown (7.5YR 5/6) masses of iron accumulation; positive reaction to alpha,alpha-dipyridyl; strongly acid; clear smooth boundary.

Btg—16 to 48 inches; 40 percent gray (10YR 6/1), 40 percent light gray (10YR 7/1), and 20 percent gray (10YR 5/1) silt loam; weak medium subangular blocky structure; friable; common prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/6) and few distinct yellowish red (5YR 4/6) masses of iron accumulation; strongly acid; clear smooth boundary.

BCg—48 to 60 inches; mixed light gray (10YR 7/1, 2.5Y 7/2, and N 7/0) silt loam; weak medium subangular blocky structure; friable; common prominent light olive brown (2.5Y 5/4) and few prominent strong brown (7.5Y 5/8) masses of iron accumulation; strongly acid; clear smooth boundary.

2Cg—60 to 70 inches; light gray (10YR 7/1) sandy loam; massive; friable; common prominent light olive brown (2.5Y 5/4) and few prominent strong brown (7.5Y 5/8) masses of iron accumulation; strongly acid.

The thickness of the solum ranges from 30 to 50 inches. In unlimed areas reaction ranges from extremely acid to strongly acid throughout the profile.

The Ap or A horizon has hue of 10YR to 2.5Y, value of 3 to 6, and chroma of 2 to 6. It is silt loam or loam.

The A, E, or BEg horizon, if it occurs, has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 1 or 2. The AE, EB, or BE horizon, if it occurs, has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 4 to 6. Masses of iron accumulation in shades of brown, yellow, and red are few or common. These horizons are silt loam or loam.

The Bt horizon has hue of 10YR to 2.5Y, value of 4 to 7, and chroma of 3 to 8. It has few or common brown to red masses of iron accumulation and iron depletions. It is silt loam or silty clay loam.

The Btg horizon has hue of 10YR to 5GY or is neutral in hue, has value of 4 to 7, and has chroma of 0 to 2. In most pedons it has reddish brown masses of iron accumulation and gray iron depletions. It is silt loam or silty clay loam.

The BCg horizon, if it occurs, has colors similar to those in the lower part of the Btg horizon. It is silt loam or loam.

The 2Cg horizon, if it occurs, has hue of 10YR to 5Y or is neutral in hue, has value of 4 to 7, and has chroma of 0 to 2. It commonly ranges from stratified sand to loam but in some pedons contains thin strata of clay.

RE—Romney and Elkton soils, cratered

Composition

Romney soil and similar soils: 55 percent
Elkton soil and similar soils: 30 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and shallow depressions
Slope: 0 to 2 percent
Note:
• This map unit consists of areas where ordnance has exploded, resulting in the formation of craters.

Component Description

Romney

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Elkton

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: High

A typical soil description for each soil is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

RoA—Romney silt loam

Composition

Romney soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and shallow depressions
Slope: 0 to 2 percent

Component Description

Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Dominant parent material: Silty eolian deposits or fluviomarine sediments, or both
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Ud—Udorthents, loamy, 0 to 10 percent slopes

Composition

Udorthents and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and side slopes
Slope: 0 to 10 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Dominant parent material: Sandy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Ur—Urban land-Udorthents complex, 0 to 10 percent slopes

Composition

Urban land: 55 percent
Udorthents and similar soils: 30 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, and side slopes
Slope: 0 to 10 percent

Component Description

Urban land

Urban land consists of areas where more than 80 percent of the surface is covered by asphalt, concrete, buildings, or other impervious surfaces. These areas include parking lots, shopping areas, airports, and building and housing complexes.

Udorthents

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Dominant parent material: Sandy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Woodstown Series

The Woodstown series consists of very deep, moderately permeable, moderately well drained soils. These soils formed in loamy marine and alluvial sediments. They are on uplands, in shallow depressions, and in swales of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 10 percent.

The Woodstown soils are similar to Beltsville and Mattapex soils and are commonly adjacent to Hambrook, Nassawango, and Fallsington soils. Mattapex and Nassawango soils have less sand and more silt in the subsoil than the Woodstown soils.

Beltsville soils have a fragipan. Nassawango and Hambrook soils are better drained than the Woodstown soils. Fallsington soils are poorly drained.

Typical pedon of Woodstown sandy loam, 2 to 5 percent slopes.

A—0 to 3 inches; dark grayish brown (2.5Y 4/2) sandy loam; weak medium granular structure; friable; many roots; strongly acid; clear wavy boundary.

E—3 to 11 inches; light yellowish brown (2.5Y 6/4) sandy loam; weak medium granular structure; friable; many roots; strongly acid; clear wavy boundary.

Bt1—11 to 19 inches; light olive brown (2.5Y 5/6) sandy clay loam; weak medium blocky and subangular blocky structure; friable; slightly sticky, slightly plastic; common roots; thin clay films; very strongly acid; clear wavy boundary.

Bt2—19 to 29 inches; light olive brown (2.5Y 5/6) sandy clay loam; moderate medium subangular blocky structure; firm; sticky, slightly plastic; few roots; thin yellowish brown (10YR 5/6) and thick olive yellow (2.5Y 6/6) clay films; common medium distinct light gray (2.5Y 7/2) iron depletions and common medium prominent strong brown (7.5YR 5/8) masses of iron accumulation; very strongly acid; clear wavy boundary.

Cg1—29 to 45 inches; light brownish gray (2.5Y 6/2) sandy loam; massive; friable; very few roots; common fine to coarse distinct yellowish brown (10YR 5/4 and 5/6) masses of iron accumulation; very strongly acid; clear wavy boundary.

Cg2—45 to 60 inches; light gray (5Y 7/2) loamy sand; common thick grayish brown (2.5Y 5/2) horizontal streaks; single grain; loose; 10 percent rounded gravel; extremely acid.

The thickness of the solum ranges from 24 to 45 inches. The content of coarse fragments consisting of round to subrounded resistant gravel ranges from 0 to 20 percent in individual horizons of the solum and in the C horizon. In unlimed areas reaction ranges from strongly acid to extremely acid.

The A horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. It is sandy loam, loam, or fine sandy loam.

The Bt horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 4 to 8. Iron depletions with chroma of 2 or less occur in the upper 24 inches of the argillic horizon. The Bt horizon is sandy clay loam, loam, sandy loam, or fine sandy loam that has 18 to 27 percent clay and 20 to 35 percent silt in the control section.

The C horizon has hue of 10YR to 5Y, value of 5 to 7, and chroma of 0 to 4. It ranges from sandy loam to sand and can contain thin strata of fine sandy clay loam or sandy clay loam.

WdA—Woodstown sandy loam, 0 to 2 percent slopes

Composition

Woodstown soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, depressions, and swales
Slope: 0 to 2 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

WdB—Woodstown sandy loam, 2 to 5 percent slopes

Composition

Woodstown soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland flats, lowland flats, depressions, and swales
Slope: 2 to 5 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)

Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

WdC—Woodstown sandy loam, 5 to 10 percent slopes

Composition

Woodstown soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Upland side slopes
Slope: 5 to 10 percent

Component Description

Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Dominant parent material: Loamy fluviomarine sediments
Flooding: None
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Zekiah Series

The Zekiah series consists of very deep, moderately permeable, poorly drained soils. These soils formed in loamy fluvial sediments overlying alluvial and marine sediments. They are on flood plains of the Mid-Atlantic Coastal Plain and are subject to scouring and uneven distribution of deposited sediment. Slopes are smooth and nearly level and are 0 to 1 percent.

The Zekiah soils are associated with Indiantown, Manahawkin, Chicone, and Fallsington soils. In some areas Indiantown soils are intermingled with the Zekiah soils. Indiantown soils have a thick organic-rich surface layer. Manahawkin and Chicone soils occur in the slightly lower landscape positions of the flood plain. Manahawkin soils are organic soils. Chicone soils formed in finer sediments than the Zekiah soils. Fallsington soils occur on the adjacent low-lying uplands.

Typical pedon of Zekiah loam; on a smooth 1 percent slope on a wooded flood plain. (Colors are for moist soil.)

A—0 to 3 inches; dark brown (7.5YR 3/2) loam; weak fine granular structure; friable; slightly sticky, slightly plastic; many very fine and fine roots; few very fine vesicular pores; very strongly acid; abrupt wavy boundary.

Cg—3 to 20 inches; dark grayish brown (10YR 4/2) silt loam; common medium prominent dark reddish brown (5YR 3/3) soft masses of iron accumulation; massive; friable; slightly sticky, slightly plastic; common very fine and fine roots; few very fine vesicular pores; very strongly acid; abrupt wavy boundary.

2Ab—20 to 27 inches; very dark gray (10YR 3/1) sandy loam; common medium prominent dark brown (7.5YR 3/4) masses of iron accumulation; massive; friable; slightly sticky; few very fine roots; very strongly acid; abrupt wavy boundary.

2Cg1—27 to 37 inches; dark grayish brown (2.5Y 4/2) sandy loam; massive; friable; slightly sticky; few medium gray (10YR 5/1) sand lenses; few medium prominent dark brownish yellow (10YR 4/6) soft masses of iron accumulation; common coarse very dark grayish brown (10YR 3/2) organic stains; extremely acid; clear wavy boundary.

2Cg2—37 to 50 inches; bluish gray (5B 5/1) loam; massive; friable; slightly sticky; few elongated strong brown (7.5YR 5/8) masses of iron accumulation; very strongly acid; clear wavy boundary.

2Cg3—50 to 72 inches; stratified grayish brown (2.5Y 5/2) loamy sand and sand; single grain; loose; common medium dark grayish brown (10YR 4/2) organic stains; extremely acid.

These soils are flooded for brief periods during storm events. In unlimed areas reaction ranges from extremely acid to strongly acid.

The A horizon has hue of 2.5Y to 7.5YR, value of 2 to 4, and chroma of 1 to 3. It is silt loam, mucky silt loam, or loam.

The Cg horizon has hue of 2.5Y or 10YR, value of 4 to 7, and chroma of 0 to 2. It is silt loam or loam.

The 2Ab horizon, if it occurs, has hue of 2.5Y or 10YR, value of 1 to 3, and chroma of 0 to 2. It is mucky loam, loam, or sandy loam. Some pedons may have a series consisting of as many as four buried surface layers.

The 2Cg horizon has hue of 10YR to 5B, value of 3 to 7, and chroma of 1 to 3. It is loam, sandy loam, loamy sand, or sand.

Ze—Zekiah loam

Composition

Zekiah soil and similar soils: 85 percent
Inclusions (unnamed soils): 15 percent

Setting

Landform: Flood plains
Slope: 0 to 2 percent

Component Description

Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Dominant parent material: Loamy alluvial sediments
Flooding: Frequent
Kind of water table: Apparent
Available water capacity: Moderate

A typical soil description is included in this section (see "Index to Series"). Additional information specific to this map unit, such as horizon depth and textures, is available in the appropriate table of this publication (see "Summary of Tables").

Management

For general and detailed information about managing this map unit, see the section "Use and Management of the Soils."

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; for woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction or crop failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others will also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The estimated yields of the main crops and pasture plants are listed for each soil, the system of land capability classification used by the Natural Resources Conservation Service is explained, and prime farmland is described.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Soil Series and Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Federal and State regulations require that any area designated as wetlands cannot be altered without prior approval. Contact the local office of the Natural Resources Conservation Service for identification of hydric soils and potential wetlands.

Cropland Limitations and Hazards

The management concerns affecting the use of the detailed soil map units in the survey area for crops are shown in table 3. The limitations and hazards listed in this table apply only to the crops shown in table 4. Some of the limitations and hazards shown in the table, especially flooding and ponding, cannot be easily overcome. The major concerns in managing nonirrigated cropland are conserving moisture, controlling soil blowing and water erosion, and maintaining soil fertility.

Conserving moisture consists primarily of reducing the evaporation and runoff rates and increasing the water intake rate. Applying conservation tillage and conservation cropping systems, farming on the contour, stripcropping, establishing field windbreaks, and leaving crop residue on the surface conserve moisture.

Generally, a combination of several practices is needed to control soil blowing and water erosion. Conservation tillage, stripcropping, field windbreaks, tall grass barriers, contour farming, conservation cropping systems, crop residue management, diversions, and grassed waterways help to prevent excessive soil loss.

Measures that are effective in maintaining soil fertility include applying fertilizer, both organic and inorganic; incorporating crop residue or green manure crops into the soil; and using proper crop rotations. Controlling erosion helps to prevent the loss of organic matter and plant nutrients and thus helps to maintain productivity, although the fertility level can be reduced even in areas where erosion is controlled. All soils used for nonirrigated crops respond well to applications of fertilizer.

Additional management concerns include excessive permeability, restricted permeability, and slope. Excessive permeability results in deep leaching of nutrients and pesticides. The capacity of the soil to retain moisture for plant use is poor. Restricted permeability can be overcome by incorporating manure or crop residue into the soil, applying a system of conservation tillage, and using conservation cropping systems. Slope is a concern where it is more than 8 percent because water erosion and soil blowing may be accelerated unless conservation farming practices are applied.

On irrigated soils the main management concerns are efficient water use, nutrient management, control of erosion, pest and weed control, and timely planting and harvesting for a successful crop. An irrigation system that provides optimum control and distribution of water at minimum cost is needed. Overirrigation wastes water, leaches plant nutrients, and causes erosion. It also can create drainage problems and raise the water table.

The criteria used to determine the limitations or hazards for the soils listed in table 3 are explained in the following paragraphs.

Erosion by water.—The surface K factor multiplied by the upper slope limit is more than 2 (same as prime farmland criteria).

Excessive permeability.—The upper limit of the permeability range is at a depth of 6 inches or more.

Flooding.—The component of the map unit is occasionally flooded or frequently flooded.

Ponding.—Ponding duration is assigned to the component of the map unit.

Restricted permeability.—Permeability is 0.06 inch per hour or less within the soil profile.

Slope.—The upper slope range of the component of the map unit is more than 8 percent.

Soil blowing.—The wind erodibility index multiplied by the selected high C factor for the survey area and then divided by the T factor is more than 8 for the component of the map unit.

High water table.—The component of the map unit has a high water table within a depth of 60 inches.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 4. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of local farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials, computer modeling, and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and cover crops; and harvesting that ensures the smallest possible loss.

A high level of management includes maintaining proper soil reaction and fertility levels as indicated by standard soil tests. The application rate of nitrogen for corn on soils that have a yield potential of 125 to 150 bushels per acre should be 140 to 160 pounds per acre. If the yield potential for corn is 100 bushels per acre or less, a rate of 100 to 120 pounds of nitrogen per acre should be used. The application of nitrogen in excess of that required for potential yields generally is not recommended. The excess nitrogen fertilizer that is not utilized by the crop is an unnecessary expense and causes a hazard of water pollution. If corn or cotton is grown after the harvest of soybeans or peanuts, nitrogen rates can be reduced by about 20 to 30 pounds per acre. Because nitrogen can be readily leached from sandy soils, applications may be needed on these soils more than once during the growing season.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed and applied. The relative productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 4 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by numerals 1 through 8. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class 5 soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation.

Class 7 soils have very severe limitations that make them unsuitable for cultivation.

Class 8 soils and miscellaneous areas have limitations that usually preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a letter, *E, W, or S* to the class numeral, for example, 2E. The letter *E* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *W* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *S* shows that the soil is limited mainly because it is shallow, droughty, or stony.

In class 1 there are no subclasses because the soils of this class have few limitations. Class 5 contains only the subclasses indicated by *W* or *S* because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the yields table.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forest land, or other land, but it is not urban or built-up land or water areas. The soil qualities, growing season, and moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management, and acceptable farming methods are applied. In general, prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it either is not frequently flooded during the growing season or is protected from flooding. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

A recent trend in land use in some parts of the survey area has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. On some soils included in the list, measures that overcome a hazard or limitation, such as flooding, wetness, and droughtiness, are needed. Onsite evaluation is needed to determine whether or not the hazard or limitation has been overcome by corrective measures. The extent of each listed map unit is shown in table 2. The location is shown on the detailed soil maps. The soil qualities that affect use and management are described under the heading "Soil Series and Detailed Soil Map Units."

Highly Erodible Land

The basis for identifying highly erodible land is the erodibility index of a soil map unit. The erodibility index of a soil is determined by dividing the potential erodibility for each soil by the soil loss tolerance (T) value established for the soil. The T value represents the maximum annual rate of soil erosion that could take place without causing a decline in long-term productivity. A soil map unit that has an erodibility index of 8 or more is a highly erodible soil map unit.

Water Erosion

Potential erodibility for sheet and rill erosion is estimated by multiplying the following factors of the Universal Soil Loss Equation (USLE): (1) rainfall and runoff factor (R), (2) susceptibility of the soil to water erosion (K), and (3) combined effects of slope length and steepness (LS).

The erodibility index for sheet and rill erosion is represented by the formula RKLS/T. A soil map unit is highly erodible if the LS factor for the shortest length and minimum percent of slope is used and the RKLS/T value equals or exceeds 8C. All highly erodible soil map units are assigned a value of *1* in table 6.

A soil map unit is potentially highly erodible if: (1) the RKLS/T value using the minimum LS factor is less than 8 and (2) the RKLS/T value using the maximum LS factor is equal to or greater than 8. All potentially highly erodible soil map units are assigned a value of *2* in table 6.

All other soil map units, that do not fall in either of the above two classes, are assigned a value of *3*, which stands for "not highly erodible."

Wind Erosion

Potential erodibility from wind erosion is estimated by multiplying the following factors of the Wind Erosion Equation (WEQ): (1) climatic characterization of windspeed and surface soil moisture (C) and (2) the susceptibility of the soil to wind erosion (I).

The erodibility index for wind erosion is represented by the formula CI/T. A soil map unit is highly erodible if the CI/T value equals or exceeds 8.

Woodland Management and Productivity

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol,* a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce in a pure stand under natural conditions. The number 1 indicates low potential productivity; 2 or 3, moderate; 4 or 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X,* stoniness or rockiness; *W,* excess water in or on the soil; *T,* toxic substances in the soil; *D,* restricted rooting depth; *C,* clay in the upper part of the soil; *S,* sandy texture; *F,* a high content of rock fragments in the soil; and *L,* low strength. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, F, and L.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a high water table and the depth to bedrock, a fragipan, or other limiting layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

Plant competition ratings indicate the degree to which undesirable species are expected to invade and grow when openings are made in the tree canopy. The main factors that affect plant competition are depth to the water table and the available water capacity. A rating of *slight* indicates that competition from undesirable plants is not likely to prevent natural regeneration or suppress the more desirable species. Planted seedlings can become established without undue competition. A rating of *moderate* indicates that competition may delay the establishment of desirable species. Competition may hamper stand development, but it will not prevent the eventual development of fully stocked stands. A rating of *severe* indicates that competition can be expected to prevent regeneration unless precautionary measures are applied.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *productivity class*. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *productivity class* represents the yield likely to be produced by the most important trees. This number, expressed as cubic meters per hectare per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Recreation

The soils of the survey area are rated in table 8 according to the limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the period of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat. The ratings in table 9 are intended to be used as a guide and are not site specific. Onsite investigation is needed for individual management plans.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining the specified element of habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, millet, wheat, oats, soybeans, sunflowers, sorghum, buckwheat, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are lovegrass, lespedeza, bromegrass, orchardgrass, timothy, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, pokeweed, goldenrod, butterflyweed, switchgrass, bluegrass, redtop, gama grass, and panic grass.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, slope, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, locust, dogwood, and hickory.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are loblolly pine, scrub pine, white pine, Virginia pine, spruce, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, arrow-arum, saltgrass, spatterdock, cordgrass, rushes, sedges, ferns, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, forbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, deer, cottontail rabbit, morning dove, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants (or both) and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, woodcock, thrushes, woodpeckers, gray squirrels, gray fox, fox squirrels, raccoon, deer, and various species of small mammals, reptiles, and songbirds.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kinds of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns, landscaping, and golf fairways. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm, dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns, landscaping, and golf fairways require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Drainage may be a major management consideration in some areas. Management of drainage in conformance with regulations concerning wetlands may require special permits and extra planning. The local office of the Natural Resources Conservation Service should be contacted for identification of hydric soils and potential wetlands.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, a low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Detailed Soil Map Units."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system and the system adopted by the American Association of State Highway and Transportation Officials.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at $\frac{1}{3}$-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time. It is the difference between the amount of soil water at field moisture capacity and the amount at wilting point.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; *high*, more than 6 percent; and *very high*, greater than 9 percent.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.64. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.

8. Soils that are not subject to wind erosion because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various water features, and table 17 gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 16, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflowing streams, by runoff from adjacent slopes, or by inflow from high tides. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in swamps and marshes or in a closed depression is considered ponding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on observations of the water table at selected sites and on the evidence of a saturated zone, namely grayish colors or mottles (redoximorphic features) in the soil. Indicated in table 16 are the depth to the high water table; the kind of water table—that is, *perched* or *apparent*; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil.

In table 17, *depth to bedrock* is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 17 shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Hydric Soil Interpretations

Hydric soils developed under conditions sufficiently wet to support the growth and regeneration of hydrophytic vegetation. Table 18 lists map units that may or may not have been drained. Some soil series that are designated as hydric have phases that are not hydric because of water table, flooding, or ponding characteristics.

Table 18 has several agricultural and nonagricultural applications. It can be used in land-use planning, conservation planning, and assessment of potential wildlife habitat. An area that meets the hydric soil criteria must also meet the hydrophytic vegetation and wetland hydrology criteria in order for it to be classified as a jurisdictional wetland.

Definition of Hydric Soil

A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. The following criteria reflect those soils that meet this definition.

Criteria for Hydric Soils

1. All Histosols except Folists, or
2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Aquisalids, Pachic subgroups, or Cumulic subgroups that are:
   A) Somewhat poorly drained with a water table equal to 0.0 feet from the surface during the growing season, or
   B) Poorly drained or very poorly drained and have either:
      (1) water table equal to 0.0 feet during the growing season if textures are coarse sand, sand, or fine sand in all layers within a depth of 20 inches, or
      (2) water table at less than or equal to 0.5 foot from the surface during the growing season if permeability is equal to or greater than 6.0 inches per hour in all layers within a depth of 20 inches, or
      (3) water table at less than or equal to 1.0 foot from the surface during the growing season if permeability is less than 6.0 inches per hour in any layer within a depth of 20 inches, or
3. Soils that are frequently ponded for long duration or very long duration during the growing season, or
4. Soils that are frequently flooded for long duration or very long duration during the growing season.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Alpha,alpha-dipridyl. A dye that when dissolved in 1N ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction indicates a type of redoximorphic feature.

Animal unit month (AUM). The amount of forage required by one mature cow of approximately 1,000 pounds weight, with or without a calf, for 1 month.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Argillite. Weakly metamorphosed mudstone or shale.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Back slope. The geomorphic component that forms the steepest inclined surface and principal element of many hillsides. Back slopes in profile are commonly steep, are linear, and may or may not include cliff segments.

Basal area. The area of a cross section of a tree, generally referring to the section at breast height and measured outside the bark. It is a measure of stand density, commonly expressed in square feet.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine strata, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediment.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Board foot. A unit of measure of the wood in lumber, logs, or trees. The amount of wood in a board 1 foot wide, 1 foot long, and 1 inch thick before finishing.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Brackish water. Water commonly in the tidal reaches of a river where sea water and fresh water mix. The content of salt in brackish water is greater than that in fresh water but less than that in sea water.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Breast height. An average height of 4.5 feet above the ground surface; the point on a tree where diameter measurements are ordinarily taken.

Canopy. The leafy crown of trees or shrubs. (See Crown.)

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. Some common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channeled. Refers to a streambed in which meandering, repeated branching, and convergence of streams, either active or abandoned, have created deeply incised cuts in alluvial material.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth. This practice is commonly called chisel plowing or ripping.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clayey soil. Silty clay, sandy clay, or clay.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Clearcutting. A method of forest harvesting that removes the entire stand of trees in one cutting. The stand is reproduced artificially or by natural seeding from adjacent stands.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Closed depression. A low area completely surrounded by higher ground and having no natural outlet.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material is 35 to 60 percent of these rock fragments, and extremely cobbly soil material is more than 60 percent.

Codominant trees. Trees whose crowns form the general level of the forest canopy and that receive full light from above but comparatively little from the sides.

Commercial forest. Forest land capable of producing 20 cubic feet or more of wood per acre per year at the culmination of mean annual increment.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane that typically takes the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Congeliturbate. Soil material disturbed by frost action.

Conglomerate. A coarse-grained, clastic rock composed of rounded to subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of cover crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. Refers to the degree of cohesion and adhesion of soil material and its resistance to deformation when ruptured. Consistence includes resistance of soil material to rupture and to penetration; plasticity, toughness, and stickiness of puddled soil material; and the manner in which the soil material behaves when subject to compression. Terms describing consistence are defined in the "Soil Survey Manual."

Consolidated sandstone. Sandstone that disperses within a few hours when fragments are placed in water. The fragments are extremely hard or very hard when dry, are not easily crushed, and cannot be textured by the usual field method.

Consolidated shale. Shale that disperses within a few hours when fragments are placed in water. The fragments are extremely hard or very hard when dry and are not easily crushed.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coppice dune. A small dune of fine-grained soil material stabilized around shrubs or small trees.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cross-slope farming. Deliberately conducting farming operations on sloping farmland in such a way that tillage is across the general slope.

Crown. The upper part of a tree or shrub, including the living branches and their foliage.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deep soil. A soil that is 40 to 60 inches deep over bedrock or to other material that restricts the penetration of plant roots.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Delta. A body of alluvium having a surface that is nearly flat and fan shaped; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Divided-slope farming. A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Dominant trees. Trees whose crowns form the general level of the forest canopy and that receive full light from above and from the sides.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—*excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained,* and *very poorly drained.* These classes are defined in the "Soil Survey Manual."

Drainage, surface. Runoff, or surface flow of water, from an area.

Drainageway. A land area that is lower in elevation than surrounding areas and in which water collects and is drained to a closed depression or lake or to a drainageway at a lower elevation. A drainageway may have distinctly incised channels at its upper reaches or throughout its course.

Draw. A small stream valley that generally is more open and has broader bottom land than a ravine or gulch.

Duff. A generally firm organic layer on the surface of mineral soils. It consists of fallen plant material that is in the process of decomposition and includes everything from the litter on the surface to underlying pure humus.

Dune. A mound, ridge, or hill of loose, windblown granular material (generally sand), either bare or covered with vegetation.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Exposed material is hard or soft bedrock. Synonym: scarp.

Estuarine. Term relating to marsh soils that may contain mineral material with a high *n* value that was deposited by tidally influenced streams in a quiescent environment.

Even-aged. Refers to a stand of trees in which only small differences in age occur between individual trees. A range of 20 years is allowed.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, or clay.

Firebreak. An area cleared of flammable material to stop or help control creeping or running fires. It also serves as a line from which to work and to facilitate the movement of firefighters and equipment. Designated roads also serve as firebreaks.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Fluviomarine. Of or pertaining to material deposited by oceans and reworked and deposited by streams after exposure.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.

Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.

Graded stripcropping. Growing crops in strips that grade toward a protected waterway.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.

Ground water. Water filling all the unblocked pores of material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Gypsum. A mineral consisting of hydrous calcium sulfate.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Head out. To form a flower head; especially referring to small grain crops.

Heavy metals. Inorganic substances that are solid at ordinary temperatures and are not soluble in water. They form oxides and hydroxides that are basic. Examples are copper, iron, cadmium, zinc, manganese, lead, and arsenic.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.

High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.

Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Hummock. A small, irregularly shaped knob or mound consisting of mineral or organic material covered by vegetation.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake, in inches per hour, is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loamy soil. Coarse sandy loam, sandy loam, fine sandy loam, very fine sandy loam, loam, silt loam, silt, clay loam, sandy clay loam, or silty clay loam.

Loess. Fine-grained material, dominantly of silt-sized particles, deposited by the wind.

Lowland. A general term for low-lying land or an extensive region of low land, at elevations near tide level.

Lowland flats. A general term for a level or nearly level surface or large area of land that is characterized by little or no relief.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mean annual increment. The average annual volume of a tree from the year of origin to the age under consideration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Merchantable trees. Trees that are of sufficient size to be economically processed into wood products.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no soil development and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately deep soil. A soil that is 20 to 40 inches deep over bedrock or to other material that restricts the penetration of plant roots.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mud flat. A level area along a shore that consists of fine-grained material alternately covered and uncovered by the tide or covered by shallow water and that is barren of vegetation during winter.

Mudstone. Sedimentary rock formed by induration of silt and clay in approximately equal amounts.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Neck. A narrow strip of land that is connected to a larger body of land but is bounded on both sides by water.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Overstory. The trees in a forest that form the upper crown cover.

Oxbow. The horseshoe-shaped channel of a former meander, remaining after the stream formed a cutoff across a narrow meander neck.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan.*

Panne. A small pond located on a tidal marsh, commonly having a higher content of salt than the surrounding areas of marsh.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. In soil physics, the rate is referred to as "saturated hydraulic conductivity," which is defined in the "Soil Survey Manual." In line with conventional usage in the engineering profession and with traditional usage in published soil surveys, this rate of flow continues to be expressed as "permeability." Terms describing permeability, measured in inches per hour, are as follows:

Extremely slow	0.00 to 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse-grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Quartzite, metamorphic. Rock consisting mainly of quartz that formed through recrystallization of quartz-rich sandstone or chert.

Quartzite, sedimentary. Very hard but unmetamorphosed sandstone consisting chiefly of quartz grains.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Red beds. Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha,alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation. Descriptive terms for concentrations and depletions are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium,* from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse,* more than 15 millimeters (about 0.6 inch).

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regeneration. The new growth of a natural plant community, developing from seed.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relict stream terrace. One of a series of platforms in or adjacent to a stream valley that formed prior to the current stream system.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Riser. The relatively short, steeply sloping area below a terrace tread that grades to a lower terrace tread or base level.

Riverwash. Unstable areas of sandy, silty, clayey, or gravelly sediments. These areas are flooded, washed, and reworked by rivers so frequently that they support little or no vegetation.

Road cut. A sloping surface produced by mechanical means during road construction. It is commonly on the uphill side of the road.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rock outcrop. An area of exposed bedrock in a map unit that has less than 0.1 percent exposed bedrock.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs the growth of plants. A saline soil does not contain excess exchangeable sodium.

Salinity. The electrical conductivity of a saline soil. It is expressed, in millimhos per centimeter, as follows:

Nonsaline	0 to 4
Slightly saline	4 to 8
Moderately saline	8 to 16
Strongly saline	more than 16

Sand. As a soil separate, individual rock or mineral fragments ranging from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sandy soil. Sand or loamy sand.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saprolite. Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Sawlogs. Logs of suitable size and quality for the production of lumber.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Scarp. An escarpment, cliff, or steep slope of considerable extent along the margin of a terrace.

Scribner's log rule. A method of estimating the number of board feet that can be cut from a log of a given diameter and length.

Second bottom. The first terrace above the normal flood plain (or first bottom) of a river.

Sedimentary plain. An extensive, nearly level to gently rolling or moderately sloping area that is underlain by sedimentary bedrock and that has a slope of 0 to 8 percent.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Semiconsolidated sedimentary beds. Soft geologic sediments that disperse when fragments are placed in water. The fragments are hard or very hard when dry. Determining the texture by the usual field method is difficult.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shallow soil. A soil that is 10 to 20 inches deep over bedrock or to other material that restricts the penetration of plant roots.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder slope. The uppermost inclined surface at the top of a hillside. It is the transition zone from the back slope to the summit of a hill or mountain. The surface is dominantly convex in profile and erosional in origin.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. One crystalline mineral form is quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75.

Skid trails. Pathways along which logs are dragged to a common site for loading onto a logging truck.

Slash. The branches, bark, treetops, reject logs, and broken or uprooted trees left on the ground after logging.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow refill (in tables). The slow filling of ponds, resulting from restricted permeability in the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Species. A single, distinct kind of plant or animal having certain distinguishing characteristics.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stream channel. The hollow bed where a natural stream of surface water flows or may flow; the deepest or central part of the bed, formed by the main current and covered more or less continuously by water.

Stream terrace. One of a series of platforms in a stream valley, flanking and more or less parallel to the stream channel. It originally formed near the level of the stream and is the dissected remnants of an abandoned flood plain, streambed, or valley floor that was produced during a former stage of erosion or deposition.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are: *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Any subsurface soil horizon (E, BE, or EB) below the surface layer.

Summit. A general term for the top, or highest level, of an upland feature, such as a hill or mountain. It commonly refers to a higher area that has a gentle slope and is flanked by steeper slopes.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, AE, and AB horizons, considered collectively. It includes all subdivisions of these horizons.

Swamp. A saturated, very poorly drained area that is intermittently or permanently covered by water. Swamps are dominantly covered by shrubs or trees.

Tailwater. The water directly downstream of a structure.

Talus. Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Trafficability. The degree to which a soil is capable of supporting vehicular traffic across a wide range in soil moisture conditions.

Tread. The relatively flat terrace surface that was cut or built by stream or wave action.

Understory. The trees and other woody species growing under a more or less continuous cover of branches and foliage formed collectively by the upper portions of adjacent trees and other woody growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley. An elongated depressional area primarily developed by stream action.

Very deep soil. A soil that is more than 60 inches deep over bedrock or to other material that restricts the penetration of plant roots.

Very shallow soil. A soil that is less than 10 inches deep over bedrock or to other material that restricts the penetration of plant roots.

Water bars. Smooth, shallow ditches or depressional areas that are excavated at an angle across a sloping road. They are used to reduce the downward velocity of water and divert it off and away from the road surface. Water bars can easily be driven over if constructed properly.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse-grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windthrow. The uprooting and tipping over of trees by the wind.

Tables

Table 1.--Classification of the Soils

Soil name	Family or higher taxonomic class
Beltsville	Fine-loamy, mixed, semiactive, mesic Typic Fragiudults
Chicone	Coarse-silty, mixed, active, acid, mesic Thapto-Histic Fluvaquents
Codorus	Fine-loamy, mixed, semiactive, mesic Fluvaquentic Dystrochrepts
Corsica	Fine-loamy, mixed, active, mesic Typic Umbraquults
Elkton	Fine-silty, mixed, active, mesic Typic Endoaquults
Fallsington	Fine-loamy, mixed, active, mesic Typic Endoaquults
Hambrook	Fine-loamy, siliceous, semiactive, mesic Typic Hapludults
Indiantown	Coarse-loamy, siliceous, active, acid, mesic Cumulic Humaquepts
Kentuck	Fine-silty, mixed, active, mesic Typic Umbraquults
Klej	Mesic, coated Aquic Quartzipsamments
Lenape	Loamy, mixed, dysic, mesic Terric Haplosaprists
Longmarsh	Coarse-loamy, siliceous, active, acid, mesic Fluvaquentic Humaquepts
Manahawkin	Sandy or sandy-skeletal, siliceous, dysic, mesic Terric Haplosaprists
Mattapex	Fine-silty, mixed, active, mesic Aquic Hapludults
Nassawango	Fine-silty, mixed, semiactive, mesic Typic Hapludults
Othello	Fine-silty, mixed, active, mesic Typic Endoaquults
Pone	Coarse-loamy, siliceous, active, mesic Typic Umbraquults
Puckum	Dysic, mesic Typic Haplosaprists
Romney	Fine-silty, mixed, active, mesic Aeric Endoaquults
Udorthents	Udorthents
Woodstown	Fine-loamy, mixed, active, mesic Aquic Hapludults
Zekiah	Coarse-loamy, siliceous, semiactive, acid, mesic Typic Fluvaquents

Table 2.--Acreage and Proportionate Extent of the Soils

Map symbol	Soil map unit name	Acres	Percent
BeA	Beltsville silt loam, 0 to 2 percent slopes	199	0.5
BeB	Beltsville silt loam, 2 to 5 percent slopes	1,874	5.0
BeC	Beltsville silt loam, 5 to 10 percent slopes	99	0.3
BU	Beltsville-Udorthents-Urban land complex, 0 to 5 percent slopes	244	0.7
Ch	Chicone silt loam	18	*
Cd	Codorus loam	732	2.0
Co	Corsica loam	522	1.4
Ek	Elkton silt loam	1,284	3.4
Fa	Fallsington sandy loam	1,232	3.3
HbA	Hambrook sandy loam, 0 to 2 percent slopes	624	1.7
HbB	Hambrook sandy loam, 2 to 5 percent slopes	651	1.7
HbC	Hambrook sandy loam, 5 to 10 percent slopes	146	0.4
HbE	Hambrook sandy loam, 10 to 60 percent slopes	90	0.2
HU	Hambrook-Udorthents-Urban land complex, 0 to 10 percent slopes	117	0.3
In	Indiantown mucky silt loam	622	1.7
Kn	Kentuck silt loam	175	0.5
Kj	Klej loamy sand	20	*
Le	Lenape mucky peat	2,331	6.2
Lo	Longmarsh sandy loam	343	0.9
Ma	Manahawkin muck	93	0.3
MpA	Mattapex silt loam, 0 to 2 percent slopes	4,516	12.1
MpB	Mattapex silt loam, 2 to 5 percent slopes	1,382	3.7
MpC	Mattapex silt loam, 5 to 10 percent slopes	90	0.2
MU	Mattapex-Udorthents-Urban land complex, 0 to 2 percent slopes	836	2.2
MwA	Mattapex silt loam, cratered	292	0.8
NnA	Nassawango silt loam, 0 to 2 percent slopes	705	1.9
NnB	Nassawango silt loam, 2 to 5 percent slopes	274	0.7
NnC	Nassawango silt loam, 5 to 10 percent slopes	43	*
Ot	Othello silt loam	63	0.2
Po	Pone mucky loam	375	1.0
Pk	Puckum muck	3,030	8.1
RE	Romney and Elkton soils, cratered	311	0.8
RoA	Romney silt loam	6,661	17.8
Ud	Udorthents, loamy, 0 to 10 percent slopes	3,228	8.6
Ur	Urban land-Udorthents complex, 0 to 10 percent slopes	1,300	3.5
WdA	Woodstown sandy loam, 0 to 2 percent slopes	2,733	7.3
WdB	Woodstown sandy loam, 2 to 5 percent slopes	752	2.0
WdC	Woodstown sandy loam, 5 to 10 percent slopes	58	0.2
Ze	Zekiah loam	523	1.4
	Water	187	0.5
	Total	38,775	100.0

* Less than 0.1 percent

Table 3.--Main Cropland Limitations and Hazards

(See text for a description of the limitations and hazards listed in this table)

Soil name and map symbol	Limitation or hazard
BeA:	
Beltsville	Acidity (additions of lime needed), restricted permeability, high water table.
BeB:	
Beltsville	Acidity (additions of lime needed), erosion by water, restricted permeability, high water table.
BeC:	
Beltsville	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
BU:	
Beltsville	Acidity (additions of lime needed), erosion by water, restricted permeability, soil blowing, high water table.
Udorthents	Acidity (additions of lime needed), restricted permeability, high water table.
Urban land	Nonsoil material.
Ch:	
Chicone	Acidity (additions of lime needed), excessive permeability, flooding, ponding, high water table.
Cd:	
Codorus	Acidity (additions of lime needed), flooding, high water table.
Co:	
Corsica	Acidity (additions of lime needed), ponding, high water table.
Ek:	
Elkton	Acidity (additions of lime needed), restricted permeability, high water table.
Fa:	
Fallsington	Acidity (additions of lime needed), high water table.

Table 3.--Main Cropland Limitations and Hazards--Continued

Soil name and map symbol	Limitation or hazard
HbA:	
Hambrook	Acidity (additions of lime needed), restricted permeability, high water table.
HbB:	
Hambrook	Acidity (additions of lime needed), restricted permeability, high water table.
HbC:	
Hambrook	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
HbE:	
Hambrook	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
HU:	
Hambrook	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
Udorthents	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
Urban land	Nonsoil material.
In:	
Indiantown	Acidity (additions of lime needed), excessive permeability, flooding, ponding, high water table.
Kn:	
Kentuck	Acidity (additions of lime needed), excessive permeability, ponding, restricted permeability, high water table.
Kj:	
Klej	Acidity (additions of lime needed), excessive permeability, restricted permeability, high water table.
Le:	
Lenape	Acidity (additions of lime needed), flooding, ponding, high water table.

Table 3.--Main Cropland Limitations and Hazards--Continued

Soil name and map symbol	Limitation or hazard
Lo:	
Longmarsh	Acidity (additions of lime needed), excessive permeability, flooding, ponding, soil blowing.
Ma:	
Manahawkin	Acidity (additions of lime needed), excessive permeability, flooding, ponding, high water table.
MpA:	
Mattapex	Acidity (additions of lime needed), excessive permeability, high water table.
MpB:	
Mattapex	Acidity (additions of lime needed), erosion by water, excessive permeability, high water table.
MpC:	
Mattapex	Acidity (additions of lime needed), erosion by water, excessive permeability, slope, high water table.
MU:	
Mattapex	Acidity (additions of lime needed), excessive permeability, high water table.
Udorthents	Nonsoil material.
Urban land	Nonsoil material.
MwA:	
Mattapex	Acidity (additions of lime needed), excessive permeability, high water table.
NnA:	
Nassawango	Acidity (additions of lime needed), excessive permeability, high water table.
NnB:	
Nassawango	Acidity (additions of lime needed), erosion by water, excessive permeability, high water table.
NnC:	
Nassawango	Acidity (additions of lime needed), erosion by water, excessive permeability, slope, high water table.

Table 3.--Main Cropland Limitations and Hazards--Continued

Soil name and map symbol	Limitation or hazard
Ot:	
Othello	Acidity (additions of lime needed), excessive permeability, ponding, high water table.
Po:	
Pone	Acidity (additions of lime needed), ponding, restricted permeability, high water table.
Pk:	
Puckum	Acidity (additions of lime needed), flooding, ponding, high water table.
RE:	
Romney	Acidity (additions of lime needed), excessive permeability, high water table.
Elkton	Acidity (additions of lime needed), restricted permeability, high water table.
RoA:	
Romney	Acidity (additions of lime needed), excessive permeability, high water table.
Ud:	
Udorthents	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
Ur:	
Urban land	Nonsoil material.
Udorthents	Acidity (additions of lime needed), erosion by water, restricted permeability, slope, high water table.
WdA:	
Woodstown	Acidity (additions of lime needed), high water table.
WdB:	
Woodstown	Acidity (additions of lime needed), high water table.
WdC:	
Woodstown	Acidity (additions of lime needed), erosion by water, slope, high water table.
Ze:	
Zekiah	Acidity (additions of lime needed), flooding, high water table.

Table 4.--Land Capability and Yields Per Acre of Crops and Pasture

(Yields in the N columns are for nonirrigated soils, and those in the I columns are for irrigated soils)

Map symbol	Soil name	Land capability N	Land capability I	Corn N	Corn I	Wheat N	Wheat I	Soybeans N	Soybeans I	Pasture N	Pasture I
				Bu		Bu		Bu		AUM*	
BeA	Beltsville	2W	---	95	---	45	---	35	---	5.5	---
BeB	Beltsville	2E	---	95	---	45	---	35	---	5.5	---
BeC	Beltsville	2E	---	95	---	45	---	35	---	5.5	---
BU**	Beltsville-Udorthents-Urban land.										
Ch**	Chicone	5W	---	---	---	---	---	---	---	---	---
Cd	Codorus	2W	---	130	---	45	---	---	---	8.1	---
Co**	Corsica	4W	---	---	---	---	---	---	---	---	---
Ek**	Elkton	4W	---	---	---	---	---	---	---	---	---
Fa	Fallsington	4W	---	70	---	35	---	30	---	5.0	---
HbA	Hambrook	1	---	110	165	50	55	45	55	---	---
HbB	Hambrook	2E	---	110	165	50	55	40	55	---	---
HbC	Hambrook	3E	---	100	155	---	---	---	---	---	---
HbE**	Hambrook	7E	---	---	---	---	---	---	---	---	---
HU**	Hambrook-Udorthents-Urban land.										
In**	Indiantown	5W	---	---	---	---	---	---	---	---	---
Kn**	Kentuck	5W	---	---	---	---	---	---	---	---	---
Kj**	Klej	4W	---	---	---	---	---	---	---	---	---
Le**	Lenape	8W	---	---	---	---	---	---	---	---	---
Lo**	Longmarsh	5W	---	---	---	---	---	---	---	---	---
Ma	Manahawkin	7W	---	---	---	---	---	---	---	---	---
MpA	Mattapex	2W	---	135	165	65	---	40	55	8.0	---
MpB	Mattapex	2E	---	135	165	60	---	40	55	8.0	---
MpC	Mattapex	3E	---	130	140	---	---	35	---	7.5	---
MU**	Mattapex-Udorthents-Urban land.										

See footnotes at end of table.

Table 4.--Land Capability and Yields Per Acre of Crops and Pasture--Continued

Map symbol	Soil name	Land capability N	Land capability I	Corn N	Corn I	Wheat N	Wheat I	Soybeans N	Soybeans I	Pasture N	Pasture I
				Bu	Bu	Bu	Bu	Bu	Bu	AUM*	AUM*
MwA	Mattapex	2W	---	135	165	65	---	40	55	8.0	---
NnA	Nassawango	1	---	140	---	60	---	45	---	---	---
NnB	Nassawango	2E	---	140	---	60	---	45	---	---	---
NnC	Nassawango	3E	---	135	---	55	---	40	---	---	---
Ot**	Othello	5W	---	---	---	---	---	---	---	---	---
Po**	Pone	4W	---	---	---	---	---	---	---	---	---
Pk**	Puckum	8W	---	---	---	---	---	---	---	---	---
RE	Romney	3W	---	100	---	45	---	40	---	10.0	---
	Elkton	4W	---	---	---	---	---	---	---	---	---
RoA	Romney	3W	---	100	---	45	---	40	---	10.0	---
Ud**	Udorthents.										
Ur**	Urban land-Udorthents.										
WdA	Woodstown	2W	---	130	170	45	50	40	50	8.0	---
WdB	Woodstown	2W	---	130	170	45	50	40	50	8.0	---
WdC	Woodstown	3E	---	120	155	40	45	35	45	8.0	---
Ze	Zekiah	5W	---	---	---	---	---	---	---	---	---

* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

** See description of the map unit for composition and behavior characteristics of the map unit.

Table 5.--Prime Farmland

Map symbol	Prime farmland code*	Soil map unit name
Cd	1	Codorus loam
Fa	2	Fallsington sandy loam
HbA	1	Hambrook sandy loam, 0 to 2 percent slopes
HbB	1	Hambrook sandy loam, 2 to 5 percent slopes
MpA	1	Mattapex silt loam, 0 to 2 percent slopes
MpB	1	Mattapex silt loam, 2 to 5 percent slopes
NnA	1	Nassawango silt loam, 0 to 2 percent slopes
NnB	1	Nassawango silt loam, 2 to 5 percent slopes
Ot	2	Othello silt loam
WdA	1	Woodstown sandy loam, 0 to 2 percent slopes
WdB	1	Woodstown sandy loam, 2 to 5 percent slopes

* Code 1 indicates that all areas are prime farmland; code 2 indicates that only drained areas are prime farmland.

Table 6.--Highly Erodible Land

[See text for definitions of classifications]

Map symbol	Soil map unit name	HEL classification
BeA	Beltsville silt loam, 0 to 2 percent slopes	3
BeB	Beltsville silt loam, 2 to 5 percent slopes	2
BeC	Beltsville silt loam, 5 to 10 percent slopes	1
BU	Beltsville-Udorthents-Urban land complex, 0 to 5 percent slopes	2
Ch	Chicone silt loam	3
Cd	Codorus loam	3
Co	Corsica loam	3
Ek	Elkton silt loam	3
Fa	Fallsington sandy loam	3
HbA	Hambrook sandy loam, 0 to 2 percent slopes	3
HbB	Hambrook sandy loam, 2 to 5 percent slopes	2
HbC	Hambrook sandy loam, 5 to 10 percent slopes	1
HbE	Hambrook sandy loam, 10 to 60 percent slopes	1
HU	Hambrook-Udorthents-Urban land complex, 0 to 10 percent slopes	2
In	Indiantown mucky silt loam	3
Kn	Kentuck silt loam	3
Kj	Klej loamy sand	3
Le	Lenape mucky peat	3
Lo	Longmarsh sandy loam	3
Ma	Manahawkin muck	3
MpA	Mattapex silt loam, 0 to 2 percent slopes	3
MpB	Mattapex silt loam, 2 to 5 percent slopes	2
MpC	Mattapex silt loam, 5 to 10 percent slopes	1

Table 6.--Highly Erodible Land--Continued

Map symbol	Soil map unit name	HEL classification
MU	Mattapex-Udorthents-Urban land complex, 0 to 2 percent slopes	3
MwA	Mattapex silt loam, cratered	3
NnA	Nassawango silt loam, 0 to 2 percent slopes	3
NnB	Nassawango silt loam, 2 to 5 percent slopes	2
NnC	Nassawango silt loam, 5 to 10 percent slopes	1
Ot	Othello silt loam	3
Po	Pone mucky loam	3
Pk	Puckum muck	3
RE	Romney and Elkton soils, cratered	3
RoA	Romney silt loam	3
Ud	Udorthents, loamy, 0 to 10 percent slopes	2
Ur	Urban land-Udorthents complex, 0 to 10 percent slopes	2
WdA	Woodstown sandy loam, 0 to 2 percent slopes	3
WdB	Woodstown sandy loam, 2 to 5 percent slopes	2
WdC	Woodstown sandy loam, 5 to 10 percent slopes	1
Ze	Zekiah loam	3

Table 7.--Woodland Management and Productivity

Map symbol	Soil name	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Productivity class	Trees to plant
BeA	Beltsville	4W	Slight	Moderate	Moderate	Moderate	Moderate	Red maple	---	---	Loblolly pine, Virginia pine.
								Sweetgum	---	---	
								White oak	---	---	
								Pin oak	---	---	
								Black oak	70	4	
								Loblolly pine	70	6	
								Virginia pine	70	8	
BeB	Beltsville	4W	Slight	Moderate	Moderate	Moderate	Moderate	Red maple	---	---	Loblolly pine, Virginia pine.
								Sweetgum	---	---	
								White oak	---	---	
								Pin oak	---	---	
								Black oak	70	4	
								Loblolly pine	70	6	
								Virginia pine	70	8	
BeC	Beltsville	4W	Slight	Moderate	Moderate	Moderate	Moderate	Red maple	---	---	Loblolly pine, Virginia pine.
								Sweetgum	---	---	
								White oak	---	---	
								Pin oak	---	---	
								Black oak	70	4	
								Loblolly pine	70	6	
								Virginia pine	70	8	
BU	Beltsville	4W	Slight	Moderate	Moderate	Moderate	Moderate	Red maple	---	---	Loblolly pine, Virginia pine.
								Sweetgum	---	---	
								White oak	---	---	
								Pin oak	---	---	
								Black oak	70	4	
								Loblolly pine	70	6	
								Virginia pine	70	8	
	Udorthents.										
	Urban land.										
Ch	Chicone	2W	Slight	Severe	Severe	Severe	Severe	Red maple	50	2	Atlantic white-cedar, baldcypress.
								Sweetgum	50	4	
								Water oak	50	2	
								Pin oak	50	2	

Table 7.--Woodland Management and Productivity

Map symbol	Soil name	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Productivity class	Trees to plant
Cd	Codorus	5W	Slight	Moderate	Slight	Slight	Slight	Northern red oak	90	5	Sugar maple, white ash, black walnut, yellow-poplar, eastern white, pine, European larch, Norway spruce.
								Sugar maple	90	4	
								White ash	90	5	
								Black walnut	100	---	
								Yellow-poplar	100	8	
								Eastern white pine	100	10	
Co	Corsica	3W	Slight	Severe	Severe	Severe	Moderate	Red maple	65	3	Swamp chestnut oak, willow oak, loblolly pine, swamp white oak, southern red oak.
								Sweetgum	65	4	
								Swamp chestnut oak	60	4	
								Willow oak	65	4	
Ek	Elkton	8W	Slight	Severe	Slight	Slight	Slight	Red maple	---	---	Loblolly pine.
								Sweetgum	80	6	
								Blackgum	---	---	
								Southern red oak	---	---	
								Willow oak	---	---	
								Loblolly pine	78	8	
Fa	Fallsington	9W	Slight	Moderate	Moderate	Moderate	Severe	White oak	---	---	Sweetgum, loblolly pine, yellow-poplar, eastern white pine.
								Willow oak	---	---	
								Sweetgum	80	6	
								Loblolly pine	90	9	
HbA	Hambrook	8A	Slight	Slight	Slight	Slight	Slight	Virginia pine	70	8	Loblolly pine.
								White oak	70	4	
								Scarlet oak	70	4	
								Black oak	65	3	
								Loblolly pine	75	7	
HbB	Hambrook	8A	Slight	Slight	Slight	Slight	Slight	Virginia pine	70	8	Loblolly pine.
								White oak	70	4	
								Scarlet oak	70	4	
								Black oak	65	3	
								Loblolly pine	75	7	
HbC	Hambrook	8A	Slight	Slight	Slight	Slight	Slight	Virginia pine	70	8	Loblolly pine.
								White oak	70	4	
								Scarlet oak	70	4	
								Black oak	65	3	
								Loblolly pine	75	7	

Table 7.--Woodland Management and Productivity

Map symbol	Soil name	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Productivity class	Trees to plant
HbE	Hambrook	8A	Severe	Severe	Slight	Slight	Slight	Virginia pine------	70	8	Loblolly pine.
								White oak----------	70	4	
								Scarlet oak--------	70	4	
								Black oak----------	65	3	
								Loblolly pine------	75	7	
HU	Hambrook	8A	Slight	Slight	Slight	Slight	Slight	Virginia pine------	70	8	Loblolly pine.
								White oak----------	70	4	
								Scarlet oak--------	70	4	
								Black oak----------	65	3	
								Loblolly pine------	75	7	
	Udorthents.										
	Urban land.										
In	Indiantown	3W	Slight	Severe	Severe	Severe	Severe	Red maple----------	60	3	Baldcypress, Atlantic white-cedar.
								Blackgum-----------	60	3	
								Water oak----------	70	4	
								Baldcypress--------	100	6	
Kn	Kentuck	3W	Slight	Severe	Severe	Severe	Severe	Red maple----------	70	3	Loblolly pine.
								Sweetgum-----------	70	4	
								Swamp chestnut oak	60	4	
								Water oak----------	70	4	
								Willow oak---------	70	4	
								Loblolly pine------	70	6	
Kj	Klej	8S	Slight	Moderate	Moderate	Slight	Moderate	Sweetgum-----------	80	6	Loblolly pine, Virginia pine, eastern white pine.
								White oak----------	70	4	
								Loblolly pine------	80	8	
								Virginia pine------	70	8	
Le	Lenape	3W	Slight	Severe	Severe	Severe	Severe	Red maple----------	50	2	Atlantic white-cedar, baldcypress.
								Blackgum-----------	60	6	
								Water oak----------	60	3	
								Baldcypress--------	70	3	
								Northern whitecedar	60	6	
Lo	Longmarsh	3W	Slight	Severe	Severe	Severe	Severe	Red maple----------	60	3	Atlantic white-cedar, green ash, baldcypress.
								Blackgum-----------	60	6	
								Water oak----------	70	4	

Table 7.--Woodland Management and Productivity

Map symbol	Soil name	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Productivity class	Trees to plant
Ma	Manahawkin	3W	Slight	Severe	Severe	Severe	Severe	Red maple	75	3	Atlantic white-cedar, baldcypress.
								Atlantic white-cedar	50	---	
								Sweetgum	75	5	
								Blackgum	60	3	
MpA	Mattapex	4A	Slight	Slight	Moderate	Slight	Moderate	Sweetgum	80	6	Loblolly pine, yellow-poplar, eastern white pine.
								Virginia pine	70	8	
								White oak	70	4	
								Northern red oak	70	4	
								Loblolly pine	81	8	
MpB	Mattapex	4A	Slight	Slight	Moderate	Slight	Moderate	Sweetgum	80	6	Loblolly pine, yellow-poplar, eastern white pine.
								Virginia pine	70	8	
								White oak	70	4	
								Northern red oak	70	4	
								Loblolly pine	81	8	
MpC	Mattapex	4A	Slight	Slight	Moderate	Slight	Moderate	Sweetgum	80	6	Loblolly pine, yellow-poplar, eastern white pine.
								Virginia pine	70	8	
								White oak	70	4	
								Northern red oak	70	4	
								Loblolly pine	81	8	
MU	Mattapex	4A	Slight	Slight	Moderate	Slight	Moderate	Sweetgum	80	6	Loblolly pine, yellow-poplar, eastern white pine.
								Virginia pine	70	8	
								White oak	70	4	
								Northern red oak	70	4	
								Loblolly pine	81	8	
	Udorthents.										
	Urban land.										
MwA	Mattapex	4A	Slight	Slight	Moderate	Slight	Moderate	Sweetgum	80	6	Loblolly pine, yellow-poplar, eastern white pine.
								Virginia pine	70	8	
								White oak	70	4	
								Northern red oak	70	4	
								Loblolly pine	81	8	
NnA	Nassawango	8A	Slight	Slight	Slight	Slight	Slight	Yellow-poplar	90	6	Loblolly pine.
								White oak	75	4	
								Loblolly pine	85	8	
NnB	Nassawango	8A	Slight	Slight	Slight	Slight	Slight	Yellow-poplar	90	6	Loblolly pine.
								White oak	75	4	
								Loblolly pine	85	8	

Table 7.--Woodland Management and Productivity

Map symbol	Soil name	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Productivity class	Trees to plant
NnC	Nassawango	8A	Slight	Slight	Slight	Slight	Slight	Yellow-poplar------	90	6	Loblolly pine.
								White oak----------	75	4	
								Loblolly pine------	85	8	
Ot	Othello	3W	Slight	Severe	Moderate	Severe	Severe	Red maple----------	70	3	Loblolly pine, baldcypress.
								Sweetgum-----------	70	4	
								Swamp chestnut oak	60	4	
								Water oak----------	70	4	
								Willow oak---------	70	4	
								Loblolly pine------	70	6	
Po	Pone	3W	Slight	Severe	Severe	Severe	Severe	Red maple----------	65	3	Loblolly pine, yellow-poplar, baldcypress.
								Sweetgum-----------	65	4	
								Swamp chestnut oak	60	4	
								Water oak----------	65	4	
								Willow oak---------	65	4	
								Loblolly pine------	60	5	
Pk	Puckum	2W	Slight	Severe	Severe	Severe	Severe	Red maple----------	50	2	Atlantic white-cedar, baldcypress.
								Sweetgum-----------	60	4	
								Blackgum-----------	60	6	
								Swamp chestnut oak	60	---	
								Water oak----------	60	3	
								Northern whitecedar	60	6	
RE	Romney	9W	Slight	Moderate	Slight	Slight	Severe	Red maple----------	---	---	Sweetgum, loblolly pine.
								Yellow-poplar------	---	---	
								Blackgum-----------	---	---	
								White oak----------	---	---	
								Southern red oak---	---	---	
								Swamp chestnut oak	---	---	
								Water oak----------	---	---	
								Sweetgum-----------	---	---	
								Loblolly pine------	87	9	
	Elkton	8W	Slight	Severe	Slight	Slight	Slight	Red maple----------	---	---	Loblolly pine.
								Sweetgum-----------	80	6	
								Blackgum-----------	---	---	
								Southern red oak---	---	---	
								Willow oak---------	---	---	
								Loblolly pine------	78	8	

Table 7.--Woodland Management and Productivity

Map symbol	Soil name	Ordination symbol	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Productivity class	Trees to plant
RoA	Romney	9W	Slight	Moderate	Slight	Slight	Severe	Red maple	---	---	Sweetgum, loblolly pine.
								Yellow-poplar	---	---	
								Blackgum	---	---	
								White oak	---	---	
								Southern red oak	---	---	
								Swamp chestnut oak	---	---	
								Water oak	---	---	
								Sweetgum	---	---	
								Loblolly pine	87	9	
WdA	Woodstown	4A	Slight	Slight	Slight	Slight	Moderate	Sweetgum	90	7	Yellow-poplar, loblolly pine, eastern white pine.
								White oak	80	4	
								Northern red oak	---	---	
								Yellow-poplar	90	6	
								Loblolly pine	85	8	
WdB	Woodstown	4A	Slight	Slight	Slight	Slight	Moderate	Sweetgum	90	7	Yellow-poplar, loblolly pine, eastern white pine.
								White oak	80	4	
								Northern red oak	---	---	
								Yellow-poplar	90	6	
								Loblolly pine	85	8	
WdC	Woodstown	4A	Slight	Slight	Slight	Slight	Moderate	Sweetgum	90	7	Yellow-poplar, loblolly pine, eastern white pine.
								White oak	80	4	
								Northern red oak	---	---	
								Yellow-poplar	90	6	
								Loblolly pine	85	8	
Ze	Zekiah	3W	Slight	Severe	Severe	Moderate	Severe	Red maple	60	3	Eastern white pine, American sycamore.
								Sweetgum	80	6	
								Water oak	70	4	

Table 8.--Recreational Development

Map symbol	Soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
BeA	Beltsville	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Severe: erodes easily.
BeB	Beltsville	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Severe: erodes easily.
BeC	Beltsville	Severe: percs slowly.	Severe: percs slowly.	Severe: slope, percs slowly.	Severe: erodes easily.
BU	Beltsville	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Severe: erodes easily.
	Udorthents	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight.
	Urban land.				
Ch	Chicone	Severe: flooding, ponding, too acid.	Severe: ponding, too acid.	Severe: ponding, too acid.	Severe: ponding.
Cd	Codorus	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.
Co	Corsica	Severe: ponding, too acid.	Severe: ponding, too acid.	Severe: ponding, too acid.	Severe: ponding.
Ek	Elkton	Severe: wetness, percs slowly, too acid.	Severe: wetness, too acid, percs slowly.	Severe: wetness, percs slowly, too acid.	Severe: wetness.
Fa	Fallsington	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
HbA	Hambrook	Slight	Slight	Moderate: small stones.	Slight.
HbB	Hambrook	Slight	Slight	Moderate: slope, small stones.	Slight.
HbC	Hambrook	Slight	Slight	Severe: slope.	Slight.
HbE	Hambrook	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

Table 8.--Recreational Development--Continued

Map symbol	Soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
HU	Hambrook	Slight	Slight	Moderate: slope, small stones.	Slight.
	Udorthents	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight.
	Urban land.				
In	Indiantown	Severe: flooding, ponding, too acid.	Severe: ponding, too acid.	Severe: ponding, flooding, too acid.	Severe: ponding.
Kn	Kentuck	Severe: ponding, too acid.	Severe: ponding, too acid.	Severe: ponding, too acid.	Severe: ponding.
Kj	Klej	Severe: wetness.	Moderate: wetness, too sandy.	Severe: wetness.	Moderate: wetness, too sandy.
Le	Lenape	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.
Lo	Longmarsh	Severe: flooding, ponding, too acid.	Severe: ponding, too acid.	Severe: ponding, flooding, too acid.	Severe: ponding.
Ma	Manahawkin	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.
MpA	Mattapex	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: erodes easily.
MpB	Mattapex	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Severe: erodes easily.
MpC	Mattapex	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Severe: erodes easily.
MU	Mattapex	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: erodes easily.
	Udorthents	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: small stones, percs slowly.	Slight.
	Urban land.				

Table 8.--Recreational Development--Continued

Map symbol	Soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
MwA	Mattapex	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: erodes easily.
NnA	Nassawango	Moderate: small stones, percs slowly.	Moderate: small stones, percs slowly.	Severe: small stones.	Slight.
NnB	Nassawango	Moderate: small stones, percs slowly.	Moderate: small stones, percs slowly.	Severe: small stones.	Slight.
NnC	Nassawango	Moderate: slope, small stones, percs slowly.	Moderate: slope, small stones, percs slowly.	Severe: slope, small stones.	Slight.
Ot	Othello	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Po	Pone	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Pk	Puckum	Severe: flooding, ponding, excess humus.	Severe: ponding, excess humus, too acid.	Severe: excess humus, ponding, flooding.	Severe: ponding, excess humus.
RE	Romney	Severe: wetness, too acid.	Severe: too acid.	Severe: wetness, too acid.	Moderate: wetness.
	Elkton	Severe: wetness, percs slowly, too acid.	Severe: wetness, too acid, percs slowly.	Severe: wetness, percs slowly, too acid.	Severe: wetness.
RoA	Romney	Severe: wetness, too acid.	Severe: too acid.	Severe: wetness, too acid.	Moderate: wetness.
Ud	Udorthents	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight.
Ur	Urban land.				
	Udorthents	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, small stones, percs slowly.	Slight.
WdA	Woodstown	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: small stones, wetness.	Moderate: wetness.
WdB	Woodstown	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, small stones, wetness.	Moderate: wetness.

Table 8.--Recreational Development--Continued

Map symbol	Soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
WdC	Woodstown	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Severe: slope.	Moderate: wetness.
Ze	Zekiah	Severe: flooding, wetness, too acid.	Severe: wetness, too acid.	Severe: wetness, flooding, too acid.	Severe: wetness.

Table 9.--Wildlife Habitat

Map symbol	Soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
BeA	Beltsville	Good	Good	Good	Good	Poor	Poor	Poor	Good	Good	Poor.
BeB	Beltsville	Good	Good	Good	Good	Poor	Poor	Poor	Good	Good	Poor.
BeC	Beltsville	Good	Good	Good	Good	Poor	Poor	Poor	Good	Good	Poor.
BU	Beltsville	Good	Good	Good	Good	Poor	Poor	Poor	Good	Good	Poor.
	Udorthents.										
	Urban land.										
Ch	Chicone	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Fair	Good.
Cd	Codorus	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
Co	Corsica	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Ek	Elkton	Poor	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
Fa	Fallsington	Poor	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
HbA	Hambrook	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
HbB	Hambrook	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
HbC	Hambrook	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
HbE	Hambrook	Very poor.	Poor	Good	Good	Poor	Very poor.	Very poor.	Poor	Good	Very poor.
HU	Hambrook	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
	Udorthents.										
	Urban land.										
In	Indiantown	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Fair	Good.
Kn	Kentuck	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Fair	Good.
Kj	Klej	Fair	Fair	Good	Fair	Fair	Poor	Poor	Fair	Fair	Poor.
Le	Lenape	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
Lo	Longmarsh	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Fair	Good.
Ma	Manahawkin	Very poor.	Poor	Poor	Poor	Poor	Good	Poor	Poor	Poor	Fair.

Table 9.--Wildlife Habitat--Contined

Map symbol	Soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Woodland wildlife	Wetland wildlife
MpA	Mattapex	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
MpB	Mattapex	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MpC	Mattapex	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
MU	Mattapex	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
	Udorthents.										
	Urban land.										
MwA	Mattapex	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
NnA	Nassawango	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Poor.
NnB	Nassawango	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Poor.
NnC	Nassawango	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Poor.
Ot	Othello	Very poor.	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good.
Po	Pone	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good.
Pk	Puckum	Very poor.	Very poor.	Poor	Poor	Poor	Good	Good	Very poor.	Poor	Good.
RE	Romney	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
	Elkton	Poor	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair.
RoA	Romney	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
WdA	Woodstown	Fair	Good	Good	Good	Poor	Poor	Poor	Good	Good	Poor.
WdB	Woodstown	Fair	Good	Good	Good	Poor	Poor	Very poor.	Good	Good	Very poor.
WdC	Woodstown	Fair	Good	Good	Good	Poor	Poor	Very poor.	Good	Good	Very poor.
Ze	Zekiah	Very poor.	Poor	Poor	Poor	Poor	Good	Good	Poor	Fair	Good.

Table 10.--Building Site Development

Map symbol	Soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns, landscaping, and golf fairways
BeA	Beltsville	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: wetness.
BeB	Beltsville	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: wetness.
BeC	Beltsville	Severe: wetness.	Moderate: wetness, slope.	Severe: wetness.	Moderate: wetness, slope.	Severe: frost action.	Moderate: wetness, slope.
BU	Beltsville	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: wetness.
	Udorthents	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Slight.
	Urban land.						
Ch	Chicone	Severe: excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: ponding, flooding.	Severe: too acid, ponding.
Cd	Codorus	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, frost action.	Moderate: flooding, wetness.
Co	Corsica	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: too acid, ponding.
Ek	Elkton	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness.	Severe: too acid, wetness.
Fa	Fallsington	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
HbA	Hambrook	Severe: cutbanks cave.	Slight--------	Moderate: wetness.	Slight---------	Moderate: frost action.	Slight.
HbB	Hambrook	Severe: cutbanks cave.	Slight--------	Moderate: wetness.	Slight---------	Moderate: frost action.	Slight.
HbC	Hambrook	Severe: cutbanks cave.	Slight--------	Moderate: wetness.	Moderate: slope.	Moderate: frost action.	Slight.
HbE	Hambrook	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
HU	Hambrook	Severe: cutbanks cave.	Slight--------	Moderate: wetness.	Moderate: slope.	Moderate: frost action.	Slight.
	Udorthents	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Slight.
	Urban land.						

Table 10.--Building Site Development--Continued

Map symbol	Soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns, landscaping, and golf fairways
In	Indiantown	Severe: cutbanks cave, excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: ponding, flooding.	Severe: too acid, ponding, flooding.
Kn	Kentuck	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding.	Severe: too acid, ponding.
Kj	Klej	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
Le	Lenape	Severe: excess humus, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, ponding, flooding.	Severe: ponding, flooding, excess humus.
Lo	Longmarsh	Severe: cutbanks cave, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding, frost action.	Severe: too acid, ponding, flooding.
Ma	Manahawkin	Severe: cutbanks cave, excess humus, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, ponding, flooding.	Severe: too acid, ponding, flooding.
MpA	Mattapex	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength.	Moderate: wetness.
MpB	Mattapex	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength.	Moderate: wetness.
MpC	Mattapex	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Severe: low strength.	Moderate: wetness.
MU	Mattapex	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength.	Moderate: wetness.
	Udorthents	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.	Slight.
	Urban land.						
MwA	Mattapex	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: low strength.	Moderate: wetness.
NnA	Nassawango	Severe: cutbanks cave.	Slight--------	Moderate: wetness.	Slight---------	Severe: low strength.	Moderate: small stones.
NnB	Nassawango	Severe: cutbanks cave.	Slight--------	Moderate: wetness.	Slight---------	Severe: low strength.	Moderate: small stones.
NnC	Nassawango	Severe: cutbanks cave.	Moderate: slope.	Moderate: wetness, slope.	Severe: slope.	Severe: low strength.	Moderate: small stones, slope.

Table 10.--Building Site Development--Continued

Map symbol	Soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns, landscaping, and golf fairways
Ot	Othello	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Po	Pone	Severe: cutbanks cave, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
Pk	Puckum	Severe: excess humus, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, flooding, ponding.	Severe: subsides, ponding, flooding.	Severe: too acid, ponding, flooding.
RE	Romney	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength.	Severe: too acid.
	Elkton	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness.	Severe: too acid, wetness.
RoA	Romney	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength.	Severe: too acid.
Ud	Udorthents	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Slight.
Ur	Urban land.						
	Udorthents	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, frost action.	Slight.
WdA	Woodstown	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
WdB	Woodstown	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
WdC	Woodstown	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness, slope.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
Ze	Zekiah	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.	Severe: too acid, wetness, flooding.

Table 11.--Sanitary Facilities

Map symbol	Soil name	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
BeA	Beltsville	Severe: wetness, percs slowly.	Severe: seepage.	Severe: seepage, wetness.	Moderate: wetness.	Fair: too clayey, wetness.
BeB	Beltsville	Severe: wetness, percs slowly.	Severe: seepage.	Severe: seepage, wetness.	Moderate: wetness.	Fair: too clayey, wetness.
BeC	Beltsville	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: seepage, wetness.	Moderate: wetness.	Fair: too clayey, slope, wetness.
BU	Beltsville	Severe: wetness, percs slowly.	Severe: seepage.	Severe: seepage, wetness.	Moderate: wetness.	Fair: too clayey, wetness.
	Udorthents	Severe: percs slowly.	Moderate: slope.	Severe: wetness.	Slight-----	Good.
	Urban land.					
Ch	Chicone	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus, too acid.
Cd	Codorus	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, wetness.	Poor: wetness.
Co	Corsica	Severe: ponding, percs slowly.	Severe: seepage, ponding.	Severe: seepage, ponding, too acid.	Severe: seepage, ponding.	Poor: ponding, too acid.
Ek	Elkton	Severe: wetness, percs slowly.	Severe: seepage.	Severe: seepage, wetness, too acid.	Severe: wetness.	Poor: wetness, too acid.
Fa	Fallsington	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
HbA	Hambrook	Severe: poor filter.	Severe: seepage.	Severe: wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
HbB	Hambrook	Severe: poor filter.	Severe: seepage.	Severe: wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
HbC	Hambrook	Severe: poor filter.	Severe: seepage, slope.	Severe: wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
HbE	Hambrook	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: wetness, too sandy, slope.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.

Table 11.--Sanitary Facilities--Continued

Map symbol	Soil name	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
HU	Hambrook	Severe: poor filter.	Severe: seepage.	Severe: wetness, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
	Udorthents	Severe: percs slowly.	Moderate: slope.	Severe: wetness.	Slight-----	Good.
	Urban land.					
In	Indiantown	Severe: flooding, ponding.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, ponding.
Kn	Kentuck	Severe: ponding, percs slowly.	Severe: seepage, ponding.	Severe: seepage, ponding, too acid.	Severe: ponding.	Poor: ponding, too acid.
Kj	Klej	Severe: wetness, percs slowly, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: seepage, wetness.
Le	Lenape	Severe: flooding, ponding, percs slowly.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, thin layer.
Lo	Longmarsh	Severe: flooding, ponding, poor filter.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: seepage, too sandy, small stones.
Ma	Manahawkin	Severe: flooding, ponding.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus, too acid.
MpA	Mattapex	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: too sandy, wetness.
MpB	Mattapex	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: too sandy, wetness.
MpC	Mattapex	Severe: wetness, percs slowly.	Severe: seepage, slope, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: too sandy, wetness.
MU	Mattapex	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: too sandy, wetness.
	Udorthents	Severe: percs slowly.	Slight--------	Severe: wetness.	Slight-----	Good.
	Urban land.					
MwA	Mattapex	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Fair: too sandy, wetness.

Table 11.--Sanitary Facilities--Continued

Map symbol	Soil name	Septic tank absorption fields	Sewage lagoons	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
NnA	Nassawango	Severe: wetness, percs slowly.	Severe: seepage.	Severe: too acid.	Slight-----	Poor: too acid.
NnB	Nassawango	Severe: wetness, percs slowly.	Severe: seepage.	Severe: too acid.	Slight-----	Poor: too acid.
NnC	Nassawango	Severe: wetness, percs slowly.	Severe: seepage, slope.	Severe: too acid.	Moderate: slope.	Poor: too acid.
Ot	Othello	Severe: ponding, percs slowly.	Severe: seepage, ponding.	Severe: seepage, ponding.	Severe: ponding.	Poor: ponding.
Po	Pone	Severe: ponding, percs slowly, poor filter.	Severe: seepage, ponding.	Severe: ponding.	Severe: seepage, ponding.	Poor: ponding.
Pk	Puckum	Severe: flooding, ponding.	Severe: seepage, flooding, excess humus.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding, excess humus, too acid.
RE	Romney	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too acid.	Severe: wetness.	Poor: wetness, too acid.
	Elkton	Severe: wetness, percs slowly.	Severe: seepage.	Severe: seepage, wetness, too acid.	Severe: wetness.	Poor: wetness, too acid.
RoA	Romney	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too acid.	Severe: wetness.	Poor: wetness, too acid.
Ud	Udorthents	Severe: percs slowly.	Moderate: slope.	Severe: wetness.	Slight-----	Good.
Ur	Urban land.					
	Udorthents	Severe: percs slowly.	Moderate: slope.	Severe: wetness.	Slight-----	Good.
WdA	Woodstown	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
WdB	Woodstown	Severe: wetness, percs slowly.	Severe: seepage, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
WdC	Woodstown	Severe: wetness, percs slowly.	Severe: seepage, slope, wetness.	Severe: seepage, wetness.	Severe: seepage, wetness.	Poor: seepage, too sandy.
Ze	Zekiah	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness, too acid.

Table 12.--Construction Materials

Map symbol	Soil name	Roadfill	Sand	Gravel	Topsoil
BeA	Beltsville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, small stones.
BeB	Beltsville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, small stones.
BeC	Beltsville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, small stones.
BU	Beltsville	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, small stones.
	Udorthents	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
	Urban land.				
Ch	Chicone	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness, too acid.
Cd	Codorus	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Co	Corsica	Poor: wetness.	Probable	Probable	Poor: area reclaim, wetness, too acid.
Ek	Elkton	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness, too acid.
Fa	Fallsington	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
HbA	Hambrook	Good	Probable	Improbable: too sandy.	Fair: too clayey, small stones, area reclaim.
HbB	Hambrook	Good	Probable	Improbable: too sandy.	Fair: too clayey, small stones, area reclaim.
HbC	Hambrook	Good	Probable	Improbable: too sandy.	Fair: too clayey, small stones, area reclaim.
HbE	Hambrook	Poor: slope.	Probable	Improbable: too sandy.	Poor: slope.

Table 12.--Construction Materials--Continued

Map symbol	Soil name	Roadfill	Sand	Gravel	Topsoil
HU	Hambrook	Good	Probable	Improbable: too sandy.	Fair: too clayey, small stones, area reclaim.
	Udorthents	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
	Urban land.				
In	Indiantown	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness, too acid.
Kn	Kentuck	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness, too acid.
Kj	Klej	Fair: wetness.	Improbable: thin layer.	Improbable: too sandy.	Fair: too sandy, small stones, thin layer.
Le	Lenape	Poor: wetness.	Probable	Improbable: too sandy.	Poor: excess humus, wetness.
Lo	Longmarsh	Poor: wetness.	Probable	Improbable: too sandy.	Poor: small stones, area reclaim, wetness.
Ma	Manahawkin	Poor: wetness.	Probable	Probable	Poor: excess humus, area reclaim, wetness.
MpA	Mattapex	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too clayey.
MpB	Mattapex	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too clayey.
MpC	Mattapex	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too clayey.
MU	Mattapex	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too clayey.
	Udorthents	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
	Urban land.				
MwA	Mattapex	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too clayey.
NnA	Nassawango	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too acid.
NnB	Nassawango	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too acid.

Table 12.--Construction Materials--Continued

Map symbol	Soil name	Roadfill	Sand	Gravel	Topsoil
NnC	Nassawango	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: too acid.
Ot	Othello	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Po	Pone	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
Pk	Puckum	Poor: wetness.	Improbable: excess humus.	Improbable: excess humus.	Poor: excess humus, wetness, too acid.
RE	Romney	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too acid.
	Elkton	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness, too acid.
RoA	Romney	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too acid.
Ud	Udorthents	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Ur	Urban land.				
	Udorthents	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
WdA	Woodstown	Fair: wetness.	Probable	Improbable: too sandy.	Poor: small stones.
WdB	Woodstown	Fair: wetness.	Probable	Improbable: too sandy.	Poor: small stones.
WdC	Woodstown	Fair: wetness.	Probable	Improbable: too sandy.	Poor: small stones.
Ze	Zekiah	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness, too acid.

Table 13.--Water Management

Map symbol	Soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
BeA	Beltsville	Severe: seepage.	Severe: piping.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, rooting depth.
BeB	Beltsville	Severe: seepage.	Severe: piping.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, rooting depth.
BeC	Beltsville	Severe: seepage, slope.	Severe: piping.	Severe: no water.	Percs slowly, frost action, slope.	Slope, wetness, percs slowly.	Slope, erodes easily, wetness.	Slope, erodes easily, rooting depth.
BU	Beltsville	Severe: seepage.	Severe: piping.	Severe: no water.	Percs slowly, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Erodes easily, rooting depth.
	Udorthents	Moderate: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
	Urban land.							
Ch	Chicone	Severe: seepage.	Severe: excess humus, ponding.	Severe: cutbanks cave.	Ponding, flooding, too acid.	Ponding, flooding, too acid.	Erodes easily, ponding.	Wetness, erodes easily.
Cd	Codorus	Severe: seepage.	Severe: wetness.	Moderate: slow refill.	Flooding, frost action.	Flooding, wetness.	Wetness----------	Flooding, wetness.
Co	Corsica	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, too acid.	Ponding, too acid.	Ponding----------	Wetness.
Ek	Elkton	Severe: seepage.	Severe: piping, wetness.	Severe: slow refill.	Percs slowly, too acid.	Wetness----------	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
Fa	Fallsington	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, soil blowing.	Wetness, too sandy.	Wetness, rooting depth.
HbA	Hambrook	Severe: seepage.	Severe: seepage, piping.	Severe: slow refill, cutbanks cave.	Deep to water	Favorable-------	Erodes easily, too sandy.	Erodes easily.
HbB	Hambrook	Severe: seepage.	Severe: seepage, piping.	Severe: slow refill, cutbanks cave.	Deep to water	Slope-----------	Erodes easily, too sandy.	Erodes easily.

Table 13.--Water Management--Continued

Map symbol	Soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
HbC	Hambrook	Severe: seepage.	Severe: seepage, piping.	Severe: slow refill, cutbanks cave.	Deep to water	Slope----------	Erodes easily, too sandy.	Erodes easily.
HbE	Hambrook	Severe: seepage.	Severe: seepage, piping.	Severe: slow refill, cutbanks cave.	Deep to water	Slope----------	Erodes easily, too sandy.	Slope, erodes easily.
HU	Hambrook	Severe: seepage.	Severe: seepage, piping.	Severe: slow refill, cutbanks cave.	Deep to water	Slope----------	Erodes easily, too sandy.	Erodes easily.
	Udorthents	Moderate: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
	Urban land.							
In	Indiantown	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding flooding, cutbanks cave.	Ponding, flooding.	Ponding, too sandy.	Wetness.
Kn	Kentuck	Severe: seepage.	Severe: ponding.	Severe: slow refill, cutbanks cave.	Ponding, percs slowly, too acid.	Ponding, percs slowly, erodes easily.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
Kj	Klej	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy, soil blowing.	Wetness, droughty, rooting depth.
Le	Lenape	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding, flooding, subsides.	Ponding, flooding.	Ponding--------	Wetness.
Lo	Longmarsh	Severe: seepage.	Severe: seepage, piping, ponding.	Severe: cutbanks cave.	Ponding, flooding, frost action.	Ponding, droughty, flooding.	Ponding, too sandy.	Wetness, droughty.
Ma	Manahawkin	Severe: seepage.	Severe: excess humus, ponding.	Severe: slow refill, cutbanks cave.	Ponding, flooding, frost action.	Ponding, soil blowing, flooding.	Ponding, soil blowing.	Wetness.
MpA	Mattapex	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness--------	Erodes easily, wetness.	Erodes easily.

Table 13.--Water Management--Continued

Map symbol	Soil name	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
MpB	Mattapex	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Slope, cutbanks cave.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.
MpC	Mattapex	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Slope, cutbanks cave.	Slope, wetness.	Erodes easily, wetness.	Erodes easily.
MU	Mattapex	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, soil blowing.	Erodes easily, wetness.	Erodes easily.
	Udorthents	Slight-----	Severe: piping.	Severe: no water.	Deep to water	Soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
	Urban land.							
MwA	Mattapex	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness--------	Erodes easily, wetness.	Erodes easily.
NnA	Nassawango	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Erodes easily, too acid.	Erodes easily	Erodes easily.
NnB	Nassawango	Severe: seepage.	Severe: thin layer.	Severe: no water.	Deep to water	Slope, erodes easily, too acid.	Erodes easily	Erodes easily.
NnC	Nassawango	Severe: seepage, slope.	Severe: thin layer.	Severe: no water.	Deep to water	Erodes easily, too acid.	Slope, erodes easily.	Slope, erodes easily.
Ot	Othello	Severe: seepage.	Severe: thin layer, ponding.	Severe: slow refill, cutbanks cave.	Ponding--------	Ponding--------	Erodes easily, ponding.	Wetness, erodes easily.
Po	Pone	Severe: seepage.	Severe: piping, ponding.	Severe: slow refill, cutbanks cave.	Ponding--------	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, rooting depth.
Pk	Puckum	Severe: seepage.	Severe: excess humus, ponding.	Slight---------	Ponding, flooding, subsides.	Ponding, flooding, too acid.	Ponding--------	Wetness.

Table 13.--Water Management--Continued

Map symbol	Soil name	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Limitations for-- Aquifer-fed excavated ponds	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
RE	Romney	Slight-----	Severe: piping, wetness.	Severe: slow refill.	Too acid-------	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
	Elkton	Severe: seepage.	Severe: piping, wetness.	Severe: slow refill.	Percs slowly, too acid.	Wetness---------	Erodes easily, wetness.	Wetness, erodes easily, percs slowly.
RoA	Romney	Slight-----	Severe: piping, wetness.	Severe: slow refill.	Too acid-------	Wetness, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily.
Ud	Udorthents	Moderate: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
Ur	Urban land.							
	Udorthents	Moderate: slope.	Severe: piping.	Severe: no water.	Deep to water	Slope, soil blowing, percs slowly.	Soil blowing, percs slowly.	Percs slowly.
WdA	Woodstown	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Cutbanks cave	Wetness, droughty.	Wetness, too sandy.	Droughty.
WdB	Woodstown	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Slope, cutbanks cave.	Slope, wetness, droughty.	Wetness, too sandy.	Droughty.
WdC	Woodstown	Severe: seepage.	Severe: seepage, piping, wetness.	Severe: slow refill, cutbanks cave.	Slope, cutbanks cave.	Slope, wetness, droughty.	Wetness, too sandy.	Droughty.
Ze	Zekiah	Severe: seepage.	Severe: piping, wetness.	Severe: cutbanks cave.	Flooding, too acid.	Wetness, droughty, erodes easily.	Erodes easily, wetness.	Wetness, erodes easily, droughty.

Table 14.--Engineering Index Properties

Map symbol	Soil name	Depth (In)	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments >3 in. (Pct)	Percent passing sieve number--: 4	10	40	200	Liquid limit (Pct)	Plas-ticity index
BeA	Beltsville*	0-14	SIL	ML, CL-ML	A-4	0	85-100	80-100	70-100	50-90	22-26	3-7
		14-25	SICL SIL	CL	A-4, A-6	0	85-100	80-100	70-100	55-95	29-32	9-12
		25-50	SICL SIL L	CL	A-6, A-4	0	85-100	80-100	70-100	50-95	29-34	9-14
		50-72	GR-SL SL CL	SM, ML, CL, GM	A-2, A-4, A-6, A-1-b	0	60-100	50-100	30-100	15-90	18-34	3-16
BeB	Beltsville	0-14	SIL	ML, CL-ML	A-4	0	85-100	80-100	70-100	50-90	22-26	3-7
		14-25	SICL SIL	CL	A-4, A-6	0	85-100	80-100	70-100	55-95	29-32	9-12
		25-50	SICL SIL L	CL	A-6, A-4	0	85-100	80-100	70-100	50-95	29-34	9-14
		50-72	GR-SL SL CL	SM, ML, CL, GM	A-2, A-4, A-6, A-1-b	0	60-100	50-100	30-100	15-90	18-34	3-16
BeC	Beltsville	0-14	SIL	ML, CL-ML	A-4	0	85-100	80-100	70-100	50-90	22-26	3-7
		14-25	SICL SIL	CL	A-4, A-6	0	85-100	80-100	70-100	55-95	29-32	9-12
		25-50	SICL SIL L	CL	A-6, A-4	0	85-100	80-100	70-100	50-95	29-34	9-14
		50-72	GR-SL SL CL	SM, ML, CL, GM	A-2, A-4, A-6, A-1-b	0	60-100	50-100	30-100	15-90	18-34	3-16
BU	Beltsville	0-14	SIL	ML, CL-ML	A-4	0	85-100	80-100	70-100	50-90	22-26	3-7
		14-25	SICL SIL	CL	A-4, A-6	0	85-100	80-100	70-100	55-95	29-32	9-12
		25-50	SICL SIL L	CL	A-6, A-4	0	85-100	80-100	70-100	50-95	29-34	9-14
		50-72	GR-SL SL CL	SM, ML, CL, GM	A-2, A-4, A-6, A-1-b	0	60-100	50-100	30-100	15-90	18-34	3-16
	Udorthents	0-2	SL	SM, SC-SM, ML	A-2, A-4	0-5	85-100	80-100	50-85	25-55	15-25	0-5
		2-65	SL L	CL, CL-ML	A-4, A-6	0-5	85-100	80-100	70-95	50-75	15-30	5-15
	Urban land.											
Ch	Chicone	0-3	MK-SIL	OL, ML, CL-ML	A-4, A-8	0	100-100	100-100	80-95	70-90	15-25	0-10
		3-15	SIL	ML, CL-ML, CL	A-4	0	100-100	100-100	80-95	70-90	15-25	0-10
		15-24	SIL	ML, CL-ML, CL	A-4	0	100-100	100-100	80-95	70-85	18-30	0-10
		24-65	Muck MPT	PT	A-8	0	---	---	---	---	0-14	0-0
		65-72	S LS	SM, SP-SM	A-2, A-1	0	80-100	70-100	20-70	5-30	0-20	0-5
Cd	Codorus	0-18	L	ML, CL, CL-ML	A-4, A-6	0	80-100	70-100	65-100	55-95	22-35	2-12
		18-54	SIL L SICL	ML, CL, CL-ML	A-4, A-6	0	80-100	75-100	65-100	55-85	22-35	2-12
		54-60	SR S SI	SM, GM, ML	A-1, A-2, A-4	0	25-100	20-100	20-85	15-65	0-35	0-7
Co	Corsica	0-12	L	OL, CL-ML, ML	A-4	0	95-100	95-100	70-90	45-90	10-20	0-5
		12-18	L SIL	SC-SM, SC, CL-ML	A-4, A-2-4	0	95-100	95-100	40-90	30-90	10-20	5-10
		18-40	CL SCL L	SC, CL-ML, CL	A-4, A-6	0	95-100	95-100	75-95	35-75	20-30	5-15
		40-48	SL SCL GR-L	SC, CL, CL-ML	A-2, A-4	0	55-100	45-100	40-95	20-75	0-30	0-10
		48-72	SR GR-S CL	SM, SP-SM, SC-SM	A-1, A-3, A-6, A-4	0	45-100	45-100	20-90	5-85	0-40	0-15

Table 14.--Engineering Index Properties--Continued

Map symbol	Soil name	Depth (In)	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments >3 in. (Pct)	Percent passing sieve number-- 4	10	40	200	Liquid limit (Pct)	Plas-ticity index
Ek	Elkton	0-10	SIL	CL-ML	A-4, A-6	0	100-100	100-100	90-100	50-95	20-45	5-20
		10-24	SICL	CL	A-6	0	100-100	100-100	90-100	85-95	25-40	10-20
		24-40	SICL SIC	CL, CH	A-6, A-7	0	100-100	100-100	95-100	85-95	30-55	10-35
		40-65	VFSL FSL	SC, ML, CL	A-4	0	100-100	95-100	85-95	45-75	20-30	0-10
Fa	Fallsington	0-10	SL	SM, CL-ML ML, SC-SM	A-2, A-4	0	95-100	90-100	65-90	30-60	0-19	0-5
		10-32	SL L SCL	SM, SC, CL, ML	A-2, A-4, A-6	0	95-100	90-100	65-85	30-55	0-30	0-15
		32-72	SR S SCL	SM, SP-SM, CL, CL-ML	A-2, A-3, A-4	0	95-100	90-100	50-85	5-55	0-30	0-15
HbA	Hambrook	0-10	SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	50-95	25-60	15-35	0-10
		10-14	L SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	40-90	20-60	10-30	0-10
		14-28	SCL SL L	SC-SM, CL, CL-ML	A-2, A-4, A-6	0	90-100	85-100	50-95	30-75	20-30	5-15
		28-65	LS S	SM, SP-SM	A-1, A-2	0	80-100	70-100	20-70	5-30	5-10	0-5
		65-72	SR FSL SICL	SC-SM, CL, CL-ML	A-4, A-6	0	85-100	70-100	70-90	40-85	15-25	5-15
HbB	Hambrook	0-10	SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	50-95	25-60	15-35	0-10
		10-14	L SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	40-90	20-60	10-30	0-10
		14-28	SCL SL L	SC-SM, CL, CL-ML	A-2, A-4, A-6	0	90-100	85-100	50-95	30-75	20-30	5-15
		28-65	LS S	SM, SP-SM	A-1, A-2	0	80-100	70-100	20-70	5-30	5-10	0-5
		65-72	SR FSL SICL	SC-SM, CL, CL-ML	A-4, A-6	0	85-100	70-100	70-90	40-85	15-25	5-15
HbC	Hambrook	0-10	SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	50-95	25-60	15-35	0-10
		10-14	L SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	40-90	20-60	10-30	0-10
		14-28	SCL SL L	SC-SM, CL, CL-ML	A-2, A-4, A-6	0	90-100	85-100	50-95	30-75	20-30	5-15
		28-65	LS S	SM, SP-SM	A-1, A-2	0	80-100	70-100	20-70	5-30	5-10	0-5
		65-72	SR FSL SICL	SC-SM, CL, CL-ML	A-4, A-6	0	85-100	70-100	70-90	40-85	15-25	5-15
HbE	Hambrook	0-10	SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	50-95	25-60	15-35	0-10
		10-14	L SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	40-90	20-60	10-30	0-10
		14-28	SCL SL L	SC-SM, CL, CL-ML	A-2, A-4, A-6	0	90-100	85-100	50-95	30-75	20-30	5-15
		28-65	LS S	SM, SP-SM	A-1, A-2	0	80-100	70-100	20-70	5-30	5-10	0-5
		65-72	SR FSL SICL	SC-SM, CL, CL-ML	A-4, A-6	0	85-100	70-100	70-90	40-85	15-25	5-15

Table 14.--Engineering Index Properties--Continued

Map symbol	Soil name	Depth (In)	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments >3 in. (Pct)	Percent passing sieve number--: 4	10	40	200	Liquid limit (Pct)	Plas-ticity index
HU	Hambrook	0-10	SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	50-95	25-60	15-35	0-10
		10-14	L SL	SM, ML, CL-ML	A-2, A-4	0	90-100	85-100	40-90	20-60	10-30	0-10
		14-28	SCL SL L	SC-SM, CL, CL-ML	A-2, A-4, A-6	0	90-100	85-100	50-95	30-75	20-30	5-15
		28-65	LS S	SM, SP-SM	A-1, A-2	0	80-100	70-100	20-70	5-30	5-10	0-5
		65-72	SR FSL SICL	SC-SM, CL, CL-ML	A-4, A-6	0	85-100	70-100	70-90	40-85	15-25	5-15
	Udorthents	0-2	SL	SM, SC-SM, ML	A-2, A-4	0-5	85-100	80-100	50-85	25-55	15-25	0-5
		2-65	SL L	CL, CL-ML	A-4, A-6	0-5	85-100	80-100	70-95	50-75	15-30	5-15
	Urban land.											
In	Indiantown	0-25	MK-SIL	OL, ML	A-4, A-8	0	100-100	100-100	90-100	75-90	25-35	0-10
		25-41	L SL LS	SM, SC-SM	A-4, A-2-4	0	100-100	100-100	40-80	25-50	5-15	0-5
		41-72	LS S	SM, SP-SM	A-3, A-2-4	0	100-100	100-100	20-70	5-30	---	0-0
Kn	Kentuck	0-13	SIL	CL, CL-ML	A-4, A-8	0	100-100	100-100	90-100	75-90	25-40	5-15
		13-24	SIL	CL, CL-ML	A-4, A-6	0	100-100	100-100	90-100	75-90	25-40	5-15
		24-45	SIL SICL	CL	A-6, A-7	0	100-100	100-100	90-100	75-95	35-45	15-20
		45-56	SL FSL	SC-SM, SC	A-4, A-2	0	100-100	100-100	60-85	30-50	15-25	5-10
		56-70	FS LS S	SM, SP-SM	A-2, A-1, A-3	0	100-100	100-100	40-80	5-35	0-20	0-5
Kj	Klej	0-9	S	SM, SP-SM	A-2	0	100-100	95-100	50-95	10-25	0-20	0-0
		9-39	LS LFS	SM, SP-SM	A-2	0	100-100	95-100	50-95	10-25	0-20	0-0
		39-47	S FS	SP-SM, SM	A-1, A-2, A-3	0	90-100	75-100	40-80	5-20	0-20	0-0
		47-60	SL SCL	SM, SC, ML, CL	A-2, A-4, A-6	0	90-100	75-100	45-95	20-60	10-30	0-15
Le	Lenape	0-8	PT	PT	A-8	---	---	---	---	---	0-14	---
		8-26	SP	PT	A-8	---	---	---	---	---	0-14	---
		26-60	L SICL SIL	CL, CL-ML	A-4, A-6	0	100-100	100-100	80-95	70-90	15-30	5-15
		60-72	S LS LFS	SC, SM, SP-SM	A-2, A-1	0	100-100	95-100	40-75	10-30	0-15	0-5
Lo	Longmarsh	0-19	SL	CL-ML, SM, ML	A-2-4, A-4	0	85-100	75-100	40-90	15-70	15-20	0-5
		19-34	SL LS FSL	SM, SP-SM	A-4, A-2-4, A-1	0	75-100	45-100	25-90	10-45	8-20	0-6
		34-66	SR GR-LS COS	SM, SP-SM, SP	A-3, A-2-4, A-1	0	75-100	45-100	10-75	0-30	0	0-0
Ma	Manahawkin	0-39	Muck	PT	A-8	---	---	---	---	---	0-14	---
		39-60	S GR-S	SW, GP-GM, SP-SM, GW	A-1	0	40-100	35-100	20-50	4-10	15-20	0-3

Table 14.--Engineering Index Properties--Continued

Map symbol	Soil name	Depth (In)	USDA texture	Classification: Unified	Classification: AASHTO	Fragments >3 in. (Pct)	Percent passing sieve number-- 4	10	40	200	Liquid limit (Pct)	Plasticity index
MpA	Mattapex	0-15	SIL	CL-ML, CL	A-4	0	95-100	90-100	80-100	80-100	15-30	5-15
		15-36	SICL SIL	CL, CL-ML	A-4, A-6, A-7	0	100-100	100-100	90-100	85-95	24-45	7-21
		36-60	FSL L LS	SM, SC, CL, ML	A-2, A-4, A-6	0	95-100	90-100	45-95	15-75	0-40	0-18
		60-65	S LS	SM, SP-SM	A-2	0	95-100	90-100	43-85	5-30	0-10	0-0
MpB	Mattapex	0-15	SIL	CL-ML, CL	A-4	0	95-100	90-100	80-100	80-100	15-30	5-15
		15-36	SICL SIL	CL, CL-ML	A-4, A-6, A-7	0	100-100	100-100	90-100	85-95	24-45	7-21
		36-60	FSL L LS	SM, SC, CL, ML	A-2, A-4, A-6	0	95-100	90-100	45-95	15-75	0-40	0-18
		60-65	S LS	SM, SP-SM	A-2	0	95-100	90-100	43-85	5-30	0-10	0-0
MpC	Mattapex	0-15	SIL	CL-ML, CL	A-4	0	95-100	90-100	80-100	80-100	15-30	5-15
		15-36	SICL SIL	CL, CL-ML	A-4, A-6, A-7	0	100-100	100-100	90-100	85-95	24-45	7-21
		36-60	FSL L LS	SM, SC, CL, ML	A-2, A-4, A-6	0	95-100	90-100	45-95	15-75	0-40	0-18
		60-65	S LS	SM, SP-SM	A-2	0	95-100	90-100	43-85	5-30	0-10	0-0
MU	Mattapex	0-15	FSL	SM, SC-SM, ML	A-4, A-2	0	95-100	90-100	80-100	30-65	15-30	0-10
		15-36	SICL SIL	CL, CL-ML	A-4, A-6, A-7	0	100-100	100-100	90-100	85-95	24-45	7-21
		36-60	FSL L LS	SM, SC, CL, ML	A-2, A-4, A-6	0	95-100	90-100	45-95	15-75	0-40	0-18
		60-65	S LS	SM, SP-SM	A-2	0	95-100	90-100	43-85	5-30	0-10	0-0
	Udorthents	0-2	SL	SM, SC-SM, ML	A-2, A-4	0-5	85-100	80-100	50-85	25-55	15-25	0-5
		2-65	SL L	CL, CL-ML	A-4, A-6	0-5	85-100	80-100	70-95	50-75	15-30	5-15
	Urban land.											
MwA	Mattapex	0-15	SIL	CL-ML, CL	A-4	0	95-100	90-100	80-100	80-100	15-30	5-15
		15-36	SICL SIL	CL, CL-ML	A-4, A-6, A-7	0	100-100	100-100	90-100	85-95	24-45	7-21
		36-60	FSL L LS	SM, SC, CL, ML	A-2, A-4, A-6	0	95-100	90-100	45-95	15-75	0-40	0-18
		60-65	S LS	SM, SP-SM	A-2	0	95-100	90-100	43-85	5-30	0-10	0-0
NnA	Nassawango	0-10	SIL	CL-ML, SC-SM	A-4	0	85-100	70-100	70-90	40-85	20-33	3-9
		10-16	SIL	ML, CL-ML	A-4	0	100-100	100-100	80-100	80-100	20-33	3-9
		16-36	SICL SIL	CL	A-7, A-6	0	100-100	100-100	80-100	80-100	27-45	10-22
		36-44	SIL L	ML, CL-ML	A-4	0	100-100	100-100	80-100	80-100	20-33	3-9
		44-60	LS S	SP-SM	A-2, A-3, A-4	0	95-100	90-100	55-70	5-40	0-15	0-0
		60-72	FSL SL SIL	SM, ML, CL-ML	A-4	0	85-100	70-95	50-90	40-85	15-30	2-9

Table 14.--Engineering Index Properties--Continued

Map symbol	Soil name	Depth (In)	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments >3 in. (Pct)	Percent passing sieve number--: 4	10	40	200	Liquid limit (Pct)	Plas-ticity index
NnB	Nassawango	0-10	SIL	CL-ML, SC-SM	A-4	0	85-100	70-100	70-90	40-85	20-33	3-9
		10-16	SIL	ML, CL-ML	A-4	0	100-100	100-100	80-100	80-100	20-33	3-9
		16-36	SICL SIL	CL	A-7, A-6	0	100-100	100-100	80-100	80-100	27-45	10-22
		36-44	SIL L	ML, CL-ML	A-4	0	100-100	100-100	80-100	80-100	20-33	3-9
		44-60	LS S	SP-SM	A-2, A-3, A-4	0	95-100	90-100	55-70	5-40	0-15	0-0
		60-72	FSL SL SIL	SM, ML, CL-ML	A-4	0	85-100	70-95	50-90	40-85	15-30	2-9
NnC	Nassawango	0-10	SIL	CL-ML, SC-SM	A-4	0	85-100	70-100	70-90	40-85	20-33	3-9
		10-16	SIL	ML, CL-ML	A-4	0	100-100	100-100	80-100	80-100	20-33	3-9
		16-36	SICL SIL	CL	A-7, A-6	0	100-100	100-100	80-100	80-100	27-45	10-22
		36-44	SIL L	ML, CL-ML	A-4	0	100-100	100-100	80-100	80-100	20-33	3-9
		44-60	LS S	SP-SM	A-2, A-3, A-4	0	95-100	90-100	55-70	5-40	0-15	0-0
		60-72	FSL SL SIL	SM, ML, CL-ML	A-4	0	85-100	70-95	50-90	40-85	15-30	2-9
Ot	Othello	0-6	SIL	CL, OL	A-4, A-6	0	100-100	100-100	90-100	75-90	30-40	5-15
		6-12	SIL	CL, CL-ML, ML	A-4, A-6	0	100-100	100-100	80-100	50-90	15-35	0-15
		12-40	SIL SICL	CL	A-6	0	100-100	100-100	80-100	50-90	20-30	10-15
		40-48	SCL SL FSL	SC-SM, CL, ML, SM	A-2, A-4	0	90-100	85-100	50-95	25-60	15-25	0-10
		48-72	LS S	SM, SP-SM	A-1, A-2, A-3	0	90-100	85-100	30-85	5-35	0-20	0-5
Po	Pone	0-14	MK-L	SC, OL, CL-ML	A-2, A-4, A-8	0	100-100	90-100	40-90	15-55	20-30	0-10
		14-26	SL L	SC-SM, CL-ML	A-2, A-4	0	90-100	85-95	40-90	20-60	10-25	0-10
		26-37	LS SL	SM, SC, SP-SM	A-1, A-2	0	90-100	85-95	30-70	10-40	0-20	0-10
		37-47	S LS	SM, SP-SM	A-1, A-2	0	80-100	75-100	20-70	5-30	0-20	0-5
		47-69	VFSL SIL SICL	CL-ML, CL	A-4, A-6	0	90-100	85-95	70-90	60-90	10-30	5-15
Pk	Puckum	0-4	Muck	PT	A-8	0	---	---	---	---	---	---
		4-80	Muck MPT	PT	A-8	0	---	---	---	---	---	---
RE	Romney	0-8	SIL	ML, CL, CL-ML	A-4	0	100-100	100-100	85-98	60-85	20-35	3-10
		8-75	L SIL	CL, CL-ML	A-6, A-7, A-4	0	100-100	100-100	85-99	60-95	22-49	6-30
	Elkton	0-10	SIL	CL-ML	A-4, A-6	0	100-100	100-100	90-100	50-95	20-45	5-20
		10-24	SICL	CL	A-6	0	100-100	100-100	90-100	85-95	25-40	10-20
		24-40	SICL SIC	CL, CH	A-6, A-7	0	100-100	100-100	95-100	85-95	30-55	10-35
		40-65	VFSL FSL	SC, ML, CL	A-4	0	100-100	95-100	85-95	45-75	20-30	0-10
RoA	Romney	0-8	SIL	ML, CL, CL-ML	A-4	0	100-100	100-100	85-98	60-85	20-35	3-10
		8-75	L SIL	CL, CL-ML	A-6, A-7, A-4	0	100-100	100-100	85-99	60-95	22-49	6-30
Ud	Udorthents	0-2	SL	SM, SC-SM, ML	A-2, A-4	0-5	85-100	80-100	50-85	25-55	15-25	0-5
		2-65	SL L	CL, CL-ML	A-4, A-6	0-5	85-100	80-100	70-95	50-75	15-30	5-15

Table 14.--Engineering Index Properties--Continued

Map symbol	Soil name	Depth (In)	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments >3 in. (Pct)	Percent passing sieve number-- 4	10	40	200	Liquid limit (Pct)	Plas- ticity index
Ur	Urban land.											
	Udorthents	0-2	SL	SM, SC-SM, ML	A-2, A-4	0-5	85-100	80-100	50-85	25-55	15-25	0-5
		2-65	SL L	CL, CL-ML	A-4, A-6	0-5	85-100	80-100	70-95	50-75	15-30	5-15
WdA	Woodstown	0-11	SL	SM, CL-ML, SC-SM	A-2, A-4	0	90-100	80-100	60-95	30-75	0-28	0-7
		11-29	SCL L SL	SM, CL-ML, CL, SC-SM	A-2, A-4, A-6	0	90-100	70-100	45-90	25-60	0-32	0-20
		29-70	SR GR-S SL	SM, SP-SM, SC-SM	A-1, A-2, A-3, A-2-4	0	80-100	70-95	35-55	5-25	0-26	0-6
WdB	Woodstown	0-11	SL	SM, CL-ML, SC-SM	A-2, A-4	0	90-100	80-100	60-95	30-75	0-28	0-7
		11-29	SCL L SL	SM, CL-ML, CL, SC-SM	A-2, A-4, A-6	0	90-100	70-100	45-90	25-60	0-32	0-20
		29-70	SR GR-S SL	SM, SP-SM, SC-SM	A-1, A-2, A-3, A-2-4	0	80-100	70-95	35-55	5-25	0-26	0-6
WdC	Woodstown	0-11	SL	SM, CL-ML, SC-SM	A-2, A-4	0	90-100	80-100	60-95	30-75	0-28	0-7
		11-29	SCL L SL	SM, CL-ML, CL, SC-SM	A-2, A-4, A-6	0	90-100	70-100	45-90	25-60	0-32	0-20
		29-70	SR GR-S SL	SM, SP-SM, SC-SM	A-1, A-2, A-3, A-2-4	0	80-100	70-95	35-55	5-25	0-26	0-6
Ze	Zekiah	0-3	L	ML, CL-ML	A-4	0	100-100	100-100	70-100	45-100	15-25	0-10
		3-20	SIL L	ML, CL-ML	A-4	0	100-100	100-100	70-100	45-100	15-25	0-10
		20-27	MK-L L SL	ML, SM	A-4, A-2-4	0	90-100	75-100	50-95	25-75	15-26	0-10
		27-37	MK-SL SL LS	SM	A-2-4	0	90-100	75-100	50-70	25-45	15-26	0-10
		37-50	L SL SIL	SM	A-4, A-2-4	0	90-100	75-100	35-70	25-50	15-25	0-10
		50-72	S LS COS	SM, SP-SM	A-3, A-2-4, A-1	0	90-100	75-100	35-70	5-25	---	0-5

Table 15.--Physical and Chemical Properties of the Soils

Map symbol	Soil name	Depth (In)	Clay (Pct)	Moist bulk density (g/cm3)	Permeability (In/hr)	Available water capacity (In/in)	Soil reaction (pH)	Salinity (mmhos/cm)	Shrink-swell potential	Erosion factor K	Erosion factor T	Wind erodibility group	Organic matter content (Pct)
BeA	Beltsville	0-14	7-20	1.20-1.40	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43	4	5	1.0-3.0
		14-25	20-30	1.30-1.50	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43			0.0-0.5
		25-50	20-30	1.60-1.90	0.0-0.2	0.05-0.10	3.6-5.5	0	Low	.32			0.0-0.5
		50-72	20-35	1.30-1.50	0.2-6.0	0.08-0.18	3.6-5.5	0	Low	.37			0.0-0.5
BeB	Beltsville	0-14	7-20	1.20-1.40	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43	4	5	1.0-3.0
		14-25	20-30	1.30-1.50	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43			0.0-0.5
		25-50	20-30	1.60-1.90	0.0-0.2	0.05-0.10	3.6-5.5	0	Low	.32			0.0-0.5
		50-72	20-35	1.30-1.50	0.2-6.0	0.08-0.18	3.6-5.5	0	Low	.37			0.0-0.5
BeC	Beltsville	0-14	7-20	1.20-1.40	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43	4	5	1.0-3.0
		14-25	20-30	1.30-1.50	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43			0.0-0.5
		25-50	20-30	1.60-1.90	0.0-0.2	0.05-0.10	3.6-5.5	0	Low	.32			0.0-0.5
		50-72	20-35	1.30-1.50	0.2-6.0	0.08-0.18	3.6-5.5	0	Low	.37			0.0-0.5
BU	Beltsville	0-14	7-20	1.20-1.40	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43	4	5	1.0-3.0
		14-25	20-30	1.30-1.50	0.6-2.0	0.18-0.21	3.6-5.5	0	Low	.43			0.0-0.5
		25-50	20-30	1.60-1.90	0.0-0.2	0.05-0.10	3.6-5.5	0	Low	.32			0.0-0.5
		50-72	20-35	1.30-1.50	0.2-6.0	0.08-0.18	3.6-5.5	0	Low	.37			0.0-0.5
	Udorthents	0-2	6-15	---	0.06-0.6	0.10-0.13	4.5-5.0	0	Low	.28	5	3	1.0-2.0
		2-65	8-20	---	0.06-0.6	0.12-0.15	4.5-5.0	0	Moderate	.28			1.0-2.0
	Urban land.												
Ch	Chicone	0-3	8-15	1.30-1.50	0.6-2.0	0.15-0.30	3.5-5.5	0	Low	.28	5	8	10.0-20.0
		3-15	8-15	1.50-1.70	0.6-6.0	0.10-0.18	3.5-5.5	0	Low	.37			0.5-3.0
		15-24	8-18	1.55-1.70	0.6-6.0	0.10-0.18	3.5-5.5	0	Low	.37			0.5-3.0
		24-65	0	0.10-0.50	6.0-20	0.35-0.45	3.5-5.5	0	Low	.05			60.0-80.0
		65-72	3-8	1.40-1.70	2.0-20	0.05-0.10	3.5-5.5	0	Low	.15			0.5-1.0
Cd	Codorus	0-18	15-25	1.20-1.40	0.6-2.0	0.14-0.20	4.5-6.0	0	Low	.37	5	5	2.0-4.0
		18-54	18-35	1.20-1.50	0.6-2.0	0.14-0.18	5.1-6.5	0	Low	.37			0.0-0.5
		54-60	5-12	1.20-1.50	2.0-20	0.04-0.08	5.1-6.5	0	Low	.24			0.0-0.5
Co	Corsica	0-12	6-15	1.10-1.50	0.6-6.0	0.15-0.30	3.5-5.5	0	Low	.24	5	5	3.0-15.0
		12-18	10-15	1.20-1.70	0.6-2.0	0.12-0.20	3.5-5.5	0	Low	.32			0.5-1.0
		18-40	18-30	1.30-1.70	0.2-6.0	0.10-0.24	3.5-5.5	0	Low	.32			0.0-0.5
		40-48	5-25	1.30-1.70	0.2-2.0	0.10-0.20	3.5-5.5	0	Low	.24			0.0-0.5
		48-72	0-35	1.50-1.80	0.2-20	0.05-0.20	3.5-5.5	0	Low	.10			0.0-0.5
Ek	Elkton	0-10	11-25	1.20-1.50	0.6-2.0	0.18-0.24	3.5-5.5	0	Low	.43	5	5	1.0-4.0
		10-24	27-35	1.35-1.55	0.06-0.2	0.14-0.20	3.5-5.5	0	Moderate	.37			0.0-0.5
		24-40	27-45	1.35-1.55	0.00-0.2	0.12-0.19	3.5-5.5	0	Moderate	.32			0.0-0.5
		40-65	10-20	1.45-1.65	0.2-20	0.10-0.15	3.5-5.5	0	Low	.32			0.0-0.5
Fa	Fallsington	0-10	5-18	1.00-1.45	0.6-6.0	0.15-0.20	3.6-5.5	0	Low	.24	5	3	0.5-2.0
		10-32	18-30	1.50-1.80	0.2-2.0	0.15-0.18	3.6-5.5	0	Low	.28			0.0-0.5
		32-72	2-30	1.50-1.85	0.6-20	0.06-0.20	3.6-5.5	0	Low	.20			0.0-0.5

Table 15.--Physical and Chemical Properties of the Soils--Continued

Map symbol	Soil name	Depth (In)	Clay (Pct)	Moist bulk density (g/cm3)	Permeability (In/hr)	Available water capacity (In/in)	Soil reaction (pH)	Salinity (mmhos/cm)	Shrink-swell potential	Erosion factor K	Erosion factor T	Wind erodibility group	Organic matter content (Pct)
HbA	Hambrook	0-10	12-18	1.30-1.60	0.6-6.0	0.12-0.20	3.6-5.5	---	Low	.28	5	5	0.5-3.0
		10-14	10-18	1.45-1.65	0.6-6.0	0.10-0.16	3.6-5.5	---	Low	.24			0.0-0.5
		14-28	18-27	1.35-1.70	0.6-2.0	0.14-0.22	3.6-5.5	---	Low	.37			0.0-0.5
		28-65	3-8	1.40-1.70	2.0-20	0.05-0.10	3.6-5.5	---	Low	.24			0.0-0.5
		65-72	15-30	1.50-1.70	0.06-0.6	0.12-0.24	3.6-5.5	---	Low	.49			0.0-0.5
HbB	Hambrook	0-10	12-18	1.30-1.60	0.6-6.0	0.12-0.20	3.6-5.5	---	Low	.28	5	5	0.5-3.0
		10-14	10-18	1.45-1.65	0.6-6.0	0.10-0.16	3.6-5.5	---	Low	.24			0.0-0.5
		14-28	18-27	1.35-1.70	0.6-2.0	0.14-0.22	3.6-5.5	---	Low	.37			0.0-0.5
		28-65	3-8	1.40-1.70	2.0-20	0.05-0.10	3.6-5.5	---	Low	.24			0.0-0.5
		65-72	15-30	1.50-1.70	0.06-0.6	0.12-0.24	3.6-5.5	---	Low	.49			0.0-0.5
HbC	Hambrook	0-10	12-18	1.30-1.60	0.6-6.0	0.12-0.20	3.6-5.5	---	Low	.28	5	5	0.5-3.0
		10-14	10-18	1.45-1.65	0.6-6.0	0.10-0.16	3.6-5.5	---	Low	.24			0.0-0.5
		14-28	18-27	1.35-1.70	0.6-2.0	0.14-0.22	3.6-5.5	---	Low	.37			0.0-0.5
		28-65	3-8	1.40-1.70	2.0-20	0.05-0.10	3.6-5.5	---	Low	.24			0.0-0.5
		65-72	15-30	1.50-1.70	0.06-0.6	0.12-0.24	3.6-5.5	---	Low	.49			0.0-0.5
HbE	Hambrook	0-10	12-18	1.30-1.60	0.6-6.0	0.12-0.20	3.6-5.5	---	Low	.28	5	5	0.5-3.0
		10-14	10-18	1.45-1.65	0.6-6.0	0.10-0.16	3.6-5.5	---	Low	.24			0.0-0.5
		14-28	18-27	1.35-1.70	0.6-2.0	0.14-0.22	3.6-5.5	---	Low	.37			0.0-0.5
		28-65	3-8	1.40-1.70	2.0-20	0.05-0.10	3.6-5.5	---	Low	.24			0.0-0.5
		65-72	15-30	1.50-1.70	0.06-0.6	0.12-0.24	3.6-5.5	---	Low	.49			0.0-0.5
HU	Hambrook	0-10	12-18	1.30-1.60	0.6-6.0	0.12-0.20	3.6-5.5	---	Low	.28	5	5	0.5-3.0
		10-14	10-18	1.45-1.65	0.6-6.0	0.10-0.16	3.6-5.5	---	Low	.24			0.0-0.5
		14-28	18-27	1.35-1.70	0.6-2.0	0.14-0.22	3.6-5.5	---	Low	.37			0.0-0.5
		28-65	3-8	1.40-1.70	2.0-20	0.05-0.10	3.6-5.5	---	Low	.24			0.0-0.5
		65-72	15-30	1.50-1.70	0.06-0.6	0.12-0.24	3.6-5.5	---	Low	.49			0.0-0.5
	Udorthents	0-2	6-15	---	0.06-0.6	0.10-0.13	4.5-5.0	0	Low	.28	5	3	1.0-2.0
		2-65	8-20	---	0.06-0.6	0.12-0.15	4.5-5.0	0	Moderate	.28			1.0-2.0
	Urban land.												
In	Indiantown	0-25	8-15	1.30-1.50	0.6-2.0	0.18-0.30	3.5-5.5	0-2	Low	.28	4	5	5.0-18.0
		25-41	5-15	1.40-1.65	2.0-6.0	0.02-0.08	3.5-5.5	0-2	Low	.32			1.0-10.0
		41-72	3-8	1.40-1.70	6.0-20	0.04-0.09	3.5-5.5	0-2	Low	.17			0.0-1.0
Kn	Kentuck	0-13	14-20	1.20-1.70	0.6-2.0	0.20-0.21	3.5-5.5	0	Low	.43	4	5	0.5-1.0
		13-24	14-20	1.40-1.70	0.6-2.0	0.15-0.21	3.5-5.5	0	Low	.43			0.5-1.0
		24-45	24-34	1.40-1.70	0.06-0.6	0.15-0.21	3.5-5.5	0	Low	.43			0.0-0.5
		45-56	10-15	1.65-1.80	2.0-6.0	0.11-0.15	3.5-5.5	0	Low	.24			0.0-0.5
		56-70	3-8	1.65-1.80	6.0-20	0.05-0.11	3.5-5.5	0	Low	.15			0.0-0.5

Table 15.--Physical and Chemical Properties of the Soils--Continued

Map symbol	Soil name	Depth (In)	Clay (Pct)	Moist bulk density (g/cm3)	Permeability (In/hr)	Available water capacity (In/in)	Soil reaction (pH)	Salinity (mmhos/cm)	Shrink-swell potential	Erosion factor K	Erosion factor T	Wind erodibility group	Organic matter content (Pct)
Kj	Klej	0-9	2-10	1.30-1.60	6.0-20	0.06-0.11	3.6-5.5	0	Low	.17	5	2	1.0-3.0
		9-39	2-10	1.30-1.60	6.0-20	0.06-0.10	3.6-5.5	0	Low	.17			0.0-0.5
		39-47	2-10	1.50-1.75	6.0-20	0.06-0.08	3.6-5.5	0	Low	.17			0.0-0.5
		47-60	10-27	1.40-1.55	0.0-2.0	0.11-0.17	3.6-5.5	0	Low	.24			0.0-0.5
Le	Lenape	0-8	0	0.10-0.80	2.0-6.0	0.35-0.45	3.6-5.5	0-2	Low	.02	2	8	30.0-90.0
		8-26	0	0.10-0.80	2.0-6.0	0.35-0.45	3.6-5.5	0-2					30.0-80.0
		26-60	15-35	1.20-1.70	0.2-0.6	0.10-0.20	3.6-5.5	0-2					1.0-5.0
		60-72	2-8	1.20-1.60	2.0-20	0.05-0.10	3.6-5.5	0-2					0.0-2.0
Lo	Longmarsh	0-19	8-15	1.40-1.70	0.6-2.0	0.15-0.21	3.5-5.5	0-2	Low	.17	4	5	0.0-5.0
		19-34	5-15	1.40-1.65	2.0-6.0	0.02-0.08	3.5-5.5	0-2	Low	.10			1.0-8.0
		34-66	0-8	1.40-1.70	6.0-20	0.04-0.09	3.5-5.5	0-2	Low	.10	5	5	0.0-1.0
Ma	Manahawkin	0-39	0	0.30-0.65	6.0-20	0.30-0.40	3.5-5.5	0-2		.05	2	2	20.0-95.0
		39-60	0-10	1.10-1.70	2.0-20	0.04-0.08	4.5-5.0	0	Low	.17			0.5-1.0
MpA	Mattapex	0-15	10-18	1.10-1.45	0.6-2.0	0.20-0.28	3.6-5.5	0	Low	.43	5	5	0.5-3.0
		15-36	18-30	1.25-1.45	0.2-2.0	0.18-0.22	3.6-5.5	0	Low	.43			0.0-0.5
		36-60	8-15	1.45-1.65	0.6-6.0	0.14-0.18	3.6-5.5	0	Low	.28			0.0-0.5
		60-65	3-8	1.50-1.80	6.0-20	0.05-0.08	3.6-5.5	0	Low	.17			0.0-0.5
MpB	Mattapex	0-15	10-18	1.10-1.45	0.6-2.0	0.20-0.28	3.6-5.5	0	Low	.43	5	5	0.5-3.0
		15-36	18-30	1.25-1.45	0.2-2.0	0.18-0.22	3.6-5.5	0	Low	.43			0.0-0.5
		36-60	8-15	1.45-1.65	0.6-6.0	0.14-0.18	3.6-5.5	0	Low	.28			0.0-0.5
		60-65	3-8	1.50-1.80	6.0-20	0.05-0.08	3.6-5.5	0	Low	.17			0.0-0.5
MpC	Mattapex	0-15	10-18	1.10-1.45	0.6-2.0	0.20-0.28	3.6-5.5	0	Low	.43	5	5	0.5-3.0
		15-36	18-30	1.25-1.45	0.2-2.0	0.18-0.22	3.6-5.5	0	Low	.43			0.0-0.5
		36-60	8-15	1.45-1.65	0.6-6.0	0.14-0.18	3.6-5.5	0	Low	.28			0.0-0.5
		60-65	3-8	1.50-1.80	6.0-20	0.05-0.08	3.6-5.5	0	Low	.17			0.0-0.5
MU	Mattapex	0-15	10-18	1.10-1.45	0.6-2.0	0.13-0.20	3.6-5.5	0	Low	.37	5	3	0.5-3.0
		15-36	18-30	1.25-1.45	0.2-2.0	0.18-0.22	3.6-5.5	0	Low	.43			0.0-0.5
		36-60	8-15	1.45-1.65	0.6-6.0	0.14-0.18	3.6-5.5	0	Low	.28			0.0-0.5
		60-65	3-8	1.50-1.80	6.0-20	0.05-0.08	3.6-5.5	0	Low	.17			0.0-0.5
	Udorthents	0-2	6-15	---	0.06-0.6	0.10-0.13	4.5-5.0	0	Low	.28	5	3	1.0-2.0
		2-65	8-20	---	0.06-0.6	0.12-0.15	4.5-5.0	0	Moderate	.28			1.0-2.0
	Urban land.												
MwA	Mattapex	0-15	10-18	1.10-1.45	0.6-2.0	0.20-0.28	3.6-5.5	0	Low	.43	5	5	0.5-3.0
		15-36	18-30	1.25-1.45	0.2-2.0	0.18-0.22	3.6-5.5	0	Low	.43			0.0-0.5
		36-60	8-15	1.45-1.65	0.6-6.0	0.14-0.18	3.6-5.5	0	Low	.28			0.0-0.5
		60-65	3-8	1.50-1.80	6.0-20	0.05-0.08	3.6-5.5	0	Low	.17			0.0-0.5

Table 15.--Physical and Chemical Properties of the Soils--Continued

Map symbol	Soil name	Depth (In)	Clay (Pct)	Moist bulk density (g/cm3)	Permeability (In/hr)	Available water capacity (In/in)	Soil reaction (pH)	Salinity (mmhos/cm)	Shrink-swell potential	Erosion factor K	Erosion factor T	Wind erodibility group	Organic matter content (Pct)
NnA	Nassawango	0-10	5-15	1.20-1.50	0.6-2.0	0.20-0.25	4.5-6.5	0	Low	.43	4	5	1.0-2.0
		10-16	5-15	1.20-1.50	0.6-2.0	0.20-0.25	4.5-6.5	0	Low	.49			0.0-0.5
		16-36	18-30	1.40-1.65	0.2-0.6	0.18-0.25	3.5-5.5	0	Low	.49			0.0-0.5
		36-44	10-20	1.40-1.65	0.6-2.0	0.18-0.25	3.5-5.5	0	Low	.28			0.0-0.5
		44-60	2-10	1.65-1.85	6.0-20	0.08-0.15	3.5-5.5	0	Low	.15			0.0-0.5
		60-72	8-20	1.40-1.70	0.2-2.0	0.15-0.24	3.5-5.5	0	Low	.28			0.0-0.5
NnB	Nassawango	0-10	5-15	1.20-1.50	0.6-2.0	0.20-0.25	4.5-6.5	0	Low	.43	4	5	1.0-2.0
		10-16	5-15	1.20-1.50	0.6-2.0	0.20-0.25	4.5-6.5	0	Low	.49			0.0-0.5
		16-36	18-30	1.40-1.65	0.2-0.6	0.18-0.25	3.5-5.5	0	Low	.49			0.0-0.5
		36-44	10-20	1.40-1.65	0.6-2.0	0.18-0.25	3.5-5.5	0	Low	.28			0.0-0.5
		44-60	2-10	1.65-1.85	6.0-20	0.08-0.15	3.5-5.5	0	Low	.15			0.0-0.5
		60-72	8-20	1.40-1.70	0.2-2.0	0.15-0.24	3.5-5.5	0	Low	.28			0.0-0.5
NnC	Nassawango	0-10	5-15	1.20-1.50	0.6-2.0	0.20-0.25	4.5-6.5	0	Low	.43	4	5	1.0-2.0
		10-16	5-15	1.20-1.50	0.6-2.0	0.20-0.25	4.5-6.5	0	Low	.49			0.0-0.5
		16-36	18-30	1.40-1.65	0.2-0.6	0.18-0.25	3.5-5.5	0	Low	.49			0.0-0.5
		36-44	10-20	1.40-1.65	0.6-2.0	0.18-0.25	3.5-5.5	0	Low	.28			0.0-0.5
		44-60	2-10	1.65-1.85	6.0-20	0.08-0.15	3.5-5.5	0	Low	.15			0.0-0.5
		60-72	8-20	1.40-1.70	0.2-2.0	0.15-0.24	3.5-5.5	0	Low	.28			0.0-0.5
Ot	Othello	0-6	14-22	1.20-1.50	0.6-2.0	0.20-0.25	3.6-5.5	0	Low	.24	4	5	3.0-10.0
		6-12	12-20	1.30-1.50	0.6-2.0	0.16-0.24	3.6-5.5	0	Low	.49			0.0-1.0
		12-40	18-30	1.40-1.70	0.2-0.6	0.18-0.24	3.6-5.5	0	Low	.49			0.0-0.5
		40-48	15-24	1.65-1.80	2.0-6.0	0.12-0.20	3.6-5.5	0	Low	.28			0.0-0.5
		48-72	3-10	1.65-1.80	6.0-20	0.05-0.10	3.6-5.5	0	Low	.15			0.0-0.5
Po	Pone	0-14	10-18	1.20-1.40	0.6-6.0	0.15-0.24	3.6-5.5	0	Low	.15	5	5	3.0-15.0
		14-26	8-18	1.55-1.75	2.0-6.0	0.10-0.16	3.6-5.5	0	Low	.24			0.0-0.5
		26-37	3-15	1.40-1.70	2.0-6.0	0.05-0.10	3.6-5.5	0	Low	.20			0.0-0.5
		37-47	3-8	1.40-1.70	2.0-20	0.05-0.10	3.6-5.5	0	Low	.15			0.0-0.5
		47-69	15-30	1.50-1.70	0.06-0.6	0.12-0.24	3.6-5.5	0	Low	.55			0.0-0.5
Pk	Puckum	0-4	0	0.10-0.50	2.0-6.0	0.35-0.45	3.5-5.5	0-4	Low	.02	3	8	45.0-90.0
		4-80	0	0.10-0.50	2.0-6.0	0.35-0.45	3.5-5.5	0-4	Low	.02			30.0-75.0
RE	Romney	0-8	6-20	1.30-1.50	0.6-2.0	0.14-0.18	3.5-5.5	0	Low	.37	5	5	2.0-4.0
		8-75	18-35	1.30-1.50	0.2-0.6	0.15-0.22	3.5-6.5	0	Low	.43			0.0-0.5
	Elkton	0-10	11-25	1.20-1.50	0.6-2.0	0.18-0.24	3.5-5.5	0	Low	.43	5	5	1.0-4.0
		10-24	27-35	1.35-1.55	0.06-0.2	0.14-0.20	3.5-5.5	0	Moderate	.37			0.0-0.5
		24-40	27-45	1.35-1.55	0.00-0.2	0.12-0.19	3.5-5.5	0	Moderate	.32			0.0-0.5
		40-65	10-20	1.45-1.65	0.2-20	0.10-0.15	3.5-5.5	0	Low	.32			0.0-0.5
RoA	Romney	0-8	6-20	1.30-1.50	0.6-2.0	0.14-0.18	3.5-5.5	0	Low	.37	5	5	2.0-4.0
		8-75	18-35	1.30-1.50	0.2-0.6	0.15-0.22	3.5-6.5	0	Low	.43			0.0-0.5

Table 15.--Physical and Chemical Properties of the Soils--Continued

Map symbol	Soil name	Depth (In)	Clay (Pct)	Moist bulk density (g/cm3)	Permeability (In/hr)	Available water capacity (In/in)	Soil reaction (pH)	Salinity (mmhos/cm)	Shrink-swell potential	Erosion factor K	Erosion factor T	Wind erodibility group	Organic matter content (Pct)
Ud	Udorthents	0-2	6-15	---	0.06-0.6	0.10-0.13	4.5-5.0	0	Low	.28	5	3	1.0-2.0
		2-65	8-20	---	0.06-0.6	0.12-0.15	4.5-5.0	0	Moderate	.28			1.0-2.0
Ur	Urban land.												
	Udorthents	0-2	6-15	---	0.06-0.6	0.10-0.13	4.5-5.0	0	Low	.28	5	3	1.0-2.0
		2-65	8-20	---	0.06-0.6	0.12-0.15	4.5-5.0	0	Moderate	.28			1.0-2.0
WdA	Woodstown	0-11	5-18	1.00-1.40	0.6-6.0	0.08-0.16	3.6-5.5	0	Low	.24	5	3	1.0-2.0
		11-29	18-30	1.35-1.70	0.2-6.0	0.06-0.16	3.6-5.5	0	Low	.28			0.0-0.5
		29-70	5-20	1.35-1.65	0.6-6.0	0.06-0.16	3.6-5.5	0	Low	.28			0.0-0.5
WdB	Woodstown	0-11	5-18	1.00-1.40	0.6-6.0	0.08-0.16	3.6-5.5	0	Low	.24	5	3	1.0-2.0
		11-29	18-30	1.35-1.70	0.2-6.0	0.06-0.16	3.6-5.5	0	Low	.28			0.0-0.5
		29-70	5-20	1.35-1.65	0.6-6.0	0.06-0.16	3.6-5.5	0	Low	.28			0.0-0.5
WdC	Woodstown	0-11	5-18	1.00-1.40	0.6-6.0	0.08-0.16	3.6-5.5	0	Low	.24	5	3	1.0-2.0
		11-29	18-30	1.35-1.70	0.2-6.0	0.06-0.16	3.6-5.5	0	Low	.28			0.0-0.5
		29-70	5-20	1.35-1.65	0.6-6.0	0.06-0.16	3.6-5.5	0	Low	.28			0.0-0.5
Ze	Zekiah	0-3	8-15	1.20-1.50	0.6-2.0	0.12-0.22	3.5-5.5	0-2	Low	.43	5	8	5.0-18.0
		3-20	8-18	1.20-1.50	0.6-2.0	0.10-0.20	3.5-5.5	0-2	Low	.43			1.0-5.0
		20-27	5-15	1.30-1.50	2.0-6.0	0.10-0.20	3.5-5.5	0-2	Low	.28			2.0-18.0
		27-37	5-15	1.30-1.60	2.0-6.0	0.08-0.15	3.5-5.5	0-2	Low	.24			1.0-18.0
		37-50	5-18	1.30-1.60	2.0-6.0	0.10-0.20	3.5-5.5	0-2	Low	.15			1.0-5.0
		50-72	2-8	1.50-1.70	2.0-20	0.05-0.10	3.5-5.5	0-2	Low	.15			1.0-5.0

Table 16.--Water Features

Map symbol	Soil name	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months
						Ft		
BeA	Beltsville	C	None		---	1.5-2.5	Perched	Nov-Apr
BeB	Beltsville	C	None		---	1.5-2.5	Perched	Nov-Apr
BeC	Beltsville	C	None		---	1.5-2.5	Perched	Nov-Apr
BU	Beltsville	C	None		---	1.5-2.5	Perched	Nov-Apr
	Udorthents	C	None		---	5.0-5.0	Apparent	Nov-Mar
	Urban land.							
Ch	Chicone	D	Occasional	Brief	Jan-Dec	+1.0-0.5	Apparent	Nov-Jun
Cd	Codorus	C	Occasional	Very brief	Dec-Apr	1.0-2.0	Apparent	Nov-Apr
Co	Corsica	C/D	None		---	+1.0-0.5	Apparent	Dec-Jun
Ek	Elkton	C/D	None		---	0-1.0	Apparent	Nov-May
Fa	Fallsington	B/D	None		---	0-1.0	Apparent	Dec-May
HbA	Hambrook	B	None		---	4.0-6.0	Apparent	Jan-May
HbB	Hambrook	B	None		---	4.0-6.0	Apparent	Jan-May
HbC	Hambrook	B	None		---	4.0-6.0	Apparent	Jan-May
HbE	Hambrook	B	None		---	4.0-6.0	Apparent	Jan-May
HU	Hambrook	B	None		---	4.0-6.0	Apparent	Jan-May
	Udorthents	C	None		---	5.0-5.0	Apparent	Nov-Mar
	Urban land.							
In	Indiantown	D	Frequent	Brief	Jan-Dec	+0.5-0.5	Apparent	Sep-Jun
Kn	Kentuck	B/D	None		---	+1.0-0.5	Apparent	Dec-Jun
Kj	Klej	B/D	None		---	1.0-2.0	Apparent	Dec-Apr
Le	Lenape	D	Frequent	Very brief	Jan-Dec	+1.0-0.5	Apparent	Jan-Dec
Lo	Longmarsh	D	Frequent	Brief	Jan-Dec	+0.5-1.5	Apparent	Sep-Jun
Ma	Manahawkin	D	Frequent	Long	Jan-Mar	+1.0-0	Apparent	Oct-Jul
MpA	Mattapex	C	None		---	1.5-3.0	Apparent	Jan-Apr
MpB	Mattapex	C	None		---	1.5-3.0	Apparent	Jan-Apr
MpC	Mattapex	C	None		---	1.5-3.0	Apparent	Jan-Apr
MU	Mattapex	C	None		---	1.5-3.0	Apparent	Jan-Apr
	Udorthents	C	None		---	5.0-5.0	Apparent	Nov-Mar
	Urban land.							
MwA	Mattapex	C	None		---	1.5-3.0	Apparent	Jan-Apr

Table 16.--Water Features--Continued

Map symbol	Soil name	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months
						Ft		
NnA	Nassawango	B	None		---	3.5-6.0	Perched	Dec-Apr
NnB	Nassawango	B	None		---	3.5-6.0	Perched	Dec-Apr
NnC	Nassawango	B	None		---	3.5-6.0	Perched	Dec-Apr
Ot	Othello	D	None		---	+1.0-0.5	Apparent	Jan-Jun
Po	Pone	B/D	None		---	+1.0-0.5	Apparent	Dec-Jun
Pk	Puckum	D	Frequent	Brief	Jan-Dec	+1.0-0	Apparent	Jan-Dec
RE	Romney	C	None		---	1.0-2.5	Apparent	Dec-May
	Elkton	C/D	None		---	0-1.0	Apparent	Nov-May
RoA	Romney	C	None		---	1.0-2.5	Apparent	Dec-May
Ud	Udorthents	C	None		---	5.0-5.0	Apparent	Nov-Mar
Ur	Urban land.							
	Udorthents	C	None		---	5.0-5.0	Apparent	Nov-Mar
WdA	Woodstown	C	None		---	1.5-3.5	Apparent	Jan-Apr
WdB	Woodstown	C	None		---	1.5-3.5	Apparent	Jan-Apr
WdC	Woodstown	C	None		---	1.5-3.5	Apparent	Jan-Apr
Ze	Zekiah	D	Frequent	Brief	Jan-Dec	0-1.0	Apparent	Sep-Jun

Table 17.--Soil Features

Map symbol	Soil name	Depth to bedrock	Subsidence		Potential frost action	Risk of corrosion	
			Initial	Total		Uncoated steel	Concrete
		In	In	In			
BeA	Beltsville	>60	0	---	High	High	High
BeB	Beltsville	>60	0	---	High	High	High
BeC	Beltsville	>60	0	---	High	High	High
BU	Beltsville	>60	0	---	High	High	High
	Udorthents	>60	0	---	Moderate	Moderate	Moderate
	Urban land.						
Ch	Chicone	>60	0	---	Moderate	High	High
Cd	Codorus	>60	0	---	High	High	Moderate
Co	Corsica	>99	0	---	Moderate	High	High
Ek	Elkton	>60	0	---	Moderate	High	High
Fa	Fallsington	>60	0	---	Moderate	High	High
HbA	Hambrook	>60	0	---	Moderate	Moderate	High
HbB	Hambrook	>60	0	---	Moderate	Moderate	High
HbC	Hambrook	>60	0	---	Moderate	Moderate	High
HbE	Hambrook	>60	0	---	Moderate	Moderate	High
HU	Hambrook	>60	0	---	Moderate	Moderate	High
	Udorthents	>60	0	---	Moderate	Moderate	Moderate
	Urban land.						
In	Indiantown	>60	0	---	Moderate	High	High
Kn	Kentuck	>60	0	---	Moderate	High	High
Kj	Klej	>60	0	---	Moderate	Low	High
Le	Lenape	>60	10-20	20-40	Low	High	High
Lo	Longmarsh	>99	0	---	High	High	High
Ma	Manahawkin	>60	6-12	18-32	High	High	High
MpA	Mattapex	>60	0	---	Moderate	High	High
MpB	Mattapex	>60	0	---	Moderate	High	High
MpC	Mattapex	>60	0	---	Moderate	High	High
MU	Mattapex	>60	0	---	Moderate	High	High
	Udorthents	>60	0	---	Moderate	Moderate	Moderate
	Urban land.						
MwA	Mattapex	>60	0	---	Moderate	High	High

Table 17.--Soil Features--Continued

Map symbol	Soil name	Depth to bedrock	Subsidence		Potential frost action	Risk of corrosion	
			Initial	Total		Uncoated steel	Concrete
		In	In	In			
NnA	Nassawango	>60	0	---	Moderate	Moderate	High
NnB	Nassawango	>60	0	---	Moderate	Moderate	High
NnC	Nassawango	>60	0	---	Moderate	Moderate	High
Ot	Othello	>60	0	---	Low	High	High
Po	Pone	>60	0	---	Moderate	High	High
Pk	Puckum	>60	10-20	20-40	Low	High	High
RE	Romney	>60	0	---	None	High	High
	Elkton	>60	0	---	Moderate	High	High
RoA	Romney	>60	0	---	None	High	High
Ud	Udorthents	>60	0	---	Moderate	Moderate	Moderate
Ur	Urban land.						
	Udorthents	>60	0	---	Moderate	Moderate	Moderate
WdA	Woodstown	>60	0	---	Moderate	Moderate	High
WdB	Woodstown	>60	0	---	Moderate	Moderate	High
WdC	Woodstown	>60	0	---	Moderate	Moderate	High
Ze	Zekiah	>60	0	---	Moderate	High	High

Table 18.--Comprehensive Hydric Soils List

[All map units are displayed regardless of hydric status and are listed in alphanumeric order by map unit symbol. The 'Hydric soils criteria' columns indicate the conditions that caused the map unit component to be classified as hydric or non-hydric. These criteria are defined in "Hydric Soils of the United States" (USDA Miscellaneous Publication No. 1491, June, 1991, as revised in the Federal Register, Vol. 60, No. 37, February 24, 1995)]

Map symbol and map unit name	Component(C)/ Inclusion(I)*	Hydric	Local landform	Hydric soils criteria: Hydric criteria code**	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
BeA: Beltsville silt loam, 0 to 2 percent slopes							
	Beltsville (C)	No					
	Unnamed soils (I)	No					
BeB: Beltsville silt loam, 2 to 5 percent slopes							
	Beltsville (C)	No					
	Unnamed soils (I)	No					
BeC: Beltsville silt loam, 5 to 10 percent slopes---------------							
	Beltsville (C)	No					
	Unnamed soils (I)	No					
BU: Beltsville-Udorthents-Urban land complex, 0 to 5 percent slopes--							
	Beltsville (C)	No					
	Udorthents (C)	No					
	Urban land (C)	Unranked					
	Unnamed soils (I)	No					
Ch: Chicone silt loam-----							
	Chicone (C)	Yes	Flat	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flat	2B3	Yes	No	No
Cd: Codorus loam----------							
	Codorus (C)	No					
	Unnamed soils (I)	No					
Co: Corsica loam----------							
	Corsica (C)	Yes	Carolina Bay	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Carolina Bay	2B3	Yes	No	No

See footnotes at end of table.

Table 18.--Comprehensive Hydric Soils List--Continued

Map symbol and map unit name	Component(C)/ Inclusion(I)*	Hydric	Local landform	Hydric soils criteria: Hydric criteria code**	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
Ek: Elkton silt loam------							
	Elkton (C)	Yes	Flat	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flat	2B3	Yes	No	No
Fa: Fallsington sandy loam							
	Fallsington (C)	Yes	Flat	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flat	2B3	Yes	No	No
HbA: Hambrook sandy loam, 0 to 2 percent slopes							
	Hambrook (C)	No					
	Unnamed soils (I)	No					
HbB: Hambrook sandy loam, 2 to 5 percent slopes							
	Hambrook (C)	No					
	Unnamed soils (I)	No					
HbC: Hambrook sandy loam, 5 to 10 percent slopes							
	Hambrook (C)	No					
	Unnamed soils (I)	No					
HbE: Hambrook sandy loam, 10 to 60 percent slopes---------------							
	Hambrook (C)	No					
	Unnamed soils (I)	No					
HU: Hambrook-Udorthents-Urban land complex, 0 to 10 percent slopes							
	Hambrook (C)	No					
	Udorthents (C)	No					
	Urban land (C)	Unranked					
	Unnamed soils (I)	No					
In: Indiantown mucky silt loam-----------------							
	Indiantown (C)	Yes	Flood Plain	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flood Plain	2B3	Yes	No	No

See footnotes at end of table.

Table 18.--Comprehensive Hydric Soils List--Continued

Map symbol and map unit name	Component(C)/ Inclusion(I)*	Hydric	Local landform	Hydric soils criteria: Hydric criteria code**	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
Kn: Kentuck silt loam							
	Kentuck (C)	Yes	Carolina Bay	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Carolina Bay	2B3	Yes	No	No
Kj: Klej loamy sand							
	Klej (C)	No					
	Unnamed soils (I)	No					
Le: Lenape mucky peat							
	Lenape (C)	Yes	Salt Marsh	1	Yes	No	No
	Unnamed soils (I)	Yes	Salt Marsh	1	Yes	No	No
Lo: Longmarsh sandy loam							
	Longmarsh (C)	Yes	Flood Plain	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flood Plain	2B3	Yes	No	No
Ma: Manahawkin muck							
	Manahawkin (C)	Yes	Marsh	1,4	Yes	Yes	No
	Unnamed soils (I)	Yes	Flood Plain	1,4	Yes	Yes	No
MpA: Mattapex silt loam, 0 to 2 percent slopes							
	Mattapex (C)	No					
	Unnamed soils (I)	No					
MpB: Mattapex silt loam, 2 to 5 percent slopes							
	Mattapex (C)	No					
	Unnamed soils (I)	No					
MpC: Mattapex silt loam, 5 to 10 percent slopes							
	Mattapex (C)	No					
	Unnamed soils (I)	No					
MU: Mattapex-Udorthents-Urban land complex, 0 to 2 percent slopes							
	Mattapex (C)	No					
	Udorthents (C)	No					
	Urban land (C)	Unranked					
	Unnamed soils (I)	No					

See footnotes at end of table.

Table 18.--Comprehensive Hydric Soils List--Continued

Map symbol and map unit name	Component(C)/ Inclusion(I)*	Hydric	Local landform	Hydric soils criteria: Hydric criteria code**	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
MwA:							
Mattapex silt loam, cratered							
	Mattapex (C)	No					
	Unnamed soils (I)	No					
NnA:							
Nassawango silt loam, 0 to 2 percent slopes							
	Nassawango (C)	No					
	Unnamed soils (I)	No					
NnB:							
Nassawango silt loam, 2 to 5 percent slopes							
	Nassawango (C)	No					
	Unnamed soils (I)	No					
NnC:							
Nassawango silt loam, 5 to 10 percent slopes							
	Nassawango (C)	No					
	Unnamed soils (I)	No					
Ot:							
Othello silt loam							
	Othello (C)	Yes	Flat	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flat	2B3	Yes	No	No
Po:							
Pone mucky loam							
	Pone (C)	Yes	Flat	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flat	2B3	Yes	No	No
Pk:							
Puckum muck							
	Puckum (C)	Yes	Swamp	1	Yes	No	No
	Unnamed soils (I)	Yes	Swamp	1	Yes	No	No
RE:							
Romney and Elkton soils, cratered							
	Romney (C)	No					
	Elkton (C)	Yes	Flat	2B3	Yes	No	No
	Unnamed soils (I)	No					
RoA:							
Romney silt loam							
	Romney (C)	No					
	Unnamed soils (I)	No					

See footnotes at end of table.

Table 18.--Comprehensive Hydric Soils List--Continued

Map symbol and map unit name	Component(C)/ Inclusion(I)*	Hydric	Local landform	Hydric soils criteria: Hydric criteria code**	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
Ud: Udorthents, loamy, 0 to 10 percent slopes							
	Udorthents (C)	No					
	Unnamed soils (I)	No					
Ur: Urban land-Udorthents complex, 0 to 10 percent slopes-------							
	Urban land (C)	Unranked					
	Udorthents (C)	No					
	Unnamed soils (I)	No					
WdA: Woodstown sandy loam, 0 to 2 percent slopes							
	Woodstown (C)	No					
	Unnamed soils (I)	No					
WdB: Woodstown sandy loam, 2 to 5 percent slopes							
	Woodstown (C)	No					
	Unnamed soils (I)	No					
WdC: Woodstown sandy loam, 5 to 10 percent slopes---------------							
	Woodstown (C)	No					
	Unnamed soils (I)	No					
Ze: Zekiah loam-----------							
	Zekiah (C)	Yes	Flood Plain	2B3	Yes	No	No
	Unnamed soils (I)	Yes	Flood Plain	2B3	Yes	No	No

* There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are defined in the maps and the USDA-NRCS Technical Guide, Part II.

** See text for explanation of hydric criteria code.

APPENDIX B

List of Flora Species Known to Occur on APG

List of Flora Species Known to Occur on APG

Scientific Name	Common Name	Occurrence	Origin
Trees			
Acer palmatum	Japanese maple	Uncommon	Introduced
Acer platanoides	Norway maple	Common	Introduced
Acer negundo	Box elder	Scarce	Native
Acer rubrum	Red maple	Common	Native
Acer saccahrum	Sugar maple	Scarce	Native
Acer saccharinum	Silver maple	Common	Native
Aesculus octandra	Sweet buckeye	Scarce	Native
Ailanthus altissima	Tree of heaven	Uncommon	Introduced
Amelanchier arborea	Common shadbush	Uncommon	Native
Betula nigra	River birch	Uncommon	Native
Betula populifolia	Gray birch	Uncommon	Native
Carpinus caroliniana	Ironwood	Uncommon	Native
Carya cordiformis	Bitternut hickory	Common	Native
Carya glabra	Pignut hickory	Common	Native
Carya ovata	Shagbark hickory	Common	Native
Carya tomentosa	Mockernut hickory	Common	Native
Castanea dentata	American chestnut	Common	Native
Catalpa speciosa	Northern catalpa	Uncommon	Native
Cedrus atlantica	Altlantic cedar	Uncommon	Introduced
Celtis occidentalis	American hackberry	Uncommon	Native
Cercis canadensis	Eastern redbud	Uncommon	Native
Chamaecyperis thyoides	Atlantic white cedar	Uncommon	Native
Cornus florida	Flowering dogwood	Common	Native
Diospyros virginiana	Persimmon	Common	Native
Fagus grandifolia	American beech	Common	Native
Fagus sylvatica	Weeping beech	Uncommon	Introduced
Fraxinus americana	White ash	Uncommon	Native
Fraxinus pennsylvanica	Green ash	Common	Native
Ginkgo biloba	Maidenhair tree	Scarce	Introduced
Gleditsia triacanthos	Honey locust	Uncommon	Native
Gymnocladus dioicus	Kentucky coffeetree	Scarce	Native
Ilex aquifolium	English holly	Uncommon	Introduced
Ilex opaca	American holly	Common	Native
Juglans cinerea	Butternut	Uncommon	Native
Juglans nigra	Black walnut	Common	Native
Juniperus virginiana	Red cedar	Common	Native
Koelreuteria paniculata	Goldenrain tree	Uncommon	Introduced
Liquidambar styraciflua	Sweetgum	Common	Introduced
Liriodendron tulipifera	Tulip tree	Common	Native
Maclura pomifera	Osage orange	Common	Native
Magnolia acuminata	Cucumber tree	Scarce	Native
Magnolia tripetala	Umbrella tree	Scarce	Native
Malus sp.	Crabapple	Scarce	Native
Metasequoia glyptostroboides	Dawn redwood	Scarce	Introduced
Morus alba	White mulberry	Uncommon	Introduced

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Nyssa sylvatica	Black gum	Common	Native
Paulownia tomentosa	Princesstree	Common	Introduced
Picea abies	Norway spruce	Scarce	Introduced
Picea pungens	Blue spruce	Uncommon	Native
Pinus nigra	Austrian pine	Uncommon	Introduced
Pinus rigida	Pitch pine	Uncommon	Native
Pinus strobus	Eastern white pine	Common	Native
Pinus taeda	Loblolly pine	Uncommon	Native
Pinus virginiana	Virginia pine	Common	Native
Platanus occidentalis	American sycamore	Common	Native
Populus sp.	Cottonwood	Common	Native
Prunus avium	Sweet cherry	Uncommon	Introduced
Prunus cerasifera	Cherry plum	Uncommon	Introduced
Prunus serotina	Black cherry	Common	Native
Prunus serrulata	Japanese flowering cherry	Uncommon	Introduced
Pseudotsuga menziesii	Douglas fir	Uncommon	Native
Pyrus calleryana	Callery pear	Uncommon	Introduced
Pyrus communis	Common pear	Scarce	Introduced
Pyrus malus	Apple	Scarce	Introduced
Quercus alba	White oak	Common	Native
Quercus bicolor	Swamp white oak	Common	Native
Quercus cerris	European turkey oak	Uncommon	Introduced
Quercus coccinea	Scarlet oak	Common	Native
Quercus falcata	Southern red oak	Common	Native
Quercus michauxii	Swamp chestnut oak	Common	Native
Quercus palustris	Pin oak	Common	Native
Quercus phellos	Willow oak	Common	Native
Quercus prinus	Chestnut oak	Common	Native
Quercus rubra	Northern red oak	Common	Native
Quercus stellate	Post oak	Uncommon	Native
Quercus velutina	Black oak	Common	Native
Robinia pseudoacacia	Black locust	Common	Native
Salix x sepulcralis	Weeping willow	Uncommon	Native
Salix nigra	Black willow	Common	Native
Sassafras albidum	Sassafras	Common	Native
Styphnolobium japonicum	Japanese pagoda tree	Scarce	Introduced
Taxodium distichum	Bald cypress	Infrequent	Native
Thuja occidentalis	Arborvitae	Locally common	Native
Tilia europaea	European linden	Scarce	Introduced
Tsuga canadensis	Eastern hemlock	Infrequent	Native
Ulmus americana	American elm	Uncommon	Native
Vibernum prunifolium	Black haw	Uncommon	Native
Zanthoxylum clava-herculis	Hercules club	Scarce	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Shrubs and Woody Vines			
Amelanchier canadensis	Canadian serviceberry	Common	Native
Amorpha fruticosa	False indigo	Locally common	Native
Asimina triloba	Pawpaw	Uncommon	Native
Baccharis halimifolia	Groundsel tree	Locally common	Native
Berberis thunbergii	Japanese barberry	Common	Introduced
Callicarpa dichotoma	Purple beautyberry	Uncommon	Native
Campsis radicans	Trumpet creeper	Uncommon	Native
Clethra alnifolia	Sweet pepperbush	Common	Native
Cornus amomum	Silky dogwood	Uncommon	Native
Crataegus sp.	Hawthorn	Scarce	Native
Elaeagnus umbellate	Autumn olive	Common	Introduced
Gaylussacia baccata	Black huckleberry	Common	Native
Gaylussacia frondosa	Blue huckleberry	Common	Native
Hedera helix	English ivy	Uncommon	Introduced
Hypericum hypericoides	St. Andrew's cross	Uncommon	Native
Ilex verticullata	Common winterberry	Uncommon	Native
Kalmia latifolia	Mountain laurel	Uncommon	Native
Leucothoe racemosa	Fetterbush	Uncommon	Native
Ligustrum sp.	Privet	Common	Introduced
Lindera benzoin	Spicebush	Common	Native
Lonicera japonica	Japanese honeysuckle	Common	Introduced
Lonicera sp.	Honeysuckle	Common	Introduced
Lyonia ligustrina	Maleberry	Uncommon	Native
Magnolia virginiana	Sweetbay	Common	Native
Morella cerifera	Wax myrtle	Uncommon	Native
Morella sp.	Bayberry	Common	Native
Parthenocissus quinquefolia	Virginia creeper	Common	Native
Rhododendron sp.	Rhododendron	Scarce	Native
Rosa multiflora	Multiflora rose	Common	Introduced
Rosa palustris	Swamp rose	Uncommon	Native
Rubus flagellaris	Dewberry	Common	Native
Rubus phoenicolasius	Wineberry	Common	Introduced
Sambucus sp.	Elderberry	Common	Native
Smilax sp.	Greenbrier	Common	Native
Spiraea alba var. latifolia	White meadowsweet	Uncommon	Native
Spiraea tomentosa	Steeplebush	Uncommon	Native
Symphoricarpos orbiculatus	Coralberry	Uncommon	Native
Toxicodendron radicans	Eastern poison ivy	Common	Native
Vaccinium angustifolium	Early low blueberry	Common	Native
Vaccinium corymbosum	Highbush blueberry	Common	Native
Vaccinium stamineum	Deerberry	Common	Native
Viburnum acerifolium	Mapleleaf viburnum	Common	Native
Viburnum dentatum	Southern arrowood	Common	Native
Vitis sp.	Grape	Common	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Ferns and Fern Allies			
Athyrium filix-femina	Lady fern	Uncommon	Native
Dennstaedtia punctilobula	Eastern hayscented fern	Unknown	Native
Dryopteris marginalis	Mariginal woodfern	Unknown	Native
Onoclea sensibilis	Sensitive fern	Common	Native
Osmunda cinnamomea	Cinnamon fern	Common	Native
Osmunda claytoniana	Interrupted fern	Infrequent	Native
Osmunda regalis	Royal fern	Abundant	Native
Polystichum acrostichoides	Christmas fern	Unknown	Native
Selaginella apoda	Meadow spikemoss	Scarce	Native
Thelypteris noveboracensis	New York fern	Common	Native
Thelypteris palustris	Marsh fern	Unknown	Native
Woodsia obtusa	Blunt-lobed woodsia	Unknown	Native
Woodwardia areolata	Netted chain fern	Scarce	Native
Woodwardia virginica	Virginia chain fern	Unknown	Native
Herbs			
Abutilon theophrasti	Velvet leaf	Scarce	Introduced
Acalypha rhomboidea	Three-sided mercury	Unknown	Native
Acalypha virginica	Three-seeded mercury	Uncommon	Native
Achillea millefolium	Yarrow	Common	Native
Acnida cannabina	Water hemp	Common	Native
Agastache scrophulariifolia	Purple giant hyssop	Unknown	Native
Agrimonia sp.	Agrimony	Common	Native
Alisma sp.	Water plaintain	Scarce	Native
Allium vineale	Field garlic	Common	Introduced
Amaranthus retroflexus	Pigweed	Uncommon	Native
Ambrosia artemesiifolia	Common ragweed	Common	Native
Anagallis arvensis	Scarlet pimpernel	Common	Introduced
Antennaria plantaginifolia	Pussy toes	Uncommon	Native
Apios americana	Groundnut	Unknown	Native
Apocynum cannabinum	Indian hemp	Uncommon	Native
Arctium minus	Common burdock	Common	Native
Arisaema triphyllum	Jack-in-the-pulpit	Uncommon	Native
Ascelpias syriaca	Common milkweed	Common	Native
Ascelpias tuberosa	Butterfly weed	Common	Native
Ascelpias viridiflora	Green milkweed	Common	Native
Asparagus officinalis	Asparagus	Uncommon	Introduced
Aster novi-belgi	New York aster	Common	Native
Barbarea vulgaris	Garden yellowrocket	Common	Introduced
Belamcanda chinensis	Blackberry lilly	Common	Introduced
Bidens aristosa	Beggar Ticks	Common	Native
Bidens bidentoides	Delmarva beggarticks	Common	Native
Bidens coronate	Crowned beggarticks	Common	Native
Bidens discoidea	Small beggarticks	Common	Native
Bidens laevis	Larger bur marigold	Common	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Boehmeria cylindrical	False nettle	Common	Native
Botrychium virginianum	Rattlesnake fern	Unknown	Native
Calibrachoa parviflora	Seaside petunia	Unknown	Native
Callitriche sp.	Water starwort	Uncommon	Introduced
Capsella bursa-pastoris	Shepherds purse	Uncommon	Introduced
Cardamine bulbosa	Bulbous bittercress	Unknown	Native
Cardamine parviflora	Small-flowered bittercress	Unknown	Native
Carduus acanthoides	Thistle	Scarce	Native
Cassia nictitans	Wild sensitive plant	Common	Native
Centaurea biebersteinii	Spotted knapweed	Unknown	Introduced
Cerastium vulgatum	Mouse-ear chickweed	Common	Introduced
Ceratophyllum echinatum	Spineless hornwort	Unknown	Native
Chelone glabra	Turtlehead	Unknown	Native
Chenopodium sp.	Goosefoot	Uncommon	Introduced
Chimaphila maculate	Spotted wintergreen	Scarce	Native
Chrysanthemum leucanthemum	Ox-eye daisy	Common	Native
Cimicifuga racemosa	Black snakeroot	Common	Native
Cichorium intybus	Chicory	Common	Native
Circaea quadrisulcata	Enchanter’s nightshade	Common	Native
Cirsium arvense	Canada thistle	Uncommon	Introduced
Cirsium discolor	Field thistle	Uncommon	Native
Cirsium horridulum	Yellow thistle	Uncommon	Native
Cirsium muticum	Swamp thistle	Uncommon	Native
Cirsium vulgare	Bull thistle	Uncommon	Introduced
Collinsonia canadensis	Horsebalm	Uncommon	Native
Commelina communis	Asiatic dayflower	Infrequent	Introduced
Conyza canadensis	Horseweed	Common	Native
Daucus carota	Queen Anne’s lace	Abundant	Introduced
Decodon verticillatus	Water willow	Unknown	Native
Desmodium ciliare	Hairy small-leaf tick trefoil	Uncommon	Native
Desmodium cuspidatum	Large-bracted tick trefoil	Uncommon	Native
Desmodium paniculatum	Panicled tick trefoil	Uncommon	Native
Desmodium sessifolium	Sessile-leaf tick trefoil	Uncommon	Native
Desmodium sessilifolium	Sessile-leaf tick trefoil	Uncommon	Native
Dianthus armeria	Deptford Pink	Uncommon	Introduced
Diodia virginiana	Virginia buttonweed	Unknown	Native
Dioscorea villosa	Wild yam	Uncommon	Introduced
Duchesnea indica	Indian strawberry	Uncommon	Introduced
Epifagus virginiana	Beech-drops	Uncommon	Native
Epilobium coloratum	Willow herb	Uncommon	Native
Erechtites hieracifolia	Pilewort	Common	Native
Erigeron annuus	Daisy fleabane	Common	Native
Erigeron strigosus	Lesser daisy fleabane	Common	Native
Euphorbia sp.	Spurge	Common	Native
Eupatorium dubium	Joe-pye weed	Common	Native
Eupatorium hyssopifolium	Hyssop-leaved boneset	Unknown	Natve
Eupatorium rotundifolium	Round-leaved boneset	Unknown	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Eupatorium sp.	Boneset	Common	Native
Fragaria sp.	Strawberry	Uncommon	Native
Galearis spectabilis	Showy orchid	Unknown	Native
Galium aparine	Cleavers	Unknown	Native
Galium circaezans	Wild licorice	Unknown	Native
Galium mollugo	Wild madder	Common	Introduced
Galium palustre	Marsh bedstraw	Unknown	Native
Geranium macuatum	Wild geranium	Unknown	Native
Geranium robertianum	Herb robert	Unknown	Introduced
Gerardia purpurea	Gerardia	Uncommon	Native
Geum canadense	White avens	Uncommon	Native
Glecoma hederaces	Ground ivy	Common	Introduced
Gnaphilum purpurea	Purple Cudweed	Uncommon	Native
Goodyera pubescens	Downy rattlesnake plaintain	Unknown	Native
Hedeoma pulegiodes	Pennyroyal	Uncommon	Native
Hemerocallis fulva	Day lily	Common	Introduced
Heteranthera dubia	Water stargrass	Common	Native
Heteranthera reniformis	Mud plantain	Infrequent	Native
Hibiscus palustris	Swamp rose mallow	Uncommon	Native
Hieracium aurantiacum	Orange hawkweed	Uncommon	Introduced
Hieracium pratense	Field hawkweed	Uncommon	Introduced
Hieracium venosum	Rattlesnake weed	Uncommon	Native
Hottonia inflata	American featherfoil	Unknown	Native
Hydrilla verticillata	Hydrilla	Common	Introduced
Hydrocotyle ranunculoides	Floating marshpennywort	Scarce	Native
Hydrophyllum virginianum	Virginia waterleaf	Unknown	Native
Hypericum gentianoides	Orangegrass	Unknown	Native
Hypericum punctatum	St. John's-wort	Uncommon	Native
Hypoxis hirsute	Yellow stargrass	Unknown	Native
Impatiens capensis	Jewelweed	Common	Native
Ipomoea purpurea	Morning glory	Uncommon	Introduced
Iris prismatica	Slender blue iris	Unknown	Native
Iris pseudacorus	Yellow iris	Unknown	Introduced
Iris versicolor	Harlequin blueflag	Unknown	Native
Krigia sp.	Dwarf dandelion	Uncommon	Native
Lactuca sp.	Lettuce	Abundant	Native
Lamium purpureum	Red dead nettle	Uncommon	Introduced
Lemna minor	Common duckweed	Common	Native
Lemna triscula	Star duckweed	Unknown	Native
Lepidium campestre	Field peppergrass	Unknown	Introduced
Lepidium virgincum	Common peppergrass	Common	Native
Lespedeza capitata	Round-head bush clover	Common	Native
Lespedeza procumbens	Trailing bush clover	Common	Native
Lespedeza repens	Creeping bush clover	Common	Native
Lespedeza violacea	Violet bush clover	Common	Native
Lespedeza virginica	Slender bush clover	Common	Native
Lilaeopsis chinensis	Eastern grasswort	Unknown	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Linaria canadensis	Blue toadflax	Unknown	Native
Linaria vulgaris	Butter-and-eggs	Uncommon	Introduced
Linum virginianum	Wild yellow flax	Uncommon	Native
Listera australis	Southern twayblade	Unknown	Native
Lobelia cardinalis	Cardinal flower	Unknown	Native
Lobelia inflate	Indian tobacco	Scarce	Native
Lobelia puberula	Downy lobelia	Unknown	Native
Ludwigia palustris	False loosestrife	Locally common	Native
Lycopus americanus	Water horehound	Unknown	Native
Lycopus uniflorus	Northern bugleweed	Unknown	Native
Lysimachia hybrid	Lowland yellow loosestrife	Unknown	Native
Lysimachia nummularia	Creeping jenny	Unknown	Introduced
Lysmachia terrestris	Swamp candles	Unknown	Native
Medeola virginiana	Indian cucumber root	Unknown	Native
Medicago lupulina	Black medick	Common	Introduced
Melampyrum lineare	Cowwheat	Unknown	Native
Melilotus alba	White sweet clover	Common	Introduced
Mentha piperita	Peppermint	Unknown	Introduced
Mentha spicata	Spearmint	Uncommon	Introduced
Mikania scandens	Climbing hempweed	Scarce	Native
Mimulus ringens	Ringeon monkeyflower	Unknown	Native
Mitchella repens	Partridgeberry	Uncommon	Introduced
Mollugo verticillata	Carpet weed	Uncommon	Introduced
Monotropa uniflora	Indian pipe	Scarce	Native
Muriophyllum exalbescens	Water milfoil	Common	Native
Myriophyllum spicatum	Eurasian watermilfoil	Common	Introduced
Nuphar luteum	Yellow water lily	Uncommon	Native
Oenothera biennis	Evening primrose	Uncommon	Native
Oenothera fruticosa	Sundrops	Uncommon	Native
Ophioglossum vulgatum	Southern adderstongue	Unknown	Native
Ornithogalum umbellatum	Star-of-Bethlehem	Unknown	Introduced
Orontium aquaticum	Golden club	Unknown	Native
Osmorhiza claytonii	Clayton’s sweetroot	Unknown	Native
Oxalis stricta	Yellow wood sorrel	Common	Native
Oxalis violacea	Violet wood sorrel	Common	Native
Passiflora lutea	Passion flower	Scarce	Native
Pedicularis lanceolata	Swamp lousewort	Unknown	Native
Peltandra virginica	Arrow arum	Common	Native
Penstemon digitalis	White beardtongue	Unknown	Native
Penthorum sedoides	Ditch stonecrop	Unknown	Native
Perilla frutesceus	Beefsteak plant	Common	Introduced
Petunia parviflora	Ground cherry	Scarce	Native
Phytolacca americana	Pokeberry	Common	Native
Pilea pumila	Clearweed	Common	Native
Plantago aristata	Bracted plaintain	Unknown	Native
Plantago lanceolata	English plaintain	Common	Introduced
Plantago major	Common plaintain	Common	Introduced

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Plantathera lacera	Green fringed orchid	Scarce	Native
Podophyllum peltatum	Mayapple	Common	Native
Polygala sp.	Milkwort	Common	Native
Polygonum cuspidatum	Japanese knotweed	Common	Introduced
Polygonum hydropiper	Common smartweed	Common	Introduced
Polygonum hydropiperoides	Mild water pepper	Unknown	Native
Polygonum pennsylvanicum	Pink knotweed	Unknown	Native
Polygonum perfoliatum	Asiatic tearthumb	Common	Introduced
Polygonum persicaria	Lady’s thumb	Common	Introduced
Polygonum sagittatum	Arrow-leaved tearthumb	Common	Native
Pontederia cordata	Pickerelweed	Unknown	Native
Portulaca oleracea	Purslane	Uncommon	Native
Potamogeton foliosus	Leafy pondweed	Common	Native
Potamogeton perfoliatus	Claspingleaf pondweed	Common	Native
Potamogeton pusillus	Small pondweed	Common	Native
Potentilla canadensis	Dwarf cinquefoil	Unknown	Native
Potentilla norvegica	Rough cinquefoil	Unknown	Native
Potentilla simplex	Common cinquefoil	Common	Native
Proserpinaca palustris	Mermaid weed	Unknown	Native
Prunella vulgaris	Heal-all	Uncommon	Native
Pycnanthemum tenuifolium	Narrowleaf mountain mint	Uncommon	Native
Pycnanthemum virginianum	Virginia mountain mint	Uncommon	Native
Ranunculus abortivus	Small-flowered crowfeet	Unknown	Native
Ranunculus trichophyllus	White water buttercup	Unknown	Native
Rhexia mariana	Maryland meadow beauty	Unknown	Native
Rudbeckia hirta	Black-eyed susan	Common	Native
Rumex acetosella	Field sorrel	Common	Introduced
Rumex crispus	Curled dock	Common	Introduced
Sabatia angularis	Rose pink	Uncommon	Native
Sabatia stellaris	Marsh pink	Uncommon	Native
Sagittaria calycina	Hooded arrowhead	Common	Native
Sagittaria latifolia	Common arrowhead	Common	Native
Salvia lyrata	Lyreleaf sage	Unknown	Native
Samolus parviflorus	Water pimpernel	Unknown	Native
Saururus cernuus	Lizard tail	Uncommon	Native
Saxifraga virginiensis	Early saxifrage	Unknown	Native
Scrophularia marilandica	Carpenter’s square	Scarce	Native
Scutellaria galericulata	Marsh skullcap	Unknown	Native
Scutellaria lateriflora	Mad-dog skullcap	Unknown	Native
Senecio aureus	Golden ragwort	Unknown	Native
Silene antirrlina	Sleepy catchfly	Uncommon	Native
Sium suave	Water parsnip	Unknown	Native
Smilacina racemosa	False solomous seal	Uncommon	Native
Solanum americanum	Black nightshade	Uncommon	Native
Solanum carolinense	Horsenettle	Common	Native
Solanum dulcamara	Climbing nightshade	Common	Native
Solidago altissima	Tall goldenrod	Common	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Solidago graminifolia	Lance-leaved goldenrod	Common	Native
Solidago odora	Sweet goldenrod	Common	Native
Solidago rugosa	Rough-stem goldenrod	Common	Native
Solidago sempervirens	Seaside goldenrod	Common	Native
Spiranthes lacera var. gracilis	Northern slender lady tresses	Unknown	Native
Stellaria media	Common chickweed	Common	Introduced
Strophostyles helvola	Wild bean	Uncommon	Native
Stylosanthes biflora	Pencil flower	Scarce	Native
Symplocarpus foetidus	Skunk cabbage	Infrequent	Native
Taraxacum officinale	Common dandelion	Common	Introduced
Teucrium canadense	American germander	Uncommon	Native
Tipularia discolor	Crippled cranefly	Unknown	Native
Toyara virginiana	Jump seed	Common	Native
Triadenum virginicum	Marsh St. Johnswort	Unknown	Native
Trichostema dichotomum	Blue curls	Unknown	Native
Trifolium dubium	Least hop clover	Common	Introduced
Trifolium repens	White clover	Common	Introduced
Typha angustifolia	Narrow-leaved cattail	Abundant	Native
Typha latifolia	Common cattail	Abundant	Native
Urtica gracilenta	Stinging nettle	Unknown	Native
Utricularia gibba	Humped bladderwort	Unknown	Native
Uvularia sessilifolia	Bellwort	Uncommon	Native
Vallisneria americana	Wild celery	Common	Native
Verbascum sp.	Mullein	Uncommon	Native
Verbena hastate	Blue vervain	Uncommon	Native
Verbesina sp.	Crownbeard	Uncommon	Native
Vernonia noveboracensis	New York Ironweed	Common	Native
Veronica arvensis	Corn speedwell	Common	Introduced
Veronica officinalis	Common gypsyweed	Common	Introduced
Veronica persica	Persian speedwell	Common	Introduced
Veronicastrum virginicum	Culver’s root	Unknown	Native
Vicia americana	American vetch	Scarce	Native
Vicia angustifolia	Narrowleaf vetch	Scarce	Introduced
Vicia cracca	Cow vetch	Scarce	Introduced
Viola affinis	Le Conte’s violet	Unknown	Native
Viola cucullata	Marsh blue violet	Unknown	Native
Viola papilionacea	Common violet	Common	Native
Wolffia papulifera	Brazilian watermeal	Scarce	Native
Xanthium sp.	Cocklebur	Uncommon	Native
Zannichellia palustris	Horned pondweed	Unknown	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Grasses			
Agropyron repens	Quack grass	Uncommon	Introduced
Agrostis alba	Red top	Common	Native
Agrostis hyemalis	Ticklegrass	Unknown	Native
Agrostis perennans	Upland bentgrass	Unknown	Native
Ammophila breviligulata	Beach grass	Uncommon	Native
Andropogon scoparius	Broom	Uncommon	Native
Andropogon virginicus	Broom Sedge	Common	Native
Anthoxanthum odoratum	Sweet vernal grass	Common	Introduced
Arthraxon hispidus	Makino	Abundant	Introduced
Bromus ciliatus	Brome grass	Unknown	Native
Bromus inermis	Smooth brome	Unknown	Natve
Bromus japonicus	Japanese brome	Common	Introduced
Cinna arundinacea	Sweet woodreed	Abundant	Native
Cynodon dactylon	Bermuda grass	Infrequent	Introduced
Dactylis glomerata	Orchard grass	Unknown	Introduced
Danthonia spicata	Poverty grass	Common	Native
Digitaria villosa	Crab grass	Common	Introduced
Distichlis spicata	Inland saltgrass	Unknown	Native
Echinochloa crusqualli	Barnyard grass	Common	Introduced
Eleusine indica	Goose grass	Infrequent	Introduced
Elymus villosus	Hairy wild rye	Common	Native
Eragrostis spectabilis	Purple love grass	Uncommon	Native
Festuca rubra	Red fescue	Common	Introduced
Glyceria septentrionalis	Eastern manna grass	Infrequent	Native
Glyceria striata	Fowl meadow grass	Unknown	Native
Holcus lanatus	Velvet grass	Common	Introduced
Leersia oryzoides	Rice cut grass	Unknown	Native
Leersia virginica	White cut grass	Common	Native
Lolium perenne	Perennial rye grass	Uncommon	Introduced
Microstegium vimineum	Japanese stilt grass	Common	Introduced
Muhlenbergia sp.	Muhly	Infrequent	Native
Panicum sp.	Panic grass	Common	Native
Panicum agrostoides	Redtop panicum	Unknown	Native
Panicum dichotomiflorum	Fall panicgrass	Unknown	Native
Panicum virgatum	Switchgrass	Unknown	Native
Paspalum leave	Smooth pasdalum	Common	Native
Phleum pratense	Timothy	Uncommon	Introduced
Phragmites australis	Common reed	Abundant	Native
Poa annua	Low speargrass	Infrequent	Introduced
Poa compressa	Canada bluegrass	Infrequent	Introduced
Poa pratensis	Kentucky bluegrass	Common	Native
Setaria viridis	Green foxtail	Common	Introduced
Sertaria geniculate	Knotroot bristlegrass	Infrequent	Introduced
Spartina cynosuroides	Big cordgrass	Common	Native
Spartina patens	Salt-meadow cord grass	Uncommon	Native

List of Flora Species Known to Occur on APG (continued)

Scientific Name	Common Name	Occurrence	Origin
Sporobolus vaginiflorus	Poverty grass	Unknown	Native
Triodia flava	Purple top	Uncommon	Native
Tripsacum dactyloides	Eastern gamagrass	Common	Native
Uniola laxa	Spike grass	Uncommon	Native
<u>Sedges</u>			
Carex crinita	Fringed sedge	Abundant	Native
Carex lanuginose	Wooly sedge	Unknown	Native
Carex laxiflora	Looseflower sedge	Unknown	Native
Carex lurida	Sallow sedge	Abundant	Native
Carex radiate	Eastern star sedge	Unknown	Native
Carex scoparia	Broom sedge	Unknown	Native
Carex stricta	Uptight sedge	Unknown	Native
Carex vulpinoidea	Foxtail sedge	Common	Native
Cyperus ovularis	Sedge	Common	Native
Cyperus strigosus	Straw-colored flat sedge	Common	Native
Eleocharis acicularis	Spike rush	Common	Native
Eleocharis obtusa	Spike rush	Common	Native
Eleocharis rostellata	Beaked spikerush	Unknown	Native
Eleocharis tenuis	Doghair	Infrequent	Native
Scirpus americanus	Three-square	Common	Native
Scirpus cyperinus	Wool grass	Unknown	Native
Scirpus olneyi	Olney bulrush	Uncommon	Native
Scirpus validus	Great bulrush	Common	Native
<u>Rushes</u>			
Juncus bufonius	Toad rush	Unknown	Native
Juncus canadensis	Canadian rush	Unknown	Native
Juncus effusus	Soft rush	Infrequent	Native
Juncus tenuis	Path rush	Common	Native
Juncus torreyi	Torrey’s rush	Unknown	Native

Survey for Rare, Threatened and Endangered Vascular Plants of the Aberdeen Proving Grounds

Harford and Baltimore Counties, Maryland

Field Seasons 1998 & 1999

Submitted by

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to

U.S. Fish and Wildlife Service
Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, Maryland 21401
&
The Aberdeen Proving Grounds
Department of Safety Health and the Environment
Aberdeen, Maryland 21005-5001

TABLE OF CONTENTS

ACKNOWLEDGMENTS

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SITE ORIENTATION AND LOGISTICS
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Joe Miller, Environmental Protection Assistant
Jim Pottie, Fish and Wildlife Biologist, Aberdeen Proving Ground
Mike Weldon, ORISE associate to Army Environmental Center, SAV Study
Julie Bortz, , ORISE associate to Army Environmental Center, SAV Study
Mike McCarter, Engineering Technician

ANNOTATION OF BOTANICAL SPECIMENS AT THE BEBB HERBARIUM
Forrest Johnson, Assistant Curator, Bebb Herbarium

ACCESSING MARYLAND HERITAGE DATABASE FILES
Lynn Davidson, Database Manager, Maryland Department of Natural Resources

CONFIRMATION OF BOTANICAL SPECIMENS
Mark Strong (US)
Bidens coronata
Carex typhina
Eleocharis tenuis var. *pseudoptera*
Hedyotis uniflora
Juncus torreyi
Lathyrus palustris
Lycopodiella caroliniana
Lysimachia hybrida
Pycnanthemum virginianum
Rhynchospora globularis var. *recognita*
Scirpus pendulus

Anton Reznicek (MICH)
Carex lupulina
Carex straminea
Eleocharis rostellata

Larry Davenport (Samford University)
Lemna perpusilla
Spirodela punctata
Wolffia papulifera

Robert Haynes (UNA)
Sagittaria spatulata
Sagittaria subulata

Charles Sheviak (NYS)
Spiranthes cernua

INTRODUCTION

THE STUDY SITE

The Aberdeen Proving Grounds (APG) occupy 79,284 acres (31,714 hectares) in northeastern Maryland along the shore of the Chesapeake Bay in Harford and Baltimore Counties. The Harford County portion of APG is divided by the Bush River into the Edgewood area to the south and the larger Aberdeen area to the north. Baltimore County contains only a small portion of APG, comprised of Carroll Island and Graces Quarters peninsula extending out to Battery Point. Since much of APG lie below 7.5 m elevation, numerous wetlands occur throughout the property. Upland areas are comprised of mowed lawns, young deciduous woodlands and some large areas of meadow that are anthropogenically managed to various degrees.

SOILS

Hunt (1974) places APG within the embayed section of the Low-lying Atlantic Coastal Plain Physiographic Province. The soils of Harford County are from Upper Teriary formation (Hunt 1974) and are dominated by silt loam, sandy loam, and mucky peat of alluvial, eolian, and fluvio-marine parent material (Ranson and Levan 1998). For more information concerning the soils of APG refer to the discussion of soil types associated with rare plant populations on page 121.

CLIMATE

The APG fall within the Temperate Continental climate zone delineated by Trewartha and Horn (1980). Between 1961 and 1990, Aberdeen recorded a mean annual temperature of 55.2 °F (12 °C), with and average annual high temperature of 65.1 °F (18 °C) and an average annual low temperature of 45.3 °F (7 °C). The month of July produces the warmest monthly average temperature of 82.6 °F (28 °C) with an average of 11 days reaching 90 °F (32 °C). Along the shores of the Chesapake Bay, 15 to 25 days per year will reach 90 °F. The month of January produces the lowest average temperature of 23.9 °F (-4 °C) and the highest average number of days falling below freezing. An average of at least 98 days per year fall below freezing. The city of Baltimore located 16 km south of APG recorded an extreme high temperature between 1951 and 1980 of 105 °F (40.5 °C) in August and a record low temperature of -7 °F (-21.5 °C) in January (Ruffner 1985, www.weatherpost.com/longterm/historical/data/aberdeen_md.htm 1999).

Aberdeen receives an average of 43.42 inches (110.2 cm) of precipitation per year. The wettest month is August which receives an average of 4.43 inches (11.2 cm) of precipitation. February is the driest month with an average of 2.70 inches (6.8 cm) of precipitation. The maximum monthly precipitation recorded between 1951 and 1980 in

Baltimore was 18.35 inches (46.6 cm) in August. The relative humidity averages about 60% from February - April and 75% from August - October. The month of October is the only month which recorded no precipitation between 1951 and 1980. Average annual snowfall is 10 to 25 inches (25.4 to 63.5 cm) occurring over 10 to 20 days per year. (Ruffner 1985, Rumney 1968, www.weatherpost.com/longterm/historical/data/aberdeen_md.htm 1999).

The average annual wind speed is from the west at 9.3 mph (15 kph). The windiest month is March which averages 11.0 mph (17.7 kph). The sunniest month is July which receives 65% of the possible sunshine. The least amount of sunshine is received in December. There is an average of 109 clear days, 106 partly cloudy days and 150 cloudy days per year. Thunderstorms occur an average of 28 days per year and heavy fog an average of 27 days. The average frost penetration is approximately 10 inches (25.4 cm) along the coast of Maryland. (Ruffner 1985, Rumney 1968, www.weatherpost.com/longterm/historical/data/aberdeen_md.htm 1999).

METHODS and RESULTS

Site surveys were conducted an average of twice monthly from April through October, 1998 and 1999 to locate occurrences of state or federal endangered or threatened vascular plant taxa. A voucher specimen was collected for each rare species located and the specimens were deposited at the Smithsonian Institution's United States National Herbarium (US) and some duplicates were distributed to MICH, BBG and UNA. The location of each rare plant population that was discovered was marked on a copy of the topographic quadrangles for the APG.

These searches resulted in the discovery of 61 vascular plant species from 44 genera in 32 families that are listed as rare, threatened or endangered by the Maryland Natural Heritage Program (1994) and the first Maryland record of *Spirodela punctata* (dotted duckweed). No plant taxa with federal status were found, although two taxa (*Bidens bidentoides* and *Juglans cinerea*) are under review for federal listing (Maryland Natural Heritage Program 1994). Twelve species were discovered with state endangered or extirpated status and two species with state threatened status, as established in Maryland's Nongame and Endangered Species Conservation Act and the Threatened and Endangered Species Regulations of the Maryland Department of Natural Resources (Code of Maryland Regulations 08.03.08). Additionally, 12 species ranked as highly state rare or state rare were found. The additional 38 species are watch listed in the State of Maryland (Maryland Natural Heritage Program 1994). Fourty-one taxa that are not listed as state rare but were previously unrecorded from the APG were also vouchered. All nomenclature in this report follows Gleason and Cronquist (1991) except for *Eleocharis engelmannii* Steud which follows Kartesz and Kartesz (1980) and the Maryland Natural Heritage Program 1994. Herbarium acronyms follow Holmgren et al. (1990).

Of the 62 rare species collected, 42 were associated with wetland habitats and 20 were found on dry to mesic soils. Carroll Island in Baltimore County and Spesutie Island in Harford County collectively contained populations of 32.3% of the rare species reported. Carroll Island supports 11 rare plant species while Spesutie Island is known to harbor populations of 9 rare species. One taxon (*Scutellaria galericulata*) listed as highly state rare was located on both islands. The Harford County portion of APG contained populations of 47 rare species, the Baltimore County portion possessed 7 rare species and 8 rare species were found in both counties.

MARYLAND NATURAL HERITAGE RANK AND STATUS CATEGORIES
[Maryland Natural Heritage Program (1994)]

EXPLANATION OF GLOBAL ELEMENT RANKS

G3 Rare and local throughout its global range or locally abundant throughout a restricted range or vulnerable to extinction by other intrinsic factors.

G4 Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally, though it may be rare in parts of its range, especially at the periphery.

EXPLANTION OF STATE ELEMENT RANKS

SH Historically known from Maryland, but not verified in the past 20 years, yet suspected to still be extant.

S1 Critically imperiled in Maryland because of extreme rarity (generally 5 or fewer extant populations known in the State). Equivalent to being ranked as Highly State Rare.

S2 Imperiled in Maryland because of rarity (generally 6 to 20 estimated occurrences in the State). Equivalent to being ranked as State Rare.

S3 Rare or uncommon in Maryland (generally 21 - 100 estimated occurrences in the State). Equivalent to being ranked as Watch List.

S3.1 A Watch List taxa that is actively tracked by the Natural Heritage Program because of the global significance of Maryland occurrences.

S4 Apparently secure in Maryland, although it may be restricted to only a portion of the State, with typically more than 100 occurrences statewide.

RANK QUALIFIERS

A range of ranks, e.g. S2S3 or G4G5, is assigned to a taxon if available information is insufficient to assign a single numerical rank.

FEDERAL LEGAL STATUS

The status of a taxon as determined by the U.S. Fish and Wildlife Service's Office of Endangered Species, in accordance with the Endangered Species Act, (modified from 50 CRF 17).

C2 Candidate taxa selected by the U.S. Fish and Wildlife Service as possibly appropriate for listing as endangered or threatened, but for which conclusive data on biological vulnerability and threats are not currently available to support proposed rules.

STATE LEGAL STATUS

The legal statuses and definitions established in Maryland's Nongame and Endangered Species Conservation Act and the Threatened and Endangered Species Regulations (COMAR 08.03.08).

X Endangered Extirpated; a species that was once a viable component of the flora, but for which no naturally occurring populations are known to exist in the State.

E Endangered; a species whose continued existence as a viable component of the State's flora is determined to be in jeopardy.

T Threatened; a species of flora or fauna which appears likely, within the foreseeable future, to become endangered in the State.

N The species has no state status.

Rare, Threatened and Endangered Vascular Plants of the Aberdeen Proving Grounds
Harford and Baltimore Counties, Maryland (listed by family)
(TABLE I)

Collection Number and County	State Rank	State Status	Global Rank/ Federal Status	Family	Genus	Species	Author	Variety	Variety Author	Common Name
981002.1 HA	S2	N	G5	Alismataceae	Sagittaria	spatulata	(J. G. Smith) Buchenau			Tidal Sagittaria
990710.2 HA	S3	N	G4	Alismataceae	Sagittaria	subulata	(L.) Buchenau			Hudson Sagittaria
980529.4 HA	S3	N	G5	Apiaceae	Hydrocotyle	ranunculoides	L. f.			Buttercup-pennywort
980724.2 BA	S3	N	G5	Apiaceae	Hydrocotyle	verticillata	Thunb.			Whorled Pennywort
990612.2 HA	SH	X	G?	Apocynaceae	Apocynum	sibiricum	Jacq.			Clasping Dogbane
980807.1 HA	S3	N	G5	Asclepiadaceae	Ampelamus	albidus	(Nutt.) Britton			Sandvine
980612.1 HA	S3	N	G4G5	Asclepiadaceae	Asclepias	purpurascens	L.			Purple Milkweed
980904.1 HA	S3.1	N	G3/C2	Asteraceae	Bidens	bidentoides	(Nutt.) Britton			Southern Estuarine Beggar-ticks
980918.2 BA	S2S3	N	G5	Asteraceae	Bidens	coronata	(L.) Britton			Northern Tickseed Sunflower
990911.5 HA	S2S3	N	G5	Asteraceae	Bidens	coronata	(L.) Britton			Northern Tickseed Sunflower
980904.2 HA	S2S3	N	G5	Asteraceae	Bidens	discoidea	(T. & G.) Britton			Few-bracted Beggar-ticks
990612.1 BA	S3	N	G5	Asteraceae	Cirsium	horridulum	Michx.			Yellow Thistle
980821.2 HA	S3	N	G5	Asteraceae	Cirsium	muticum	Michx.			Swamp-Thistle
980724.9 HA	S3	N	G5	Asteraceae	Helenium	flexuosum	Raf.			Southern Sneezeweed
980529.1 HA	S3	N	G5	Asteraceae	Senecio	anonymus	A. Wood			Appalachian Groundsel
990626.3 HA	S1	T	G5	Boraginaceae	Myosotis	macrosperma	Engelm.			Big-seed Forget-me-not
990508.2 HA	S3	N	G5	Boraginaceae	Myosotis	verna	Nutt.			Spring Forget-me-not
980720.4 HA	S1	N	G5	Caesalpiniaceae	Gymnocladus	dioica	(L.) K. Koch			Kentucky Coffee-tree
980515.7 HA	S1	E	G4G5	Ceratophyllaceae	Ceratophyllum	echinatum	A. Gray			Hornwort
980720.1 HA	S3	N	G5	Cuscutaceae	Cuscuta	pentagona	Engelm.			Field-dodder
990612.4 HA	S3	N	G5	Cyperaceae	Carex	atlantica	L. Bailey	capillaceae	(L. Bailey) Cronq.	Eastern Sedge
980515.1 HA	S3	N	G5	Cyperaceae	Carex	canescens	L.			Canescent Sedge
980529.8 HA	S3	N	G5	Cyperaceae	Carex	complanata	Torr. & Hook			Flattened Sedge
980612.2 HA	S3	N	G4	Cyperaceae	Carex	grayi	Carey			Gray's Sedge
980529.5 HA	S1	E	G4	Cyperaceae	Carex	radiata	(Wahlenb.) Small			Radiate Sedge
980417.1 HA	S3	N	G4	Cyperaceae	Carex	seorsa	Howe.			Separated Sedge
980515.4 HA	S3	N	G5	Cyperaceae	Carex	straminea	Willd.			Straw-colored Sedge
990626.1 HA	S1	N	G5	Cyperaceae	Carex	typhina	Michx.			Cat-tail Sedge
980724.2 BA	S3	N	G5	Cyperaceae	Cladium	mariscoides	(Muhl) Torr.			Twig-rush
990724.5 HA	S3	N	G5	Cyperaceae	Cladium	mariscoides	(Muhl) Torr.			Twig-rush
980720.3 HA	S3	N	G5	Cyperaceae	Cyperus	lancastriensis	Porter			Lancaster's Sedge
990626.5 HA	?	?	?	Cyperaceae	Eleocharis	tenuis	(Willd.) Schultes	pseudoptera	(Weath.) Svenson	A Spikerush
980720.2 HA	S3	N	G5	Cyperaceae	Eleocharis	engelmannii	Steud.			Engelmann's Spikerush
980724.19 BA	S3	N	G5	Cyperaceae	Eleocharis	flavescens	(Poiret) Urban	olivacea	(Torr.) Gleason	Olive-brown Spikerush
990807.6 HA	S3	N	G5	Cyperaceae	Eleocharis	flavescens	(Poiret) Urban	olivacea	(Torr.) Gleason	Olive-brown Spikerush
980724.18 BA	S1	T	G5	Cyperaceae	Eleocharis	rostellata	(Torr.) Torr.			Small-beaked Spikerush
990724.4 HA	S1	E	G5	Cyperaceae	Rhynchospora	globularis	(Chapman) Small	recognita	Gale	Globular Beak-rush
980720.7 BA	S3	N	G5	Cyperaceae	Scirpus	pendulus	Muhl.			Drooping Bulrush

Collection Number and County	State Rank	State Status	Global Rank/ Federal Status	Family	Genus	Species	Author	Variety	Variety Author	Common Name
990724.3 HA	S3	N	G5	Cyperaceae	Scirpus	pendulus	Muhl.			Drooping Bulrush
980807.8 HA	S3	N	G5	Eriocaulaceae	Commelina	virginica	L.			Virginia Dayflower
980807.2 HA	S1	X	G5	Fabaceae	Lathyrus	palustris	L.			Marsh Wild Pea
990522.1 HA	S2S3	N	G4	Fagaceae	Castanea	dentata	(Marshall) Borkh.			American Chestnut
980724.15 BA	S3	N	G5	Gentianaceae	Sabatia	dodecandra	(L.) BSP.			Perennial Sea-pink
990807.4 HA	S3	N	G5	Gentianaceae	Sabatia	dodecandra	(L.) BSP.			Perennial Sea-pink
990807.2 HA	S1	E	G4G5	Iridaceae	Iris	prismatica	Pursh.			Slender Blue Flag
980724.13 BA	S1	E	G4G5	Iridaceae	Iris	prismatica	Pursh.			Slender Blue Flag
980515.2 HA	S3	N	G4	Isoetaceae	Isoetes	riparia	Engelm.			Riverbank-quillwort
980821.4 HA	S2S3	N	G3/C2	Juglandaceae	Juglans	cinerea	L.			Butternut
980724.1 BA	S1	E	G5	Juncaceae	Juncus	torreyi	Cov.			Torrey's Rush
980807.4 HA	S2	N	G5	Lamiaceae	Pycnanthemum	virginianum	(L.) Durand & B.D. Jackson			Virginia Mountain Mint
980807.7 HA	S1	N	G5	Lamiaceae	Scutellaria	galericulata	L.			Marsh-skullcap
980724.21 BA	S1	N	G5	Lamiaceae	Scutellaria	galericulata	L.			Marsh-skullcap
980529.7 HA	S3	N	G5	Lemnaceae	Lemna	perpusilla	Torr.			Duckweed
990626.4 HA	S?	SR	G?	Lemnaceae	Spirodela	punctata	(G. Meyer) C. Thompson			Lesser Spirodela
980529.6 HA	S2	N	G4	Lemnaceae	Wolffia	papulifera	C. Thompson			Water-meal
980724.5 HA	S3	N	G5	Lentibulariaceae	Utricularia	gibba	L.			Creeping Bladderwort
990911.7 HA	SH	X	G5	Lycopodiaceae	Lycopodium	carolinianum	L.			Slender Clubmoss
980724.1 HA	S3S4	N	G5	Lythraceae	Rotala	ramosior	(L.) Koehne			Tooth-cup
980722.2 BA	S3	N	G5	Najadaceae	Najas	guadelupensis	(Sprengel) Magnus			Southern Water-nymph
990925.1 HA	S3	N	G5	Passifloraceae	Passiflora	lutea	L.			Yellow Passion-flower
980515.6 HA	S3	N	G5	Poaceae	Glyceria	septentrionalis	A. Hitchc.			Eastern Mannagrass
980724.4 HA	S1	E	G5	Potamogetonaceae	Potamogeton	foliosus	Raf.			Leafy Pondweed
980722.1 BA	S2	N	G5	Potamogetonaceae	Potamogeton	perfoliatus	L.			Redhead-grass
980722.3 BA	S1	N	G5	Potamogetonaceae	Potamogeton	pusillus	L.			Slender Pondweed
980529.2 HA	S1	E	G3G4	Primulaceae	Hottonia	inflata	Elliott			Featherfoil
980724.6 HA	S1	E	G5	Primulaceae	Lysimachia	hybrida	Michx.			Mississippi-valley Loosestrife
980408.1 BA	S3	N	G5	Ranunculaceae	Ranunculus	pusillus	Poiret			Low Spearwort
980529.3 HA	S3	N	G5	Ranunculaceae	Ranunculus	pusillus	Poiret			Low Spearwort
990911.1 HA	S2	N	G5	Rubiaceae	Hedyotis	uniflora	(L.) Lam.			Clustered Bluets
980904.3 HA	S1	E	G5	Scrophulariaceae	Pedicularis	lanceolata	Michx.			Swamp-lousewort
990911.2 HA	S2	N	G5	Xyridaceae	Xyris	difformis	Chapman			Variable Yellow-eyed Grass

HA = Harford County
BA = Baltimore County

Rare, Threatened and Endangered Vascular Plants of the Aberdeen Proving Grounds
Harford and Baltimore Counties, Maryland (listed by genus and species)
(TABLE II)

Collection Number and County	State Rank	State Status	Global Rank/ Federal Status	Family	Genus	Species	Author	Variety	Variety Author	Common Name
980807.1 HA	S3	N	G5	Asclepiadaceae	Ampelamus	albidus	(Nutt.) Britton			Sandvine
990612.2 HA	SH	X	G?	Apocynaceae	Apocynum	sibiricum	Jacq.			Clasping Dogbane
980612.1 HA	S3	N	G4G5	Asclepiadaceae	Asclepias	purpurascens	L.			Purple Milkweed
980904.1 HA	S3.1	N	G3/C2	Asteraceae	Bidens	bidentoides	(Nutt.) Britton			Southern Estuarine Beggar-ticks
980918.2 BA	S2S3	N	G5	Asteraceae	Bidens	coronata	(L.) Britton			Northern Tickseed Sunflower
990911.5 HA	S2S3	N	G5	Asteraceae	Bidens	coronata	(L.) Britton			Northern Tickseed Sunflower
980904.2 HA	S2S3	N	G5	Asteraceae	Bidens	discoidea	(T. & G.) Britton			Few-bracted Beggar-ticks
990612.4 HA	S3	N	G5	Cyperaceae	Carex	atlantica	L. Bailey	capillaceae	(L. Bailey) Cronq.	Eastern Sedge
980515.1 HA	S3	N	G5	Cyperaceae	Carex	canescens	L.			Canescent Sedge
980529.8 HA	S3	N	G5	Cyperaceae	Carex	complanata	Torr. & Hook			Flattened Sedge
980612.2 HA	S3	N	G4	Cyperaceae	Carex	grayi	Carey			Gray's Sedge
980529.5 HA	S1	E	G4	Cyperaceae	Carex	radiata	(Wahlenb.) Small			Radiate Sedge
980417.1 HA	S3	N	G4	Cyperaceae	Carex	seorsa	Howe.			Separated Sedge
980515.4 HA	S3	N	G5	Cyperaceae	Carex	straminea	Willd.			Straw-colored Sedge
990626.1 HA	S1	N	G5	Cyperaceae	Carex	typhina	Michx.			Cat-tail Sedge
990522.1 HA	S2S3	N	G4	Fagaceae	Castanea	dentata	(Marshall) Borkh.			American Chestnut
980515.7 HA	S1	E	G4G5	Ceratophyllaceae	Ceratophyllum	echinatum	A. Gray			Hornwort
990612.1 BA	S3	N	G5	Asteraceae	Cirsium	horridulum	Michx.			Yellow Thistle
980821.2 HA	S3	N	G5	Asteraceae	Cirsium	muticum	Michx.			Swamp-Thistle
980724.2 BA	S3	N	G5	Cyperaceae	Cladium	mariscoides	(Muhl) Torr.			Twig-rush
990724.5 HA	S3	N	G5	Cyperaceae	Cladium	mariscoides	(Muhl) Torr.			Twig-rush
980807.8 HA	S3	N	G5	Eriocaulaceae	Commelina	virginica	L.			Virginia Dayflower
980720.1 HA	S3	N	G5	Cuscutaceae	Cuscuta	pentagona	Engelm.			Field-dodder
980720.3 HA	S3	N	G5	Cyperaceae	Cyperus	lancastriensis	Porter			Lancaster's Sedge
980720.2 HA	S3	N	G5	Cyperaceae	Eleocharis	engelmannii	Steud.			Engelmann's Spikerush
980724.19 BA	S3	N	G5	Cyperaceae	Eleocharis	flavescens	(Poiret) Urban	olivacea	(Torr.) Gleason	Olive-brown Spikerush
990807.6 HA	S3	N	G5	Cyperaceae	Eleocharis	flavescens	(Poiret) Urban	olivacea	(Torr.) Gleason	Olive-brown Spikerush
980724.18 BA	S1	T	G5	Cyperaceae	Eleocharis	rostellata	(Torr.) Torr.			Small-beaked Spikerush
990626.5 HA	?	?	?	Cyperaceae	Eleocharis	tenuis	(Willd.) Schultes	pseudoptera	(Weath.) Svenson	A Spikerush
980515.6 HA	S3	N	G5	Poaceae	Glyceria	septentrionalis	A. Hitchc.			Eastern Mannagrass
980720.4 HA	S1	N	G5	Caesalpiniaceae	Gymnocladus	dioica	(L.) K. Koch			Kentucky Coffee-tree
990911.1 HA	S2	N	G5	Rubiaceae	Hedyotis	uniflora	(L.) Lam.			Clustered Bluets
980724.9 HA	S3	N	G5	Asteraceae	Helenium	flexuosum	Raf.			Southern Sneezeweed
980529.2 HA	S1	E	G3G4	Primulaceae	Hottonia	inflata	Elliott			Featherfoil
980529.4 HA	S3	N	G5	Apiaceae	Hydrocotyle	ranunculoides	L. f.			Buttercup-pennywort
980724.2 BA	S3	N	G5	Apiaceae	Hydrocotyle	verticillata	Thunb.			Whorled Pennywort
990807.2 HA	S1	E	G4G5	Iridaceae	Iris	prismatica	Pursh.			Slender Blue Flag
980724.13 BA	S1	E	G4G5	Iridaceae	Iris	prismatica	Pursh.			Slender Blue Flag

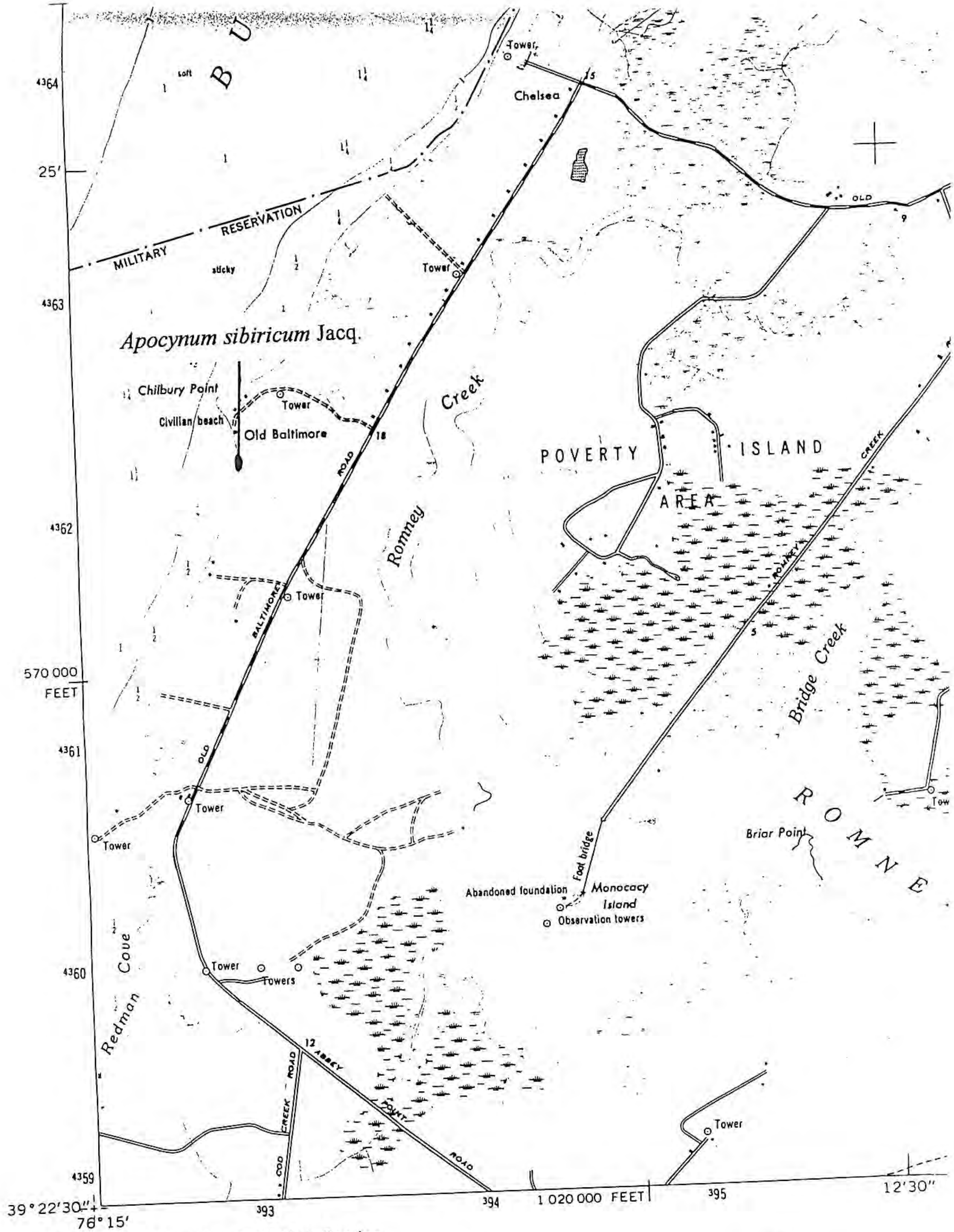
Collection Number and County	State Rank	State Status	Global Rank/ Federal Status	Family	Genus	Species	Author	Variety	Variety Author	Common Name
980515.2 HA	S3	N	G4	Isoetaceae	Isoetes	riparia	Engelm.			Riverbank-quillwort
980821.4 HA	S2S3	N	G3/C2	Juglandaceae	Juglans	cinerea	L.			Butternut
980724.1 BA	S1	E	G5	Juncaceae	Juncus	torreyi	Cov.			Torrey's Rush
980807.2 HA	S1	X	G5	Fabaceae	Lathyrus	palustris	L.			Marsh Wild Pea
980529.7 HA	S3	N	G5	Lemnaceae	Lemna	perpusilla	Torr.			Duckweed
990911.7 HA	SH	X	G5	Lycopodiaceae	Lycopodium	carolinianum	L.			Slender Clubmoss
980724.6 HA	S1	E	G5	Primulaceae	Lysimachia	hybrida	Michx.			Mississippi-valley Loosestrife
990626.3 HA	S1	T	G5	Boraginaceae	Myosotis	macrosperma	Engelm.			Big-seed Forget-me-not
990508.2 HA	S3	N	G5	Boraginaceae	Myosotis	verna	Nutt.			Spring Forget-me-not
980722.2 BA	S3	N	G5	Najadaceae	Najas	guadelupensis	(Sprengel) Magnus			Southern Water-nymph
990925.1 HA	S3	N	G5	Passifloraceae	Passiflora	lutea	L.			Yellow Passion-flower
980904.3 HA	S1	E	G5	Scrophulariaceae	Pedicularis	lanceolata	Michx.			Swamp-lousewort
980724.4 HA	S1	E	G5	Potamogetonaceae	Potamogeton	foliosus	Raf.			Leafy Pondweed
980722.1 BA	S2	N	G5	Potamogetonaceae	Potamogeton	perfoliatus	L.			Redhead-grass
980722.3 BA	S1	N	G5	Potamogetonaceae	Potamogeton	pusillus	L.			Slender Pondweed
980807.4 HA	S2	N	G5	Lamiaceae	Pycnanthemum	virginianum	(L.) Durand & B.D. Jackson			Virginia Mountain Mint
980408.1 BA	S3	N	G5	Ranunculaceae	Ranunculus	pusillus	Poiret			Low Spearwort
980529.3 HA	S3	N	G5	Ranunculaceae	Ranunculus	pusillus	Poiret			Low Spearwort
990724.4 HA	S1	E	G5	Cyperaceae	Rhynchospora	globularis	(Chapman) Small	recognita	Gale	Globular Beak-rush
980724.1 HA	S3S4	N	G5	Lythraceae	Rotala	ramosior	(L.) Koehne			Tooth-cup
980724.15 BA	S3	N	G5	Gentianaceae	Sabalia	dodecandra	(L.) BSP.			Perennial Sea-pink
990807.4 HA	S3	N	G5	Gentianaceae	Sabalia	dodecandra	(L.) BSP.			Perennial Sea-pink
981002.1 HA	S2	N	G5	Alismataceae	Sagittaria	spatulata	(J. G. Smith) Buchenau			Tidal Sagittaria
990710.2 HA	S3	N	G4	Alismataceae	Sagittaria	subulata	(L.) Buchenau			Hudson Sagittaria
980720.7 BA	S3	N	G5	Cyperaceae	Scirpus	pendulus	Muhl.			Drooping Bulrush
990724.3 HA	S3	N	G5	Cyperaceae	Scirpus	pendulus	Muhl.			Drooping Bulrush
980807.7 HA	S1	N	G5	Lamiaceae	Scutellaria	galericulata	L.			Marsh-skullcap
980724.21 BA	S1	N	G5	Lamiaceae	Scutellaria	galericulata	L.			Marsh-skullcap
980529.1 HA	S3	N	G5	Asteraceae	Senecio	anonymus	A. Wood			Appalachian Groundsel
990626.4 HA	S?	SR	G?	Lemnaceae	Spirodela	punctata	(G. Meyer) C. Thompson			Lesser Spirodela
980724.5 HA	S3	N	G5	Lentibulariaceae	Utricularia	gibba	L.			Creeping Bladderwort
980529.6 HA	S2	N	G4	Lemnaceae	Wolffia	papulifera	C. Thompson			Water-meal
990911.2 HA	S2	N	G5	Xyridaceae	Xyris	difformis	Chapman			Variable Yellow-eyed Grass

HA = Harford County
BA = Baltimore County

SYNONYMOUS NOMENCLATURE

Four specimens were confirmed using nomenclature differing from that used by Gleason and Cronquist (1991). These taxa and their synonyms are listed below.

Gleason & Cronquist Nomenclature	Synonymous Nomenclature
Lycopodium carolinianum L.	*Pseudolycopodiella* (*Lycopodiella*) *caroliniana* (L.) Pichi Sermolli
Rhynchospora globularis (Chapman) Small var. *recognita* Gale	*Rhynchospora recognita* (Gale) Kral
Sagittaria spatulata (J. G. Smith) Buchenau	*Sagittaria montevidensis* Chamisso & Schlechtendal subsp. *spongiosa* (G. Engelmann)
Wolffia papulifera C. Thompson	*Wolffia brasiliensis* Weddell



(GUNPOWDER NECK)
5762 IV SE

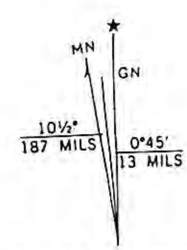
Mapped by the Army Map Service
Published for civil use by the Geological Survey

Control by NOS/NOAA

Planimetry by photogrammetric methods from aerial photographs taken 1943. Topography by planetable surveys 1944. Culture revised from aerial photographs taken 1947. Field checked 1948

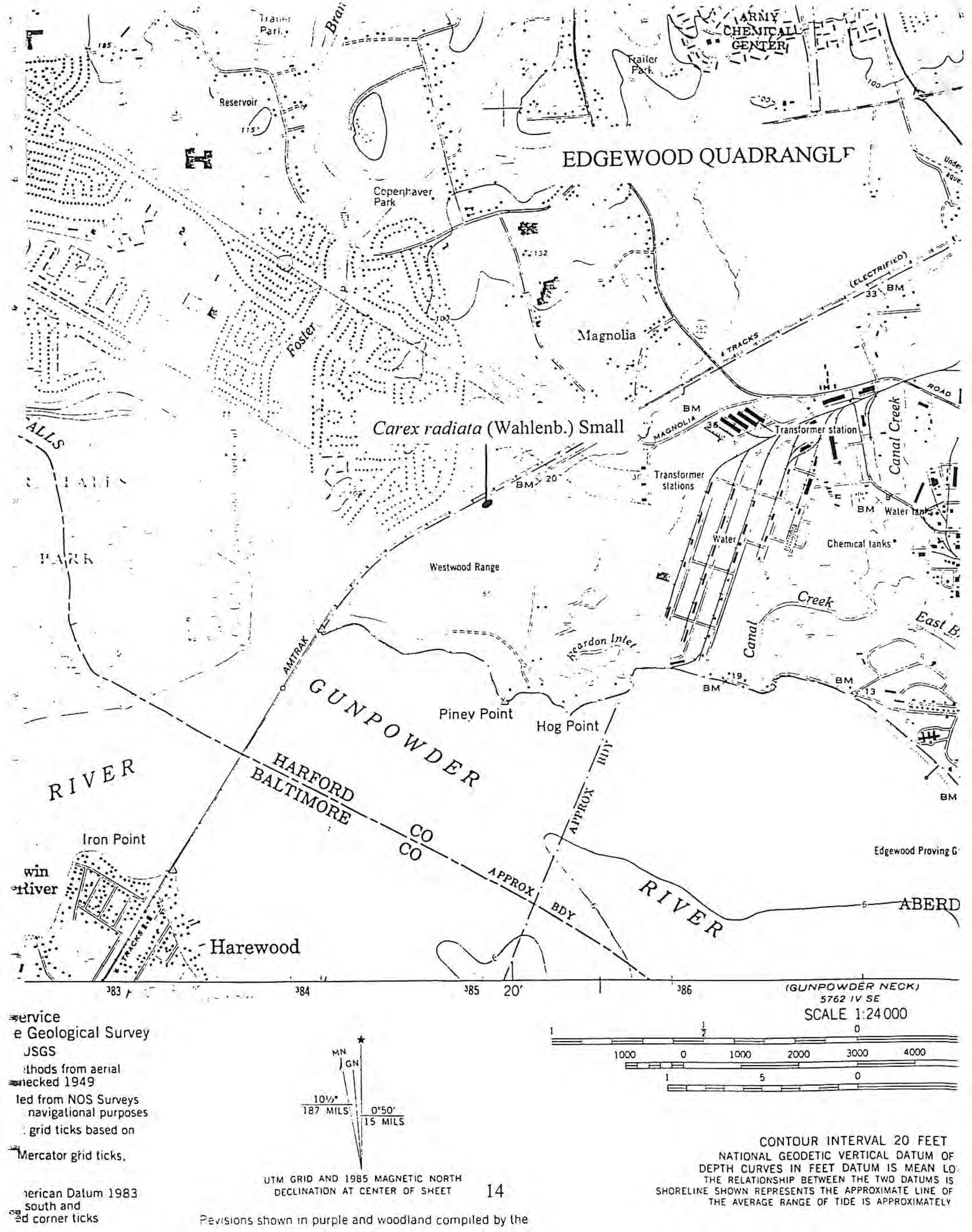
Selected hydrographic data compiled fr hart 572 (1947)
This information is not intended for nav 13 a urposes

Polyconic projection. 10,000-foot gri ed on
Maryland coordinate system
1000-meter Universal Transverse Mercator grid ticks, zone 18, shown in blue
1927 North American Datum
To place on the predicted North American Datum 1983
the projection lines 7 meters south and

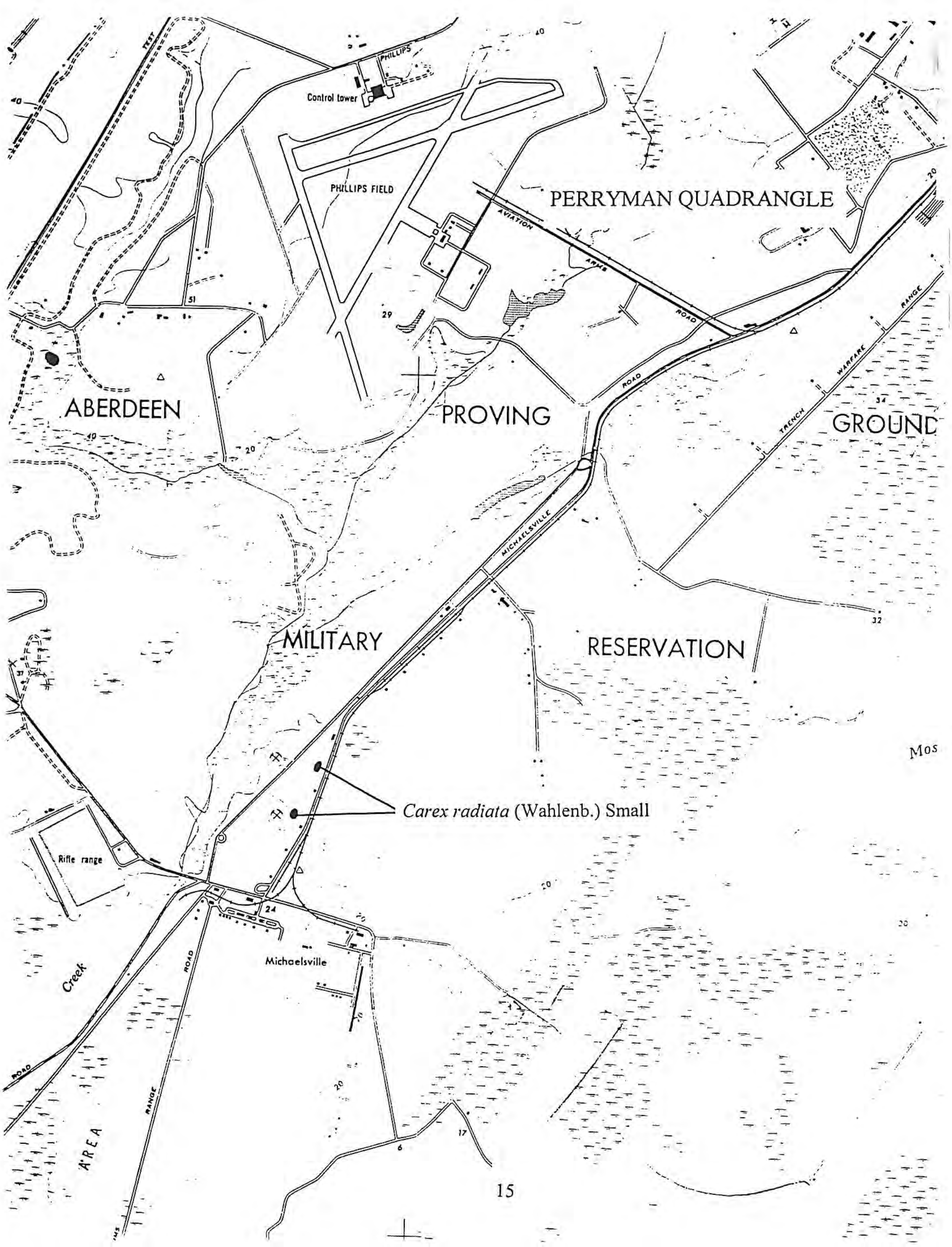


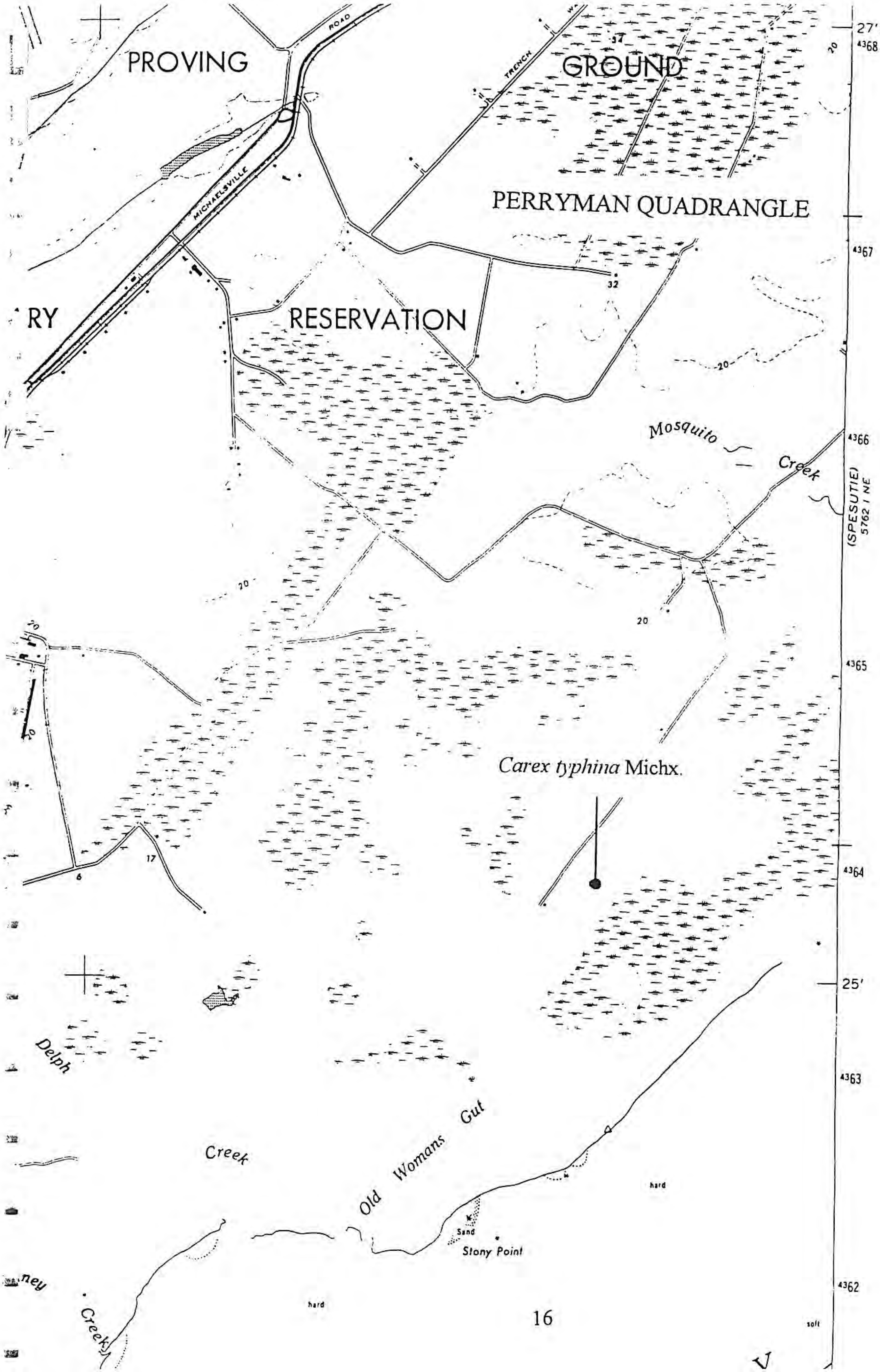
UTM GRID AND 1984 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

Revisions shown in purple and woodland compiled
by the Geological Survey from aerial photographs

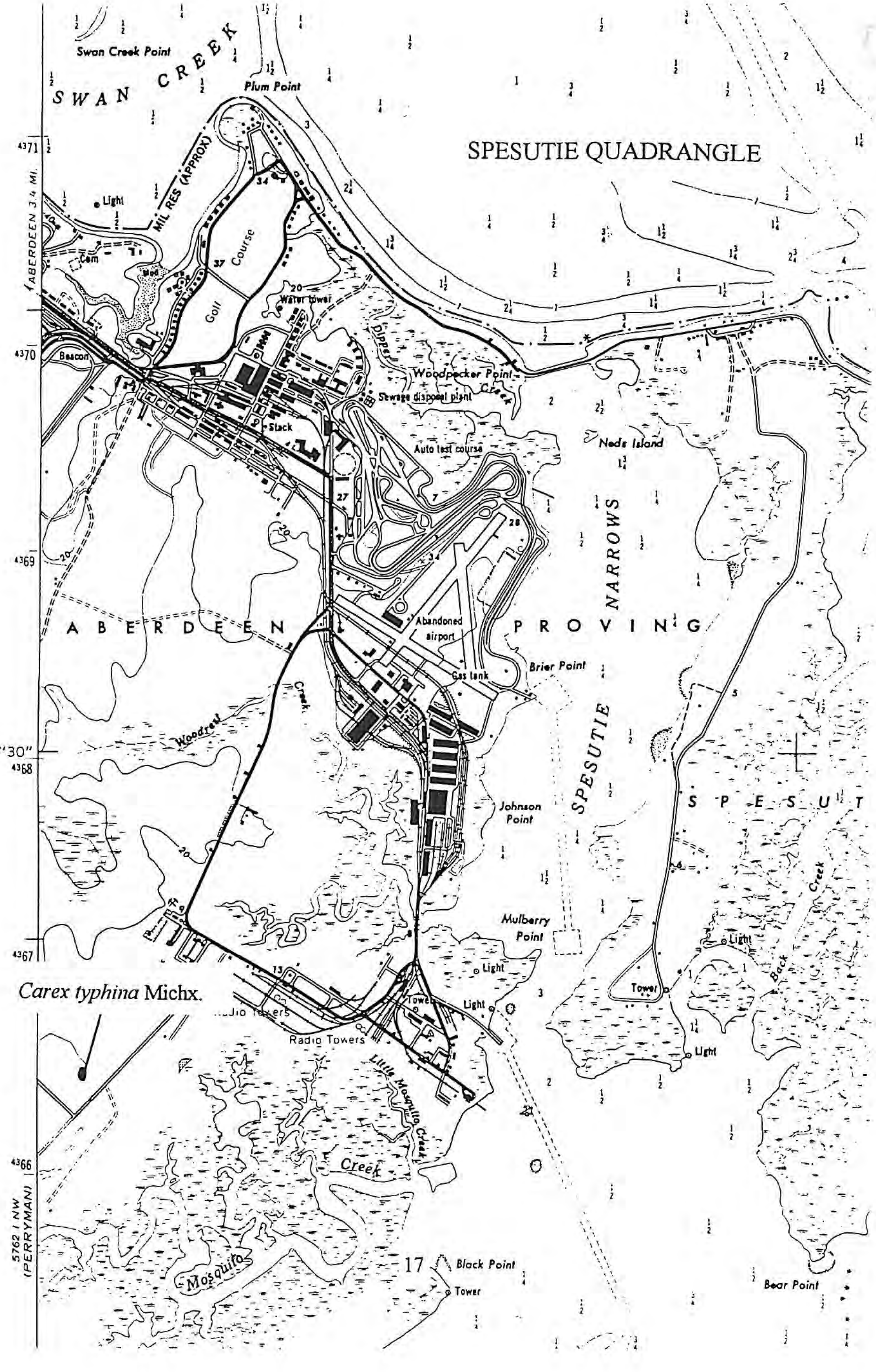


EDGEWOOD QUADRANGLE
Carex radiata (Wahlenb.) Small
ARMY CHEMICAL CENTER
Trailer Park
Reservoir
Copenhaver Park
Foster
Magnolia
TRACKS
(ELECTRIFIED)
ROAD
MAGNOLIA
BM
Transformer station
Transformer stations
Canal Creek
Water tanks
Water
Chemical tanks
Westwood Range
Creek
Canal
East B
Reardon Inlet
AMTRAK
GUNPOWDER
Piney Point
Hog Point
APPROX BDY
RIVER
HARFORD
BALTIMORE
CO
CO
APPROX
BDY
RIVER
Edgewood Proving G
ABERD
Iron Point
Harewood
TRACKS
PARK
383
384
385
20′
386
(GUNPOWDER NECK)
5762 IV SE
SCALE 1:24 000
1000
0
1000
2000
3000
4000
MN
GN
10½°
187 MILS
0°50′
15 MILS
UTM GRID AND 1985 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET
CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF
DEPTH CURVES IN FEET DATUM IS MEAN LO
THE RELATIONSHIP BETWEEN THE TWO DATUMS IS
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF
THE AVERAGE RANGE OF TIDE IS APPROXIMATELY
ervice
e Geological Survey
JSGS
thods from aerial
ecked 1949
led from NOS Surveys
navigational purposes
grid ticks based on
Mercator grid ticks.
erican Datum 1983
south and
d corner ticks
Revisions shown in purple and woodland compiled by the


PERRYMAN QUADRANGLE
Control tower
PHILLIPS
PHILLIPS FIELD
AVIATION
ARMS
ROAD
ABERDEEN
PROVING
GROUND
MICHAELSVILLE
TRENCH
WARFARE
RANGE
MILITARY
RESERVATION
Mos
Carex radiata (Wahlenb.) Small
Rifle range
Michaelsville
Creek
ROAD
RANGE
AREA

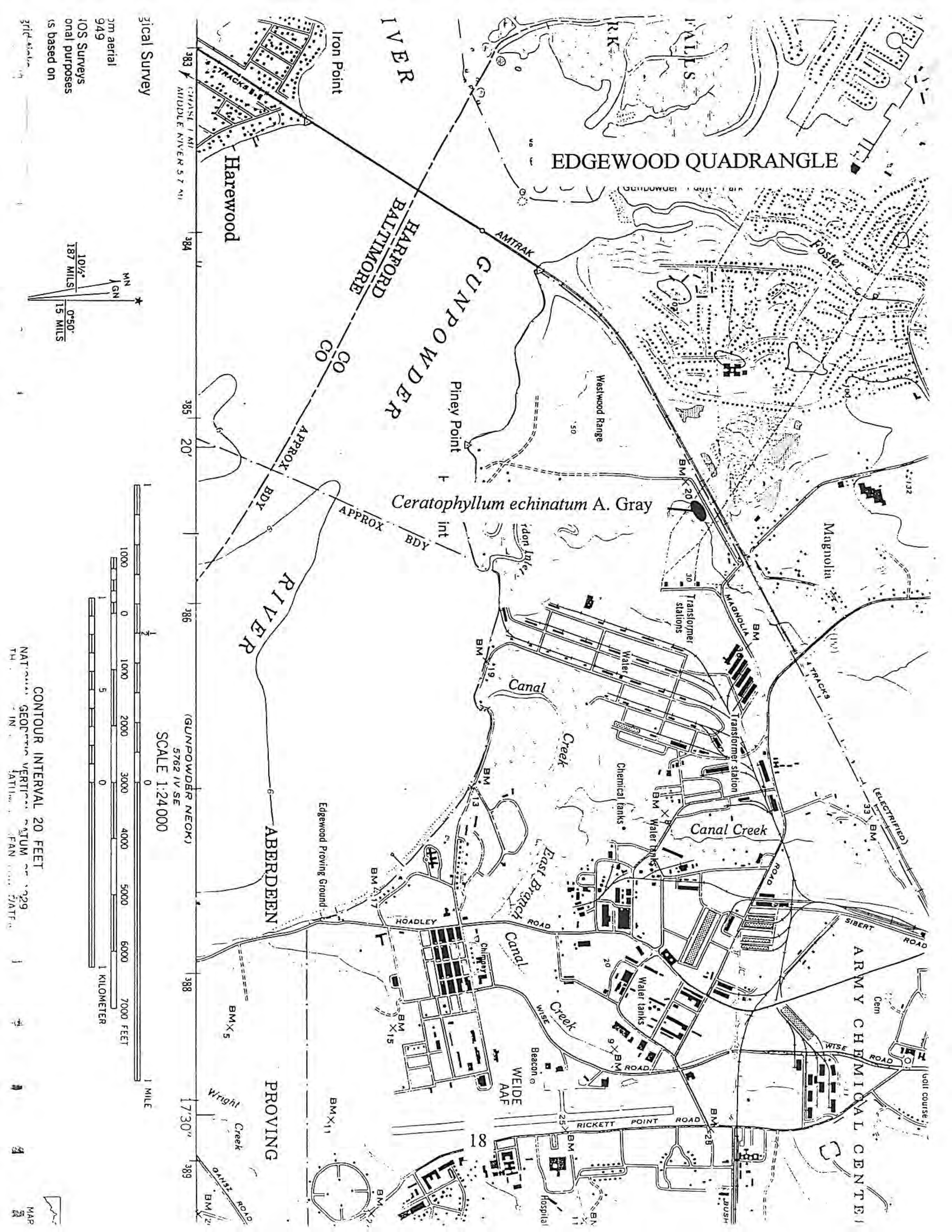

PROVING
GROUND
RY
RESERVATION
PERRYMAN QUADRANGLE
Carex typhina Michx.
ROAD
TRENCH
MICHAELSVILLE
Mosquito
Creek
(SPESUTIE)
5762 I NE
27'30"
4368
4367
4366
4365
4364
25'
4363
4362
Delph
Creek
Old Womans Gut
Sand
Stony Point
hard
soft
ney
Creek

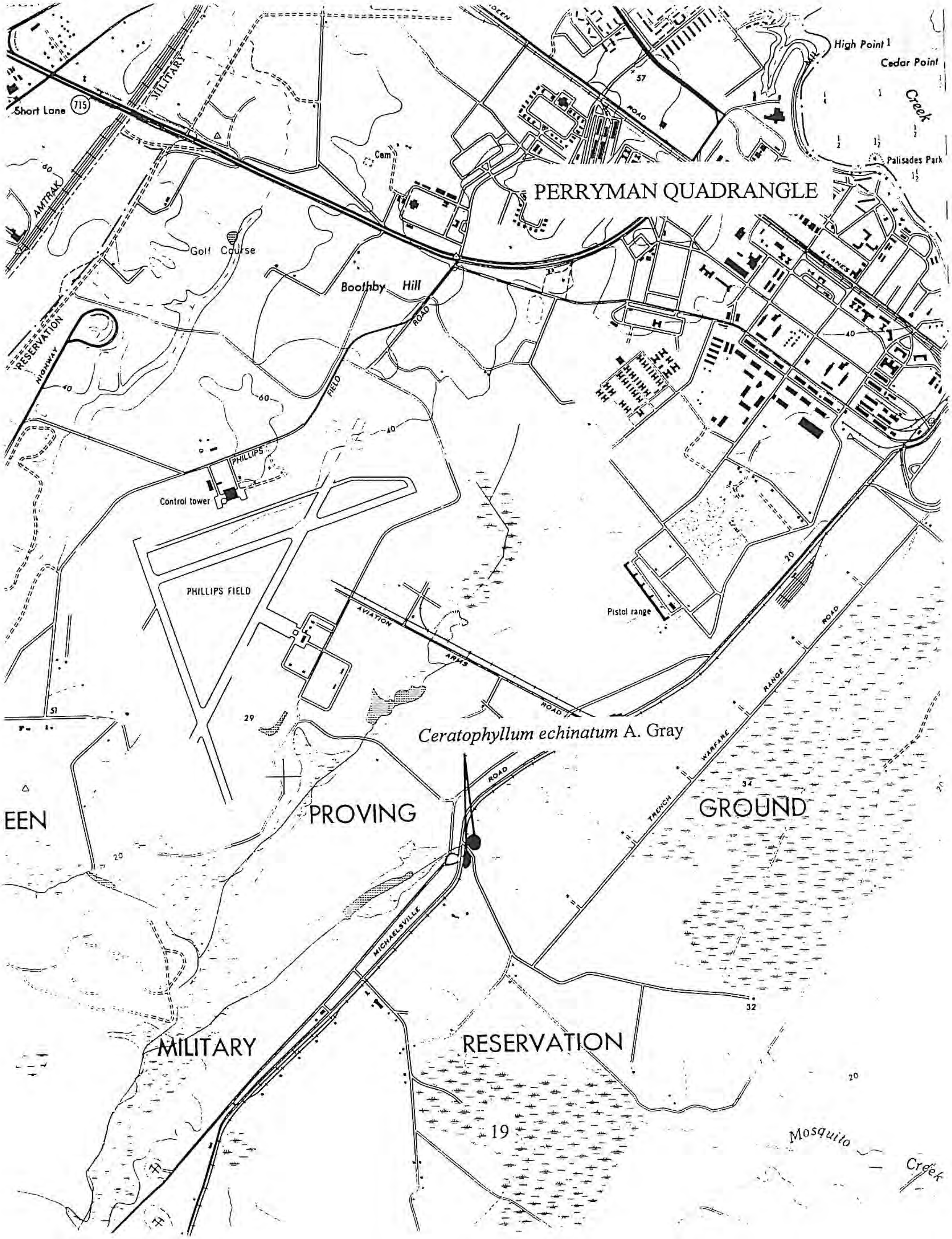
SPESUTIE QUADRANGLE

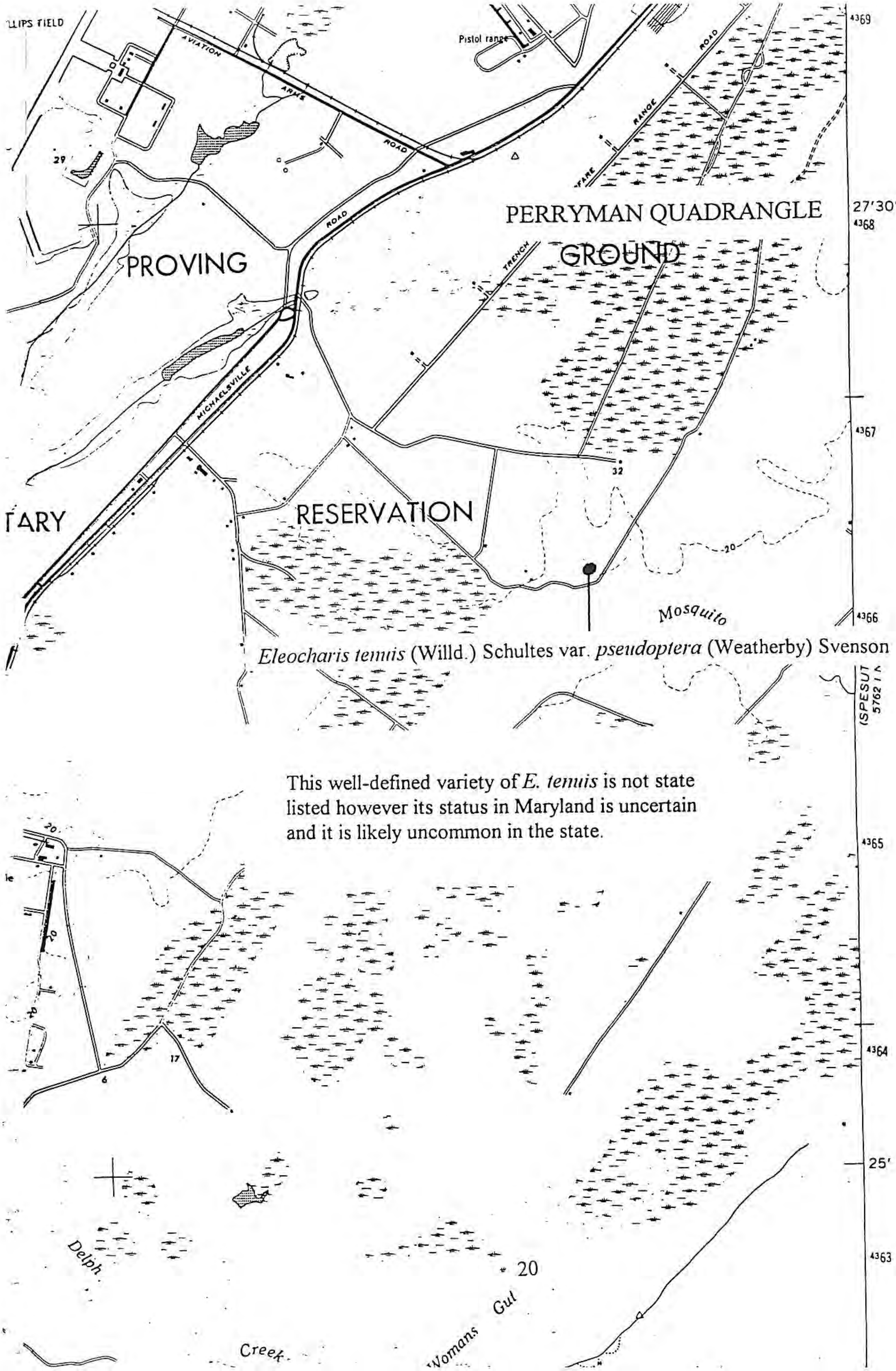


Carex typhina Michx.

EDGEWOOD QUADRANGLE

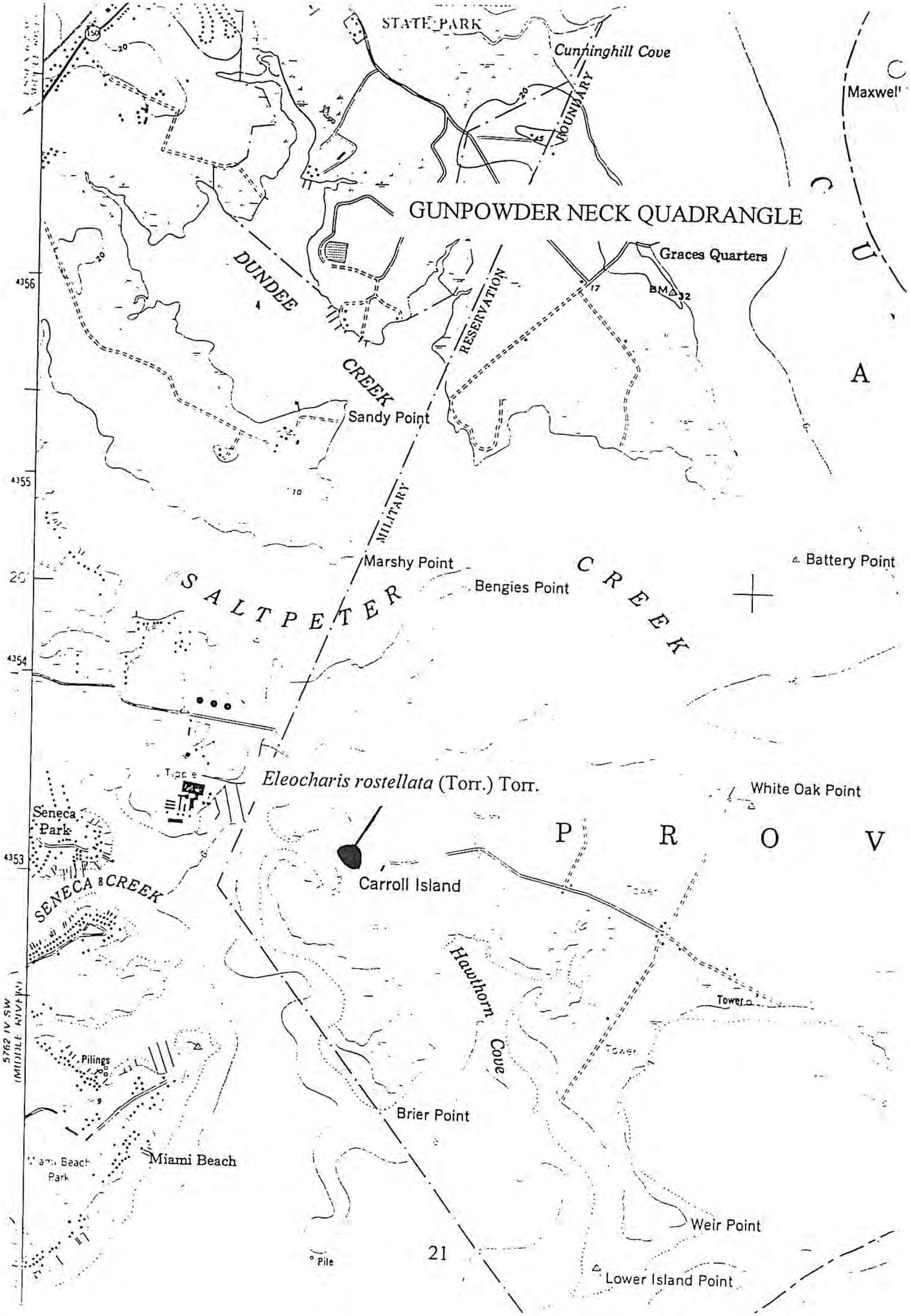



PERRYMAN QUADRANGLE
Ceratophyllum echinatum A. Gray
High Point
Cedar Point
Creek
Palisades Park
Short Lane
715
MILITARY
AMTRAK
ROAD
Cem
Golf Course
Boothby Hill
RESERVATION
HIGHWAY
FIELD
PHILLIPS
Control tower
PHILLIPS FIELD
AVIATION
ARMS
Pistol range
RANGE
WARFARE
TRENCH
EEN
PROVING
GROUND
MICHAELSVILLE
MILITARY
RESERVATION
Mosquito
Creek

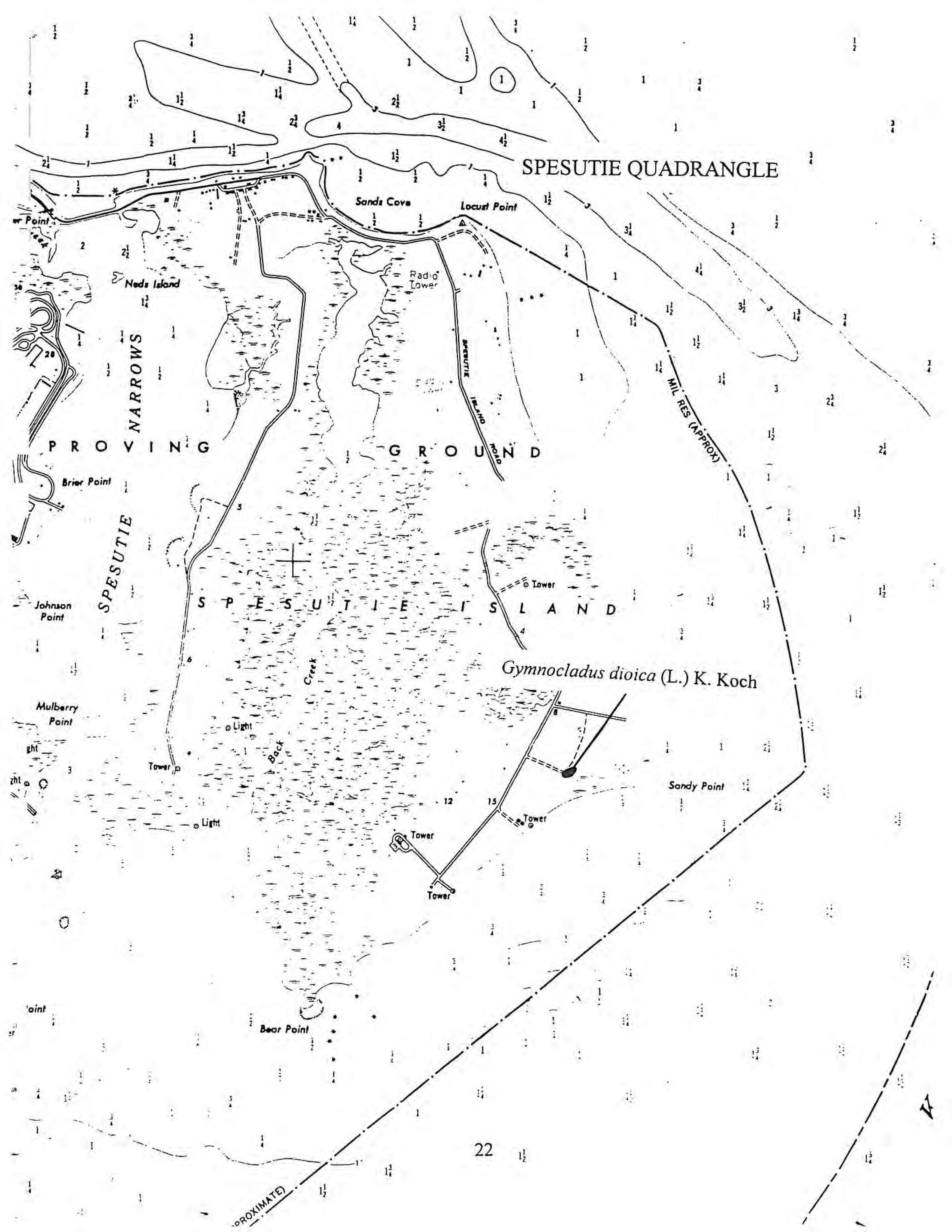


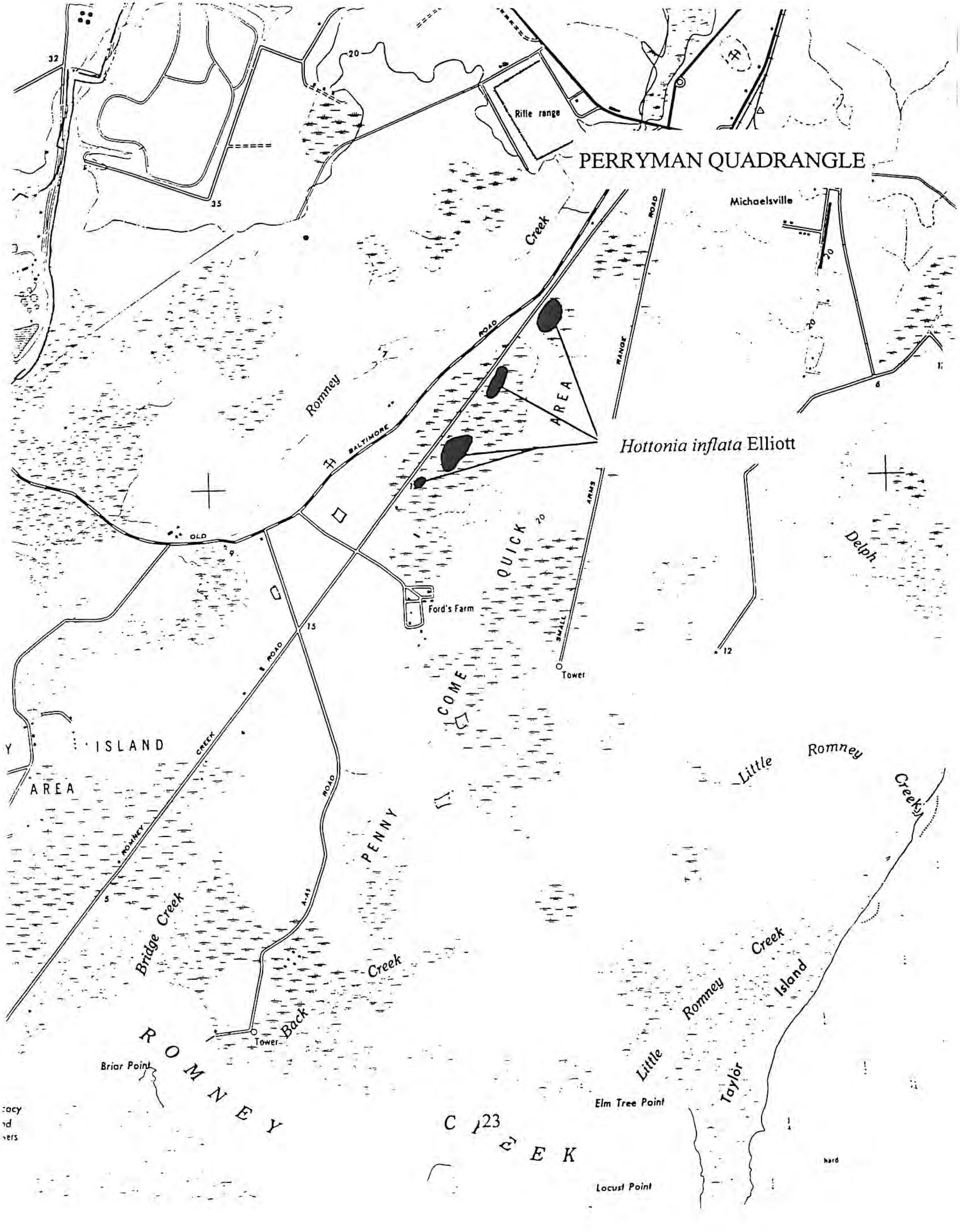
Eleocharis tenuis (Willd.) Schultes var. *pseudoptera* (Weatherby) Svenson

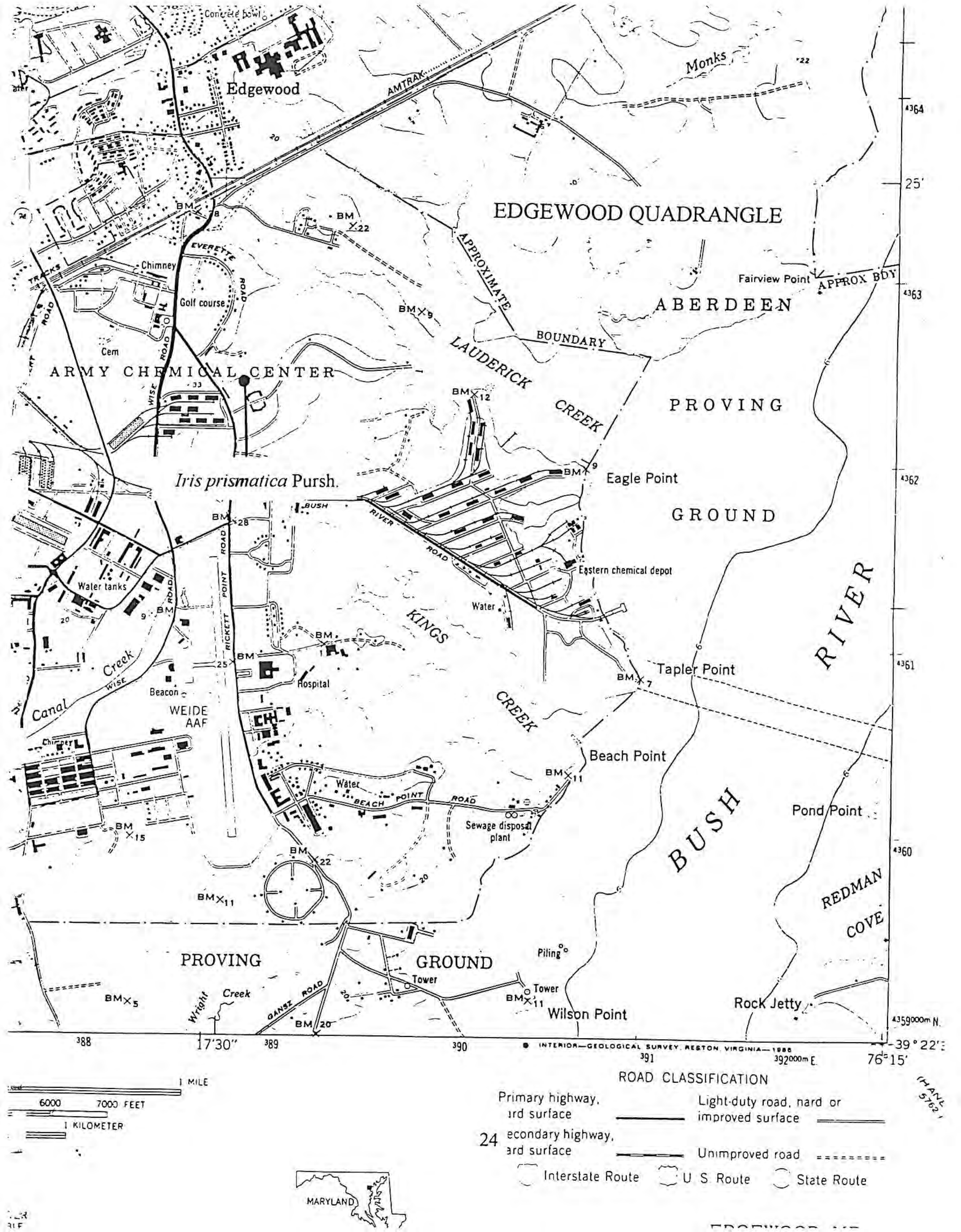
This well-defined variety of *E. tenuis* is not state listed however its status in Maryland is uncertain and it is likely uncommon in the state.



GUNPOWDER NECK QUADRANGLE
STATE PARK
Cunninghill Cove
BOUNDARY
Maxwell
Graces Quarters
DUNDEE CREEK
RESERVATION
Sandy Point
MILITARY
Marshy Point
Bengies Point
Battery Point
SALTPETER CREEK
Eleocharis rostellata (Torr.) Torr.
White Oak Point
Seneca Park
PROV
Carroll Island
SENECA CREEK
Hawthorn Cove
Tower
Pilings
Brier Point
Miami Beach
Miami Beach Park
Weir Point
Pile
Lower Island Point
5762 IV SW (MIDDLE RIVER)

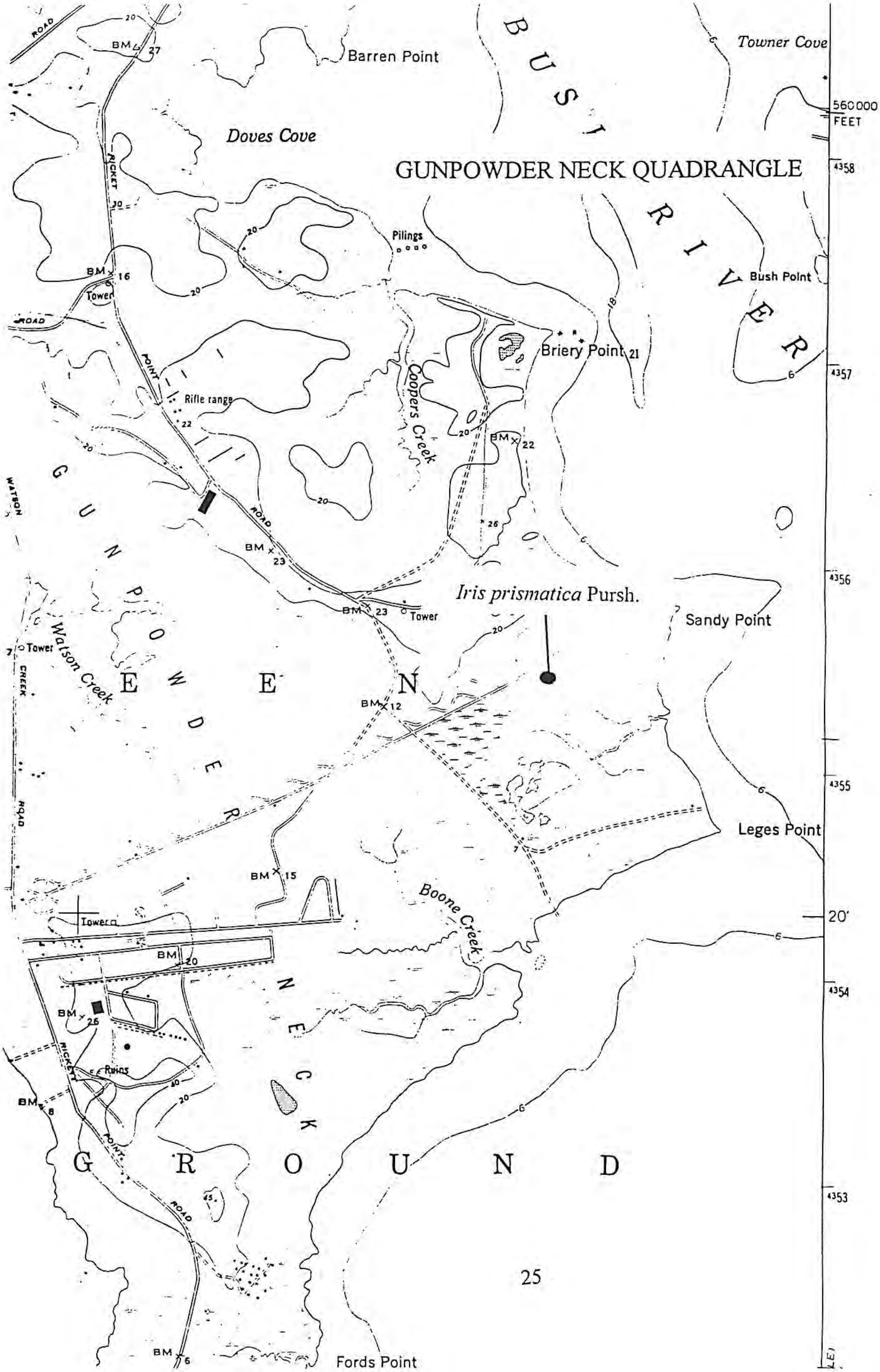

SPESUTIE QUADRANGLE
Sands Cove
Locust Point
Radio Tower
Neds Island
NARROWS
PROVING GROUND
SPESUTIE ISLAND ROAD
MIL RES (APPROX)
Brier Point
SPESUTIE
Johnson Point
SPESUTIE ISLAND
Tower
Gymnocladus dioica (L.) K. Koch
Mulberry Point
Light
Back Creek
Tower
Sandy Point
Light
Tower
Tower
Bear Point

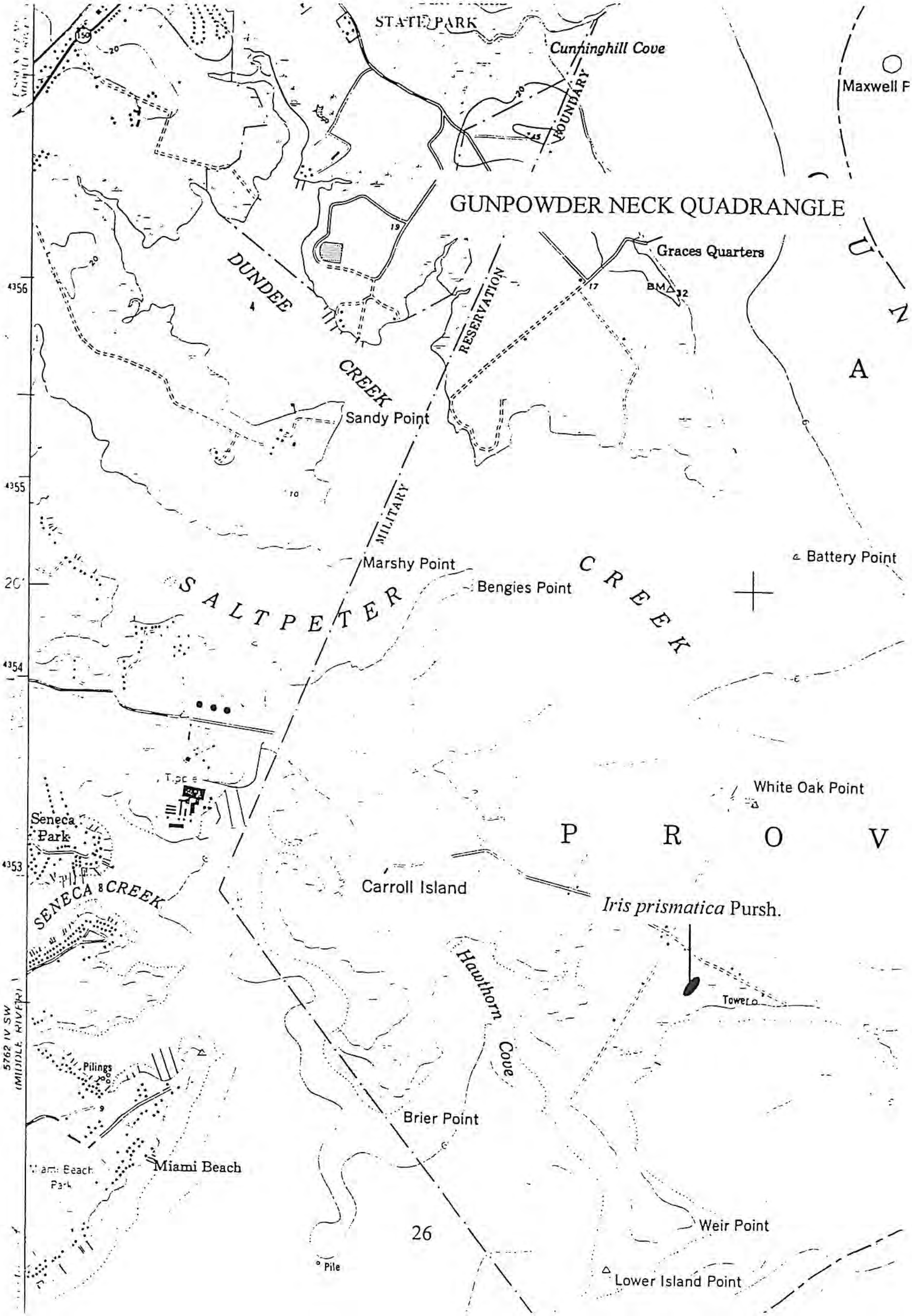

PERRYMAN QUADRANGLE
Hottonia inflata Elliott
Rifle range
Michaelsville
Romney Creek
BALTIMORE ROAD
OLD
RANGE ROAD
SMALL ARMS
AREA
QUICK
COME
PENNY
Ford's Farm
Tower
Delph
Little Romney Creek
ISLAND
AREA
ROMNEY CREEK ROAD
A-AS ROAD
Bridge Creek
Back Creek
Tower
Briar Point
ROMNEY
Little Romney Creek Island
Taylor
Elm Tree Point
Locust Point

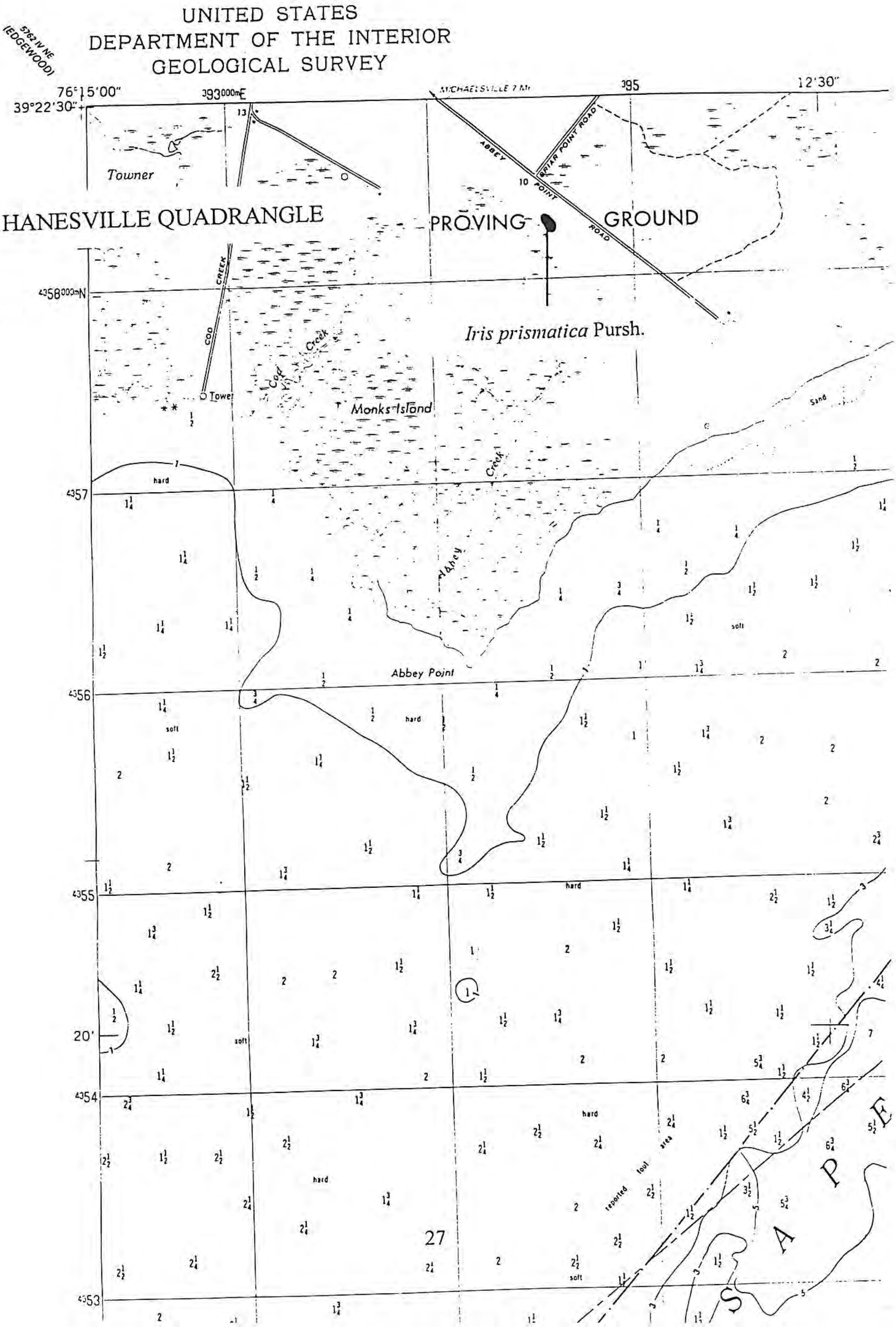


EDGEWOOD QUADRANGLE

Iris prismatica Pursh.

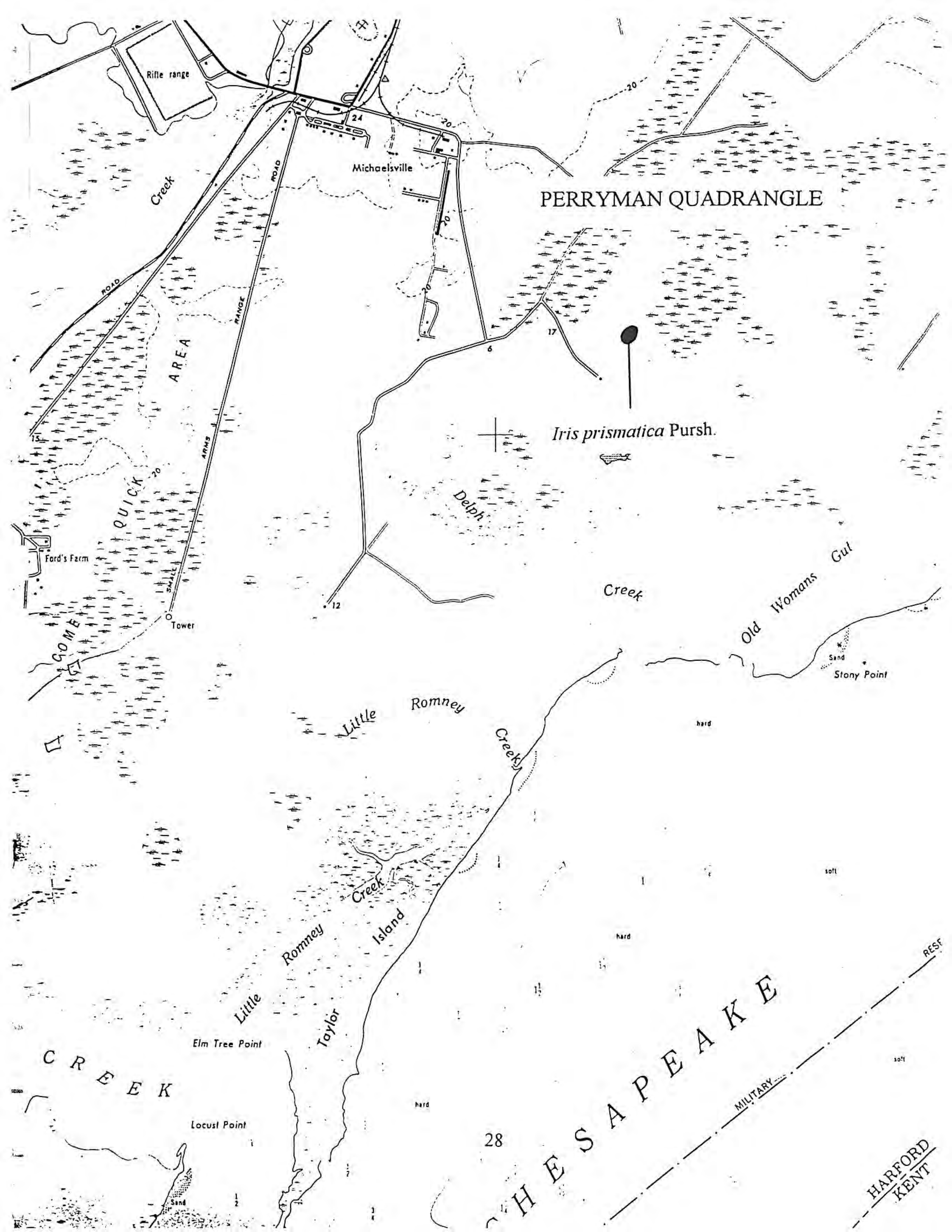

GUNPOWDER NECK QUADRANGLE
Iris prismatica Pursh.
BUSH RIVER
GUNPOWDER NECK
EDGEWOOD ARSENAL
EDGEWOOD ARSENAL PROVING GROUND
Barren Point
Towner Cove
Doves Cove
Pilings
Bush Point
Briery Point
Coopers Creek
Rifle range
Sandy Point
Watson Creek
Leges Point
Boone Creek
Tower
Ruins
Fords Point
RICKET POINT ROAD
560000 FEET
4358
4357
4356
4355
20'
4354
4353


STATE PARK
Cunninghill Cove
Maxwell P
GUNPOWDER NECK QUADRANGLE
Graces Quarters
BOUNDARY
RESERVATION
MILITARY
DUNDEE
CREEK
Sandy Point
Marshy Point
Bengies Point
Battery Point
SALTPETER
CREEK
White Oak Point
P R O V
Seneca Park
SENECA CREEK
Carroll Island
Iris prismatica Pursh.
Hawthorn Cove
Tower
Pilings
Brier Point
Miami Beach
Weir Point
Pile
Lower Island Point
5762 IV SW (MIDDLE RIVER)
4356
4355
4354
4353

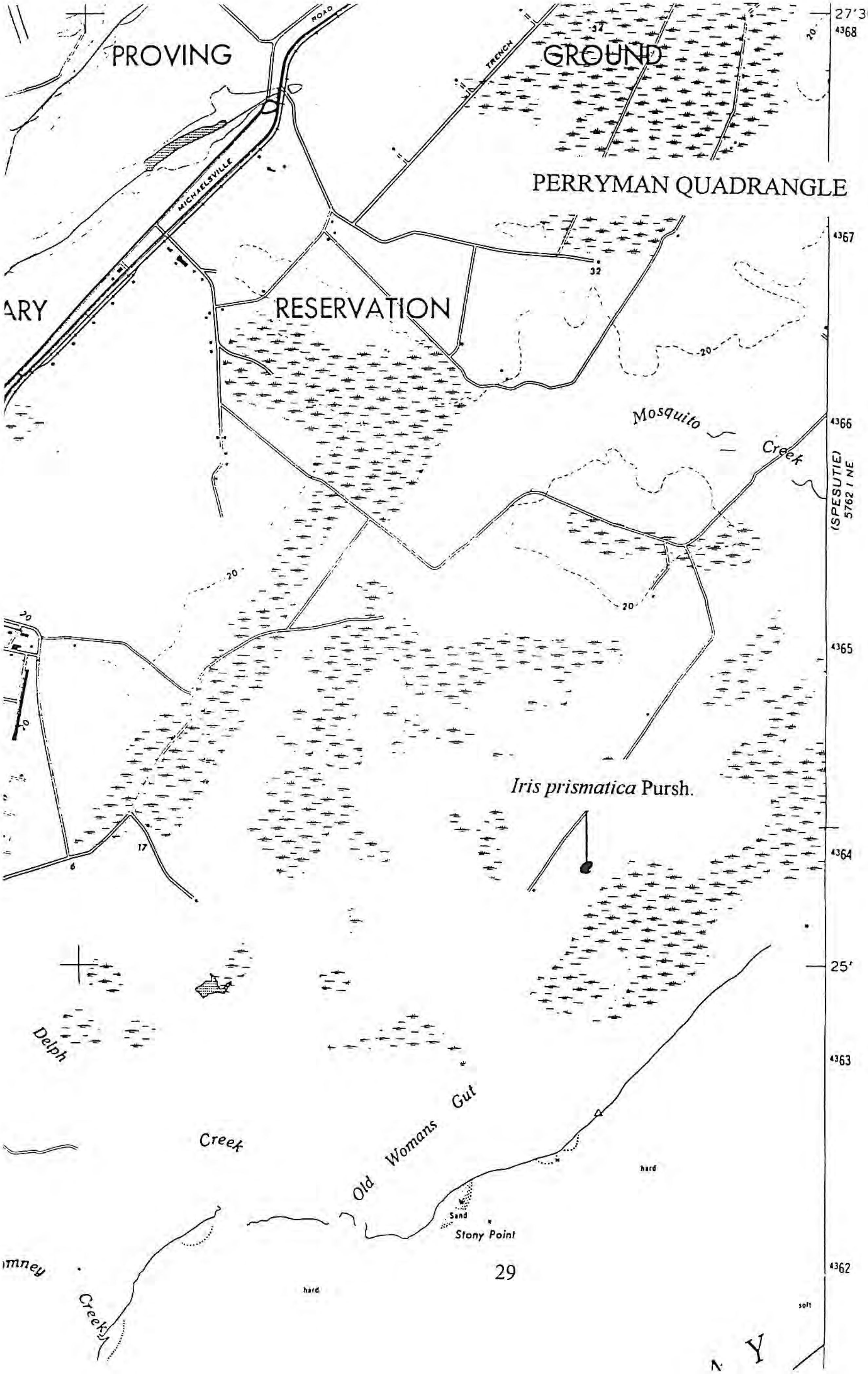


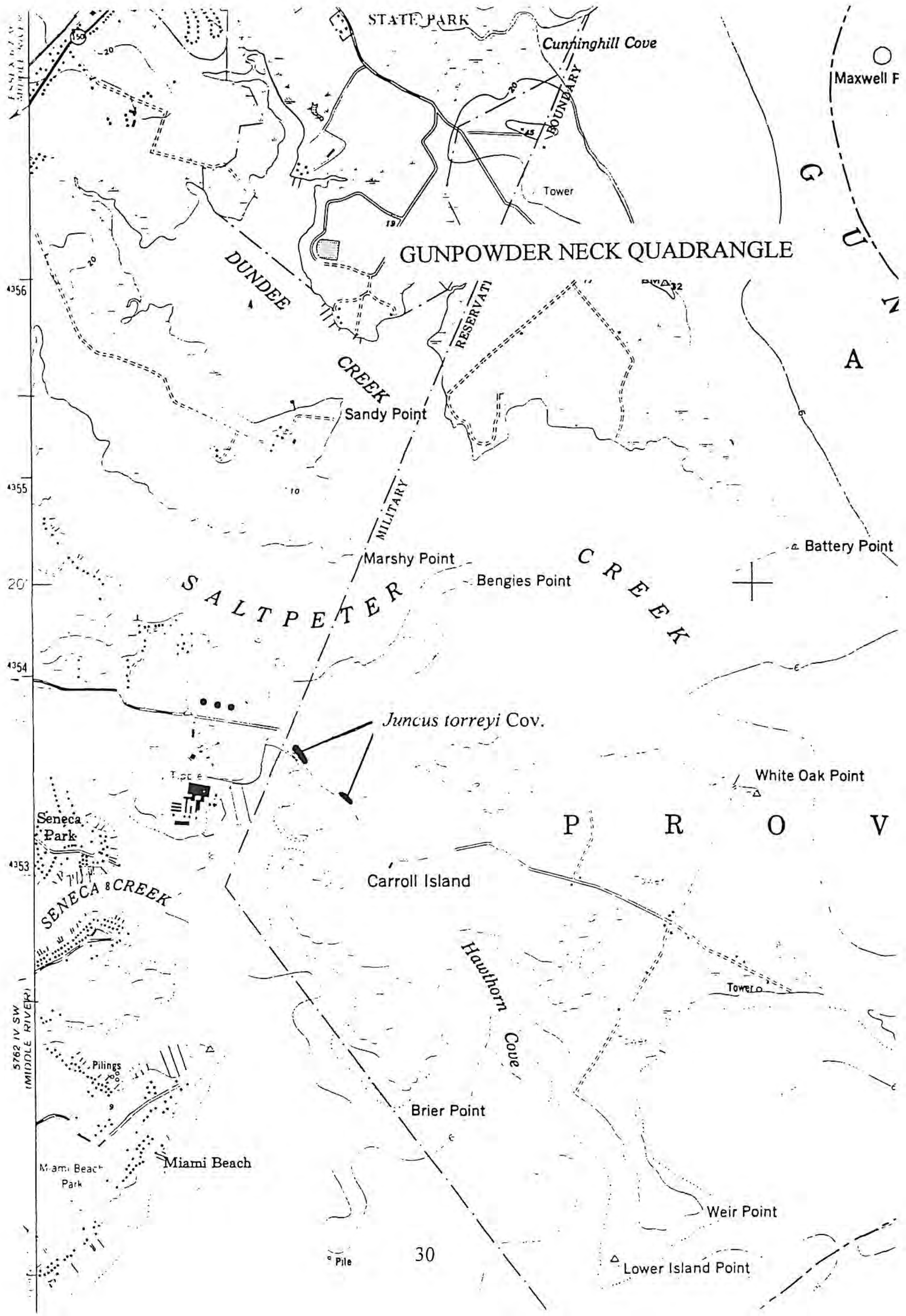
HANESVILLE QUADRANGLE

Iris prismatica Pursh.

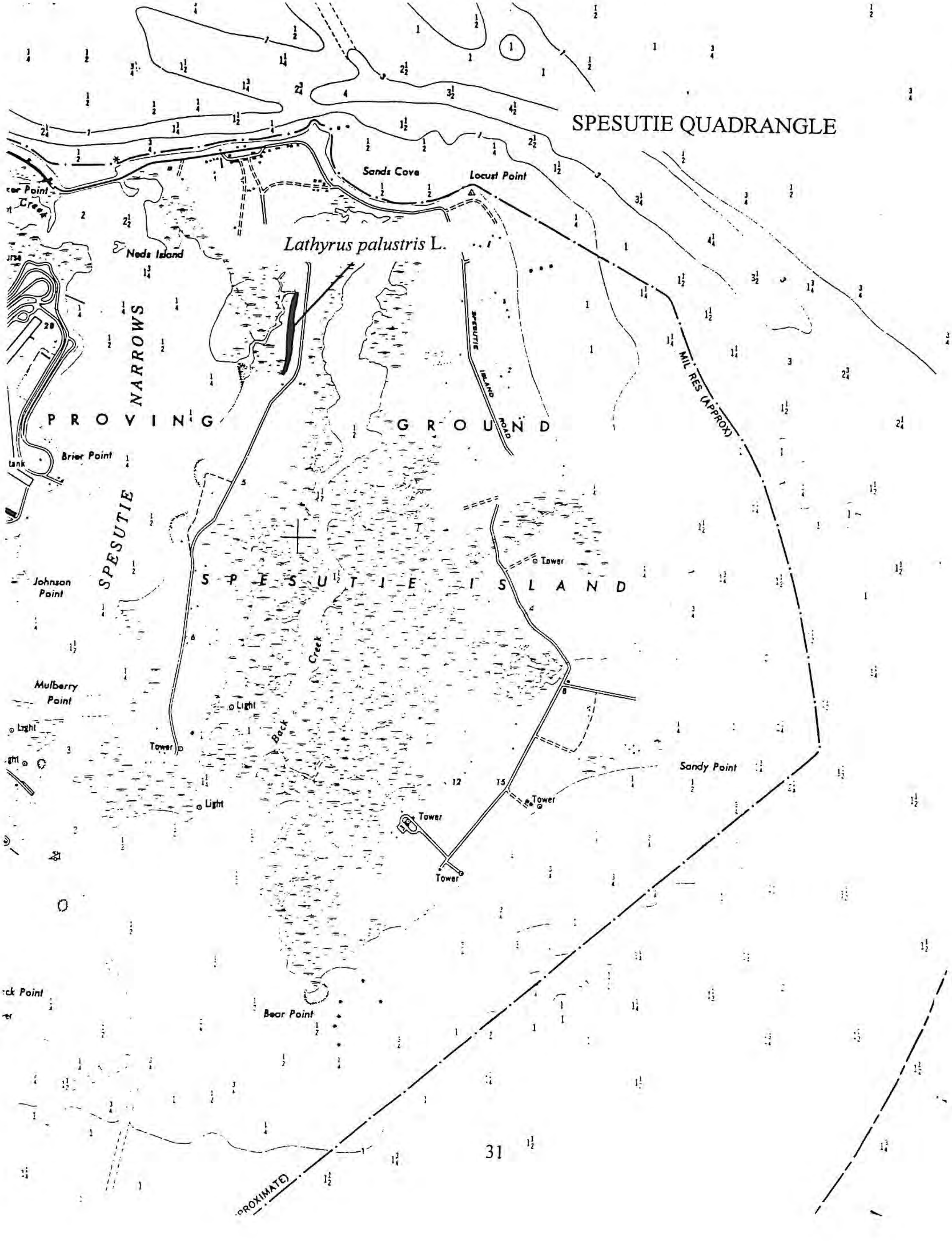


PERRYMAN QUADRANGLE
Iris prismatica Pursh.
Rifle range
Michaelsville
Creek
ROAD
RANGE
ARMS
SMALL
AREA
QUICK
COME
Ford's Farm
Tower
Delph
Creek
Old Womans Gut
Sand
Stony Point
Little Romney Creek
hard
soft
Creek
Little Romney Island
Taylor
Elm Tree Point
Locust Point
CREEK
CHESAPEAKE
MILITARY
HARFORD
KENT


PROVING
GROUND
ROAD
TRENCH
MICHAELSVILLE
PERRYMAN QUADRANGLE
ARY
RESERVATION
27'30"
4368
4367
4366
4365
4364
4363
4362
25'
(SPESUTIE)
5762 I NE
Mosquito
Creek
Iris prismatica Pursh.
Delph
Creek
Old Womans Gut
Sand
Stony Point
hard
soft

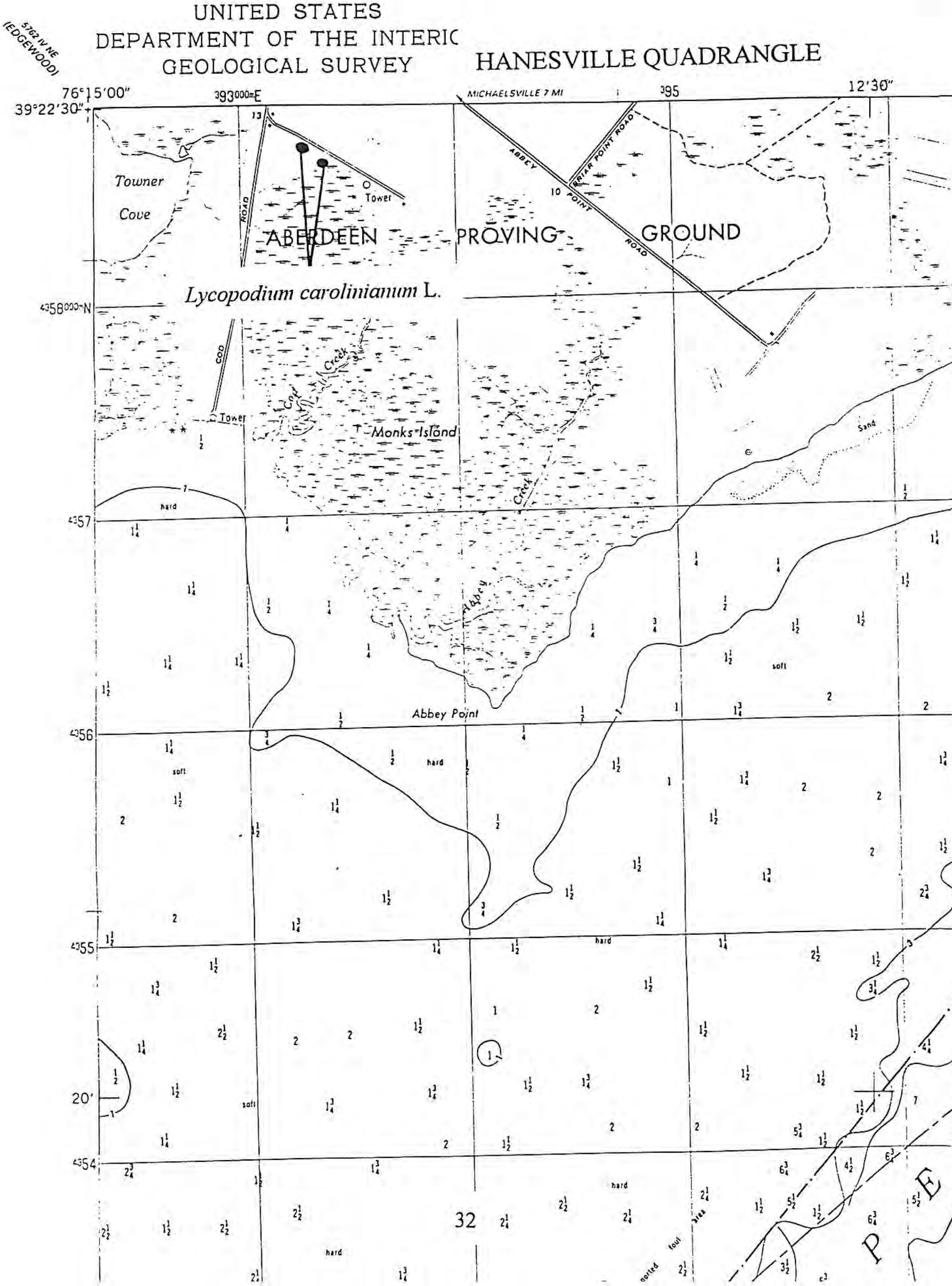

STATE PARK
Cunninghill Cove
Maxwell F
BOUNDARY
Tower
GUNPOWDER NECK QUADRANGLE
DUNDEE
CREEK
RESERVATI
Sandy Point
MILITARY
Battery Point
Marshy Point
Bengies Point
SALTPETER
CREEK
Juncus torreyi Cov.
White Oak Point
Seneca Park
P R O V
Carroll Island
SENECA CREEK
Hawthorn Cove
Tower
5762 IV SW (MIDDLE RIVER)
Pilings
Brier Point
Miami Beach
Miami Beach Park
Weir Point
Pile
Lower Island Point
4356
4355
20'
4354
4353

SPESUTIE QUADRANGLE

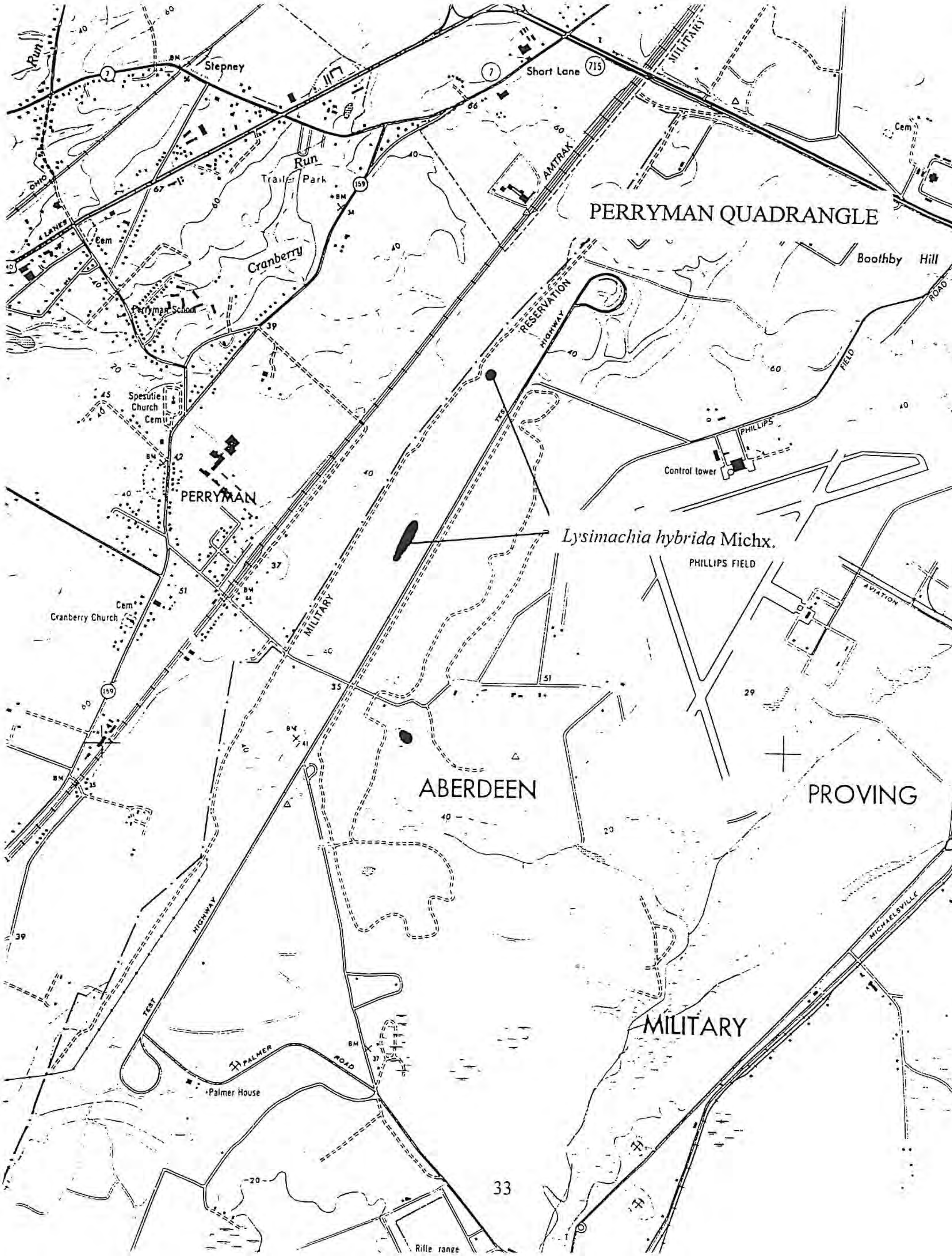


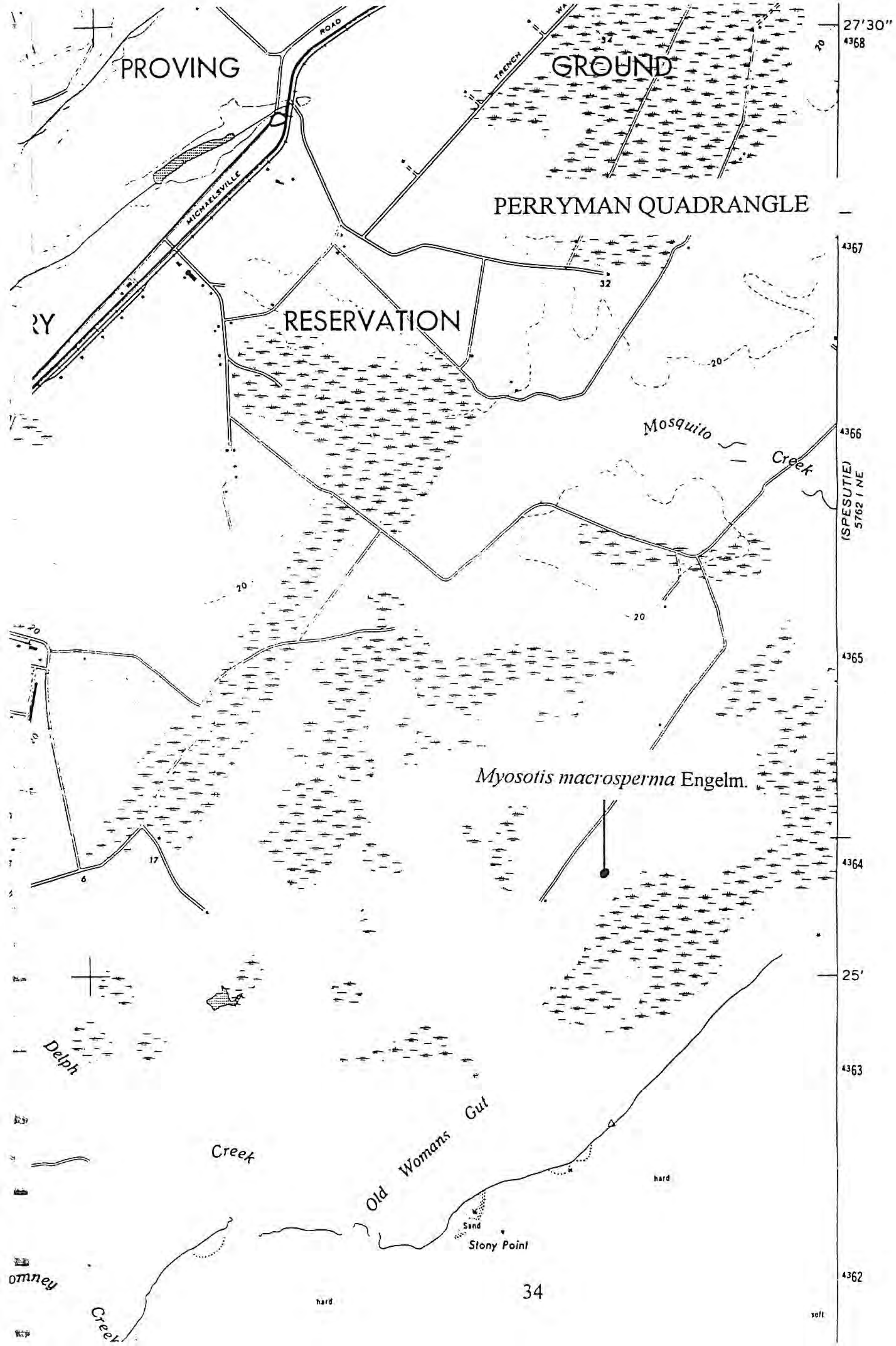
UNITED STATES
DEPARTMENT OF THE INTERIC
GEOLOGICAL SURVEY

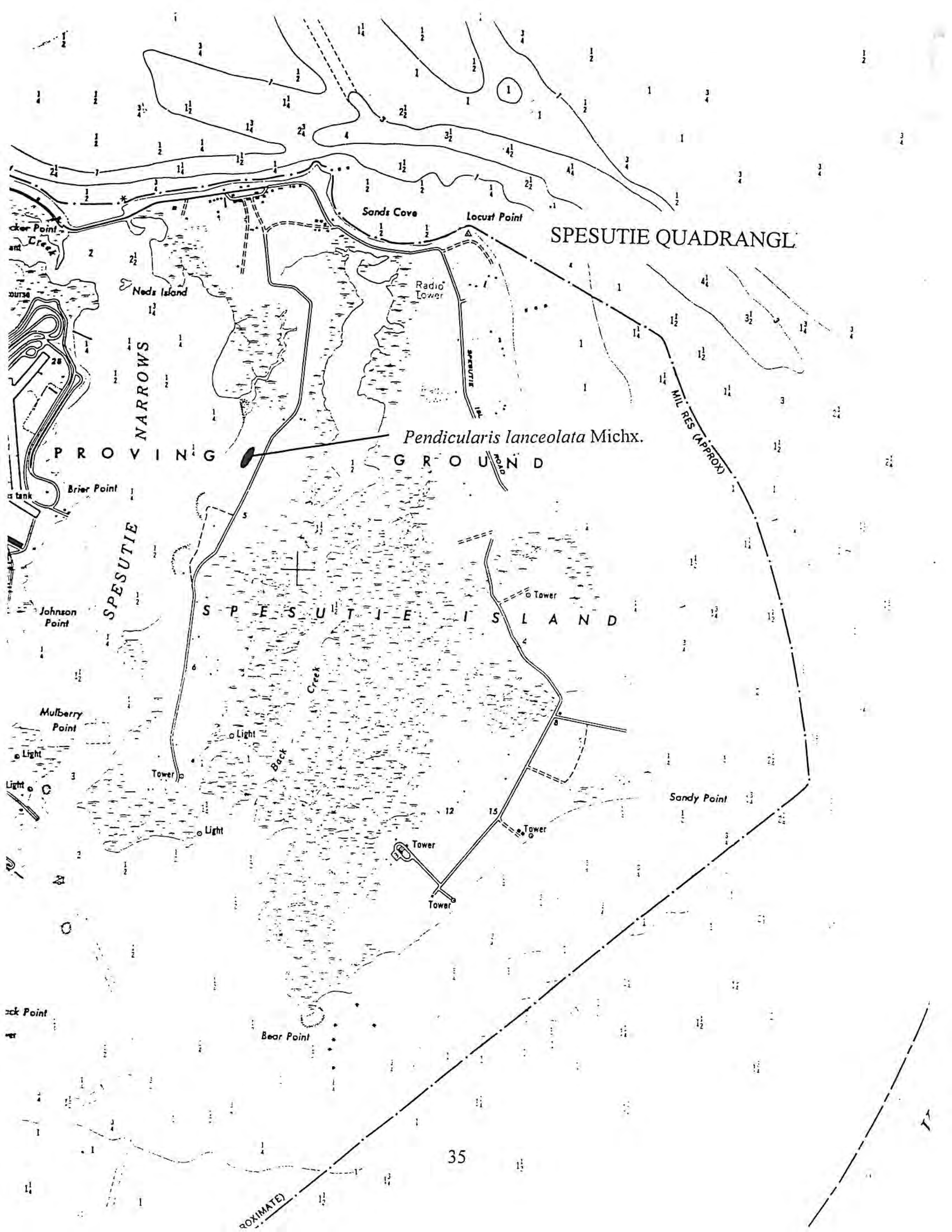
HANESVILLE QUADRANGLE

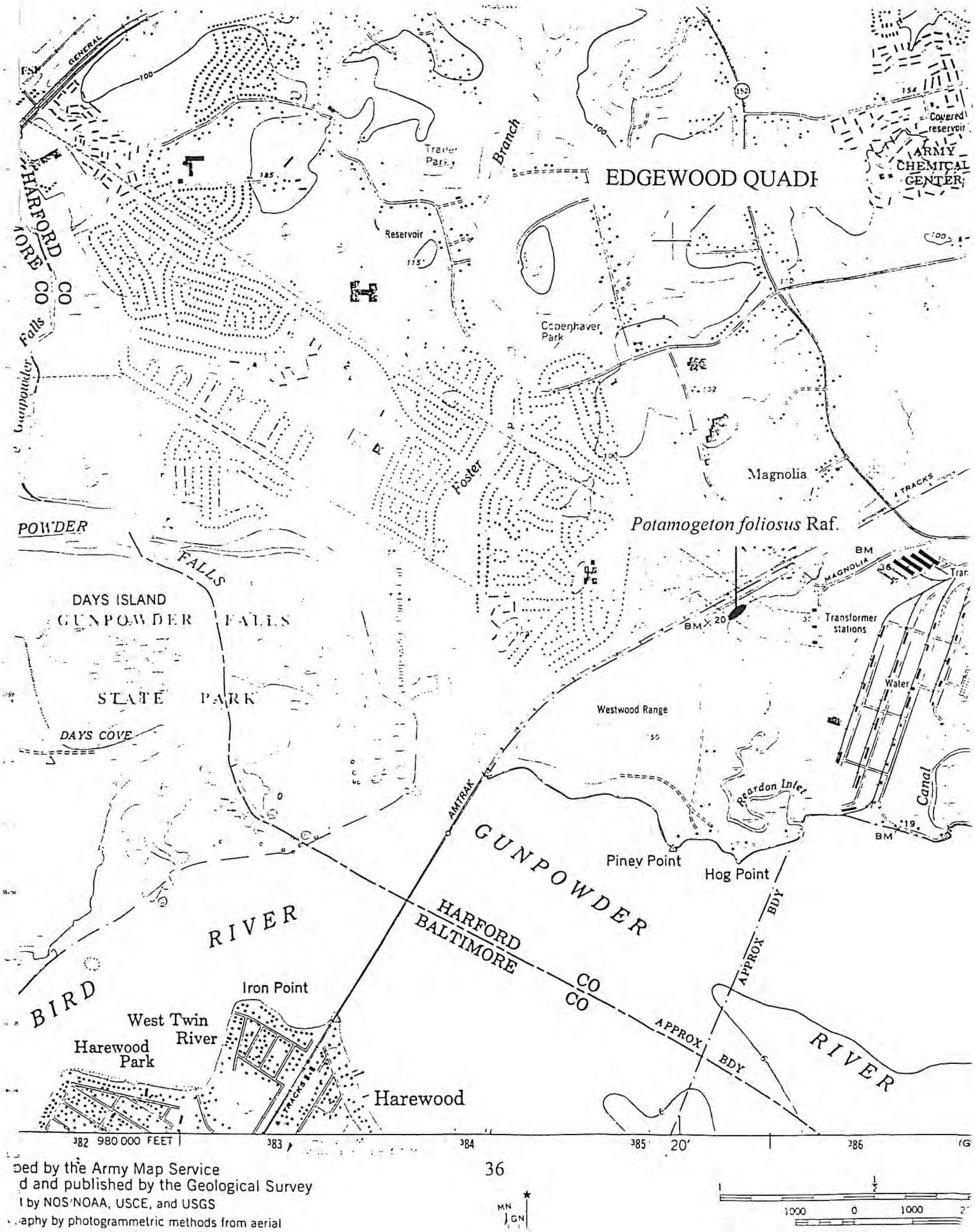


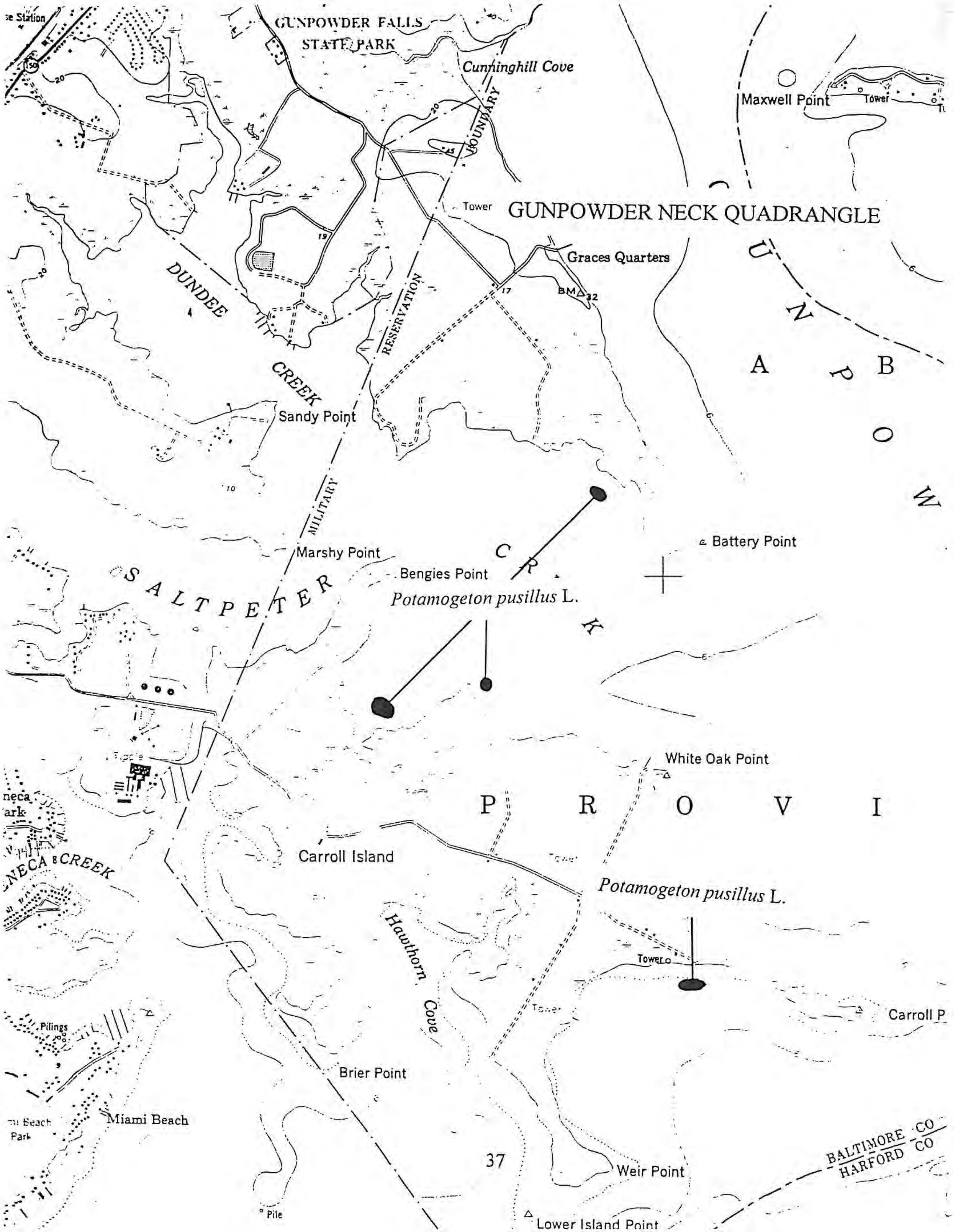
Lycopodium carolinianum L.


PERRYMAN QUADRANGLE
Lysimachia hybrida Michx.
Stepney
Short Lane
Run
Trailer Park
Cranberry
Cem
Perryman School
Spesutie Church Cem
PERRYMAN
Cem
Cranberry Church
AMTRAK
MILITARY
RESERVATION
HIGHWAY
TEST
Boothby Hill
FIELD
ROAD
PHILLIPS
Control tower
PHILLIPS FIELD
AVIATION
ABERDEEN
PROVING
MILITARY
MICHAELSVILLE
PALMER ROAD
Palmer House
Rifle range
OHIO
4 LANES

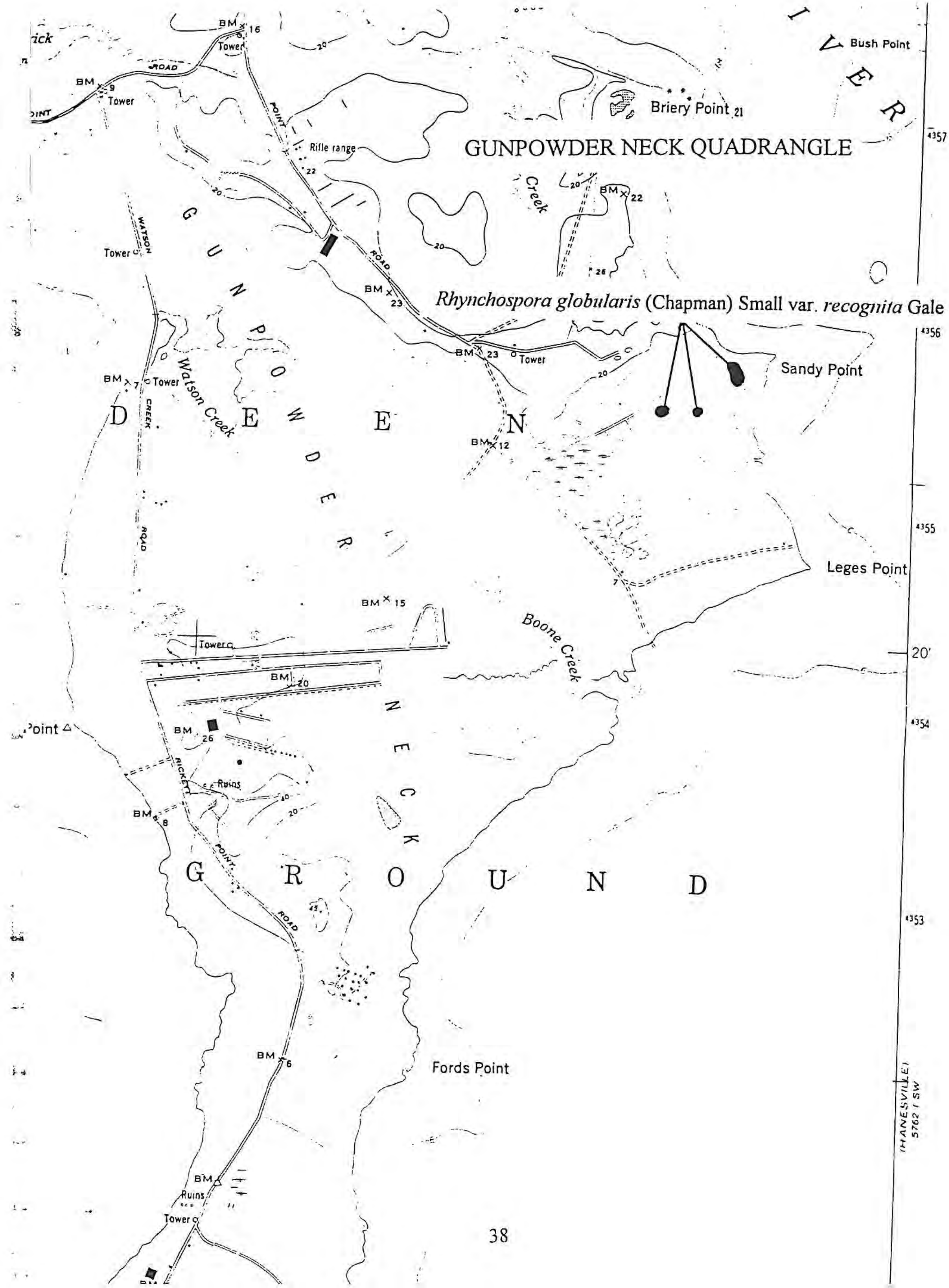

PROVING
GROUND
RESERVATION
PERRYMAN QUADRANGLE
MICHAELSVILLE
ROAD
TRENCH
27'30"
4368
4367
4366
4365
4364
4363
4362
25'
(SPESUTIE)
5762 I NE
Mosquito
Creek
Myosotis macrosperma Engelm.
Delph
Creek
Old Womans Gut
Sand
Stony Point
hard
soft
Creek
20
32
17
6


SPESUTIE QUADRANGL
Pendicularis lanceolata Michx.
Sands Cove
Locust Point
Neds Island
Radio Tower
NARROWS
PROVING GROUND
SPESUTIE
SPESUTIE ISLAND
MIL RES (APPROX)
SPESUTIE ROAD
Brier Point
Johnson Point
Mulberry Point
Back Creek
Light
Tower
Sandy Point
Bear Point

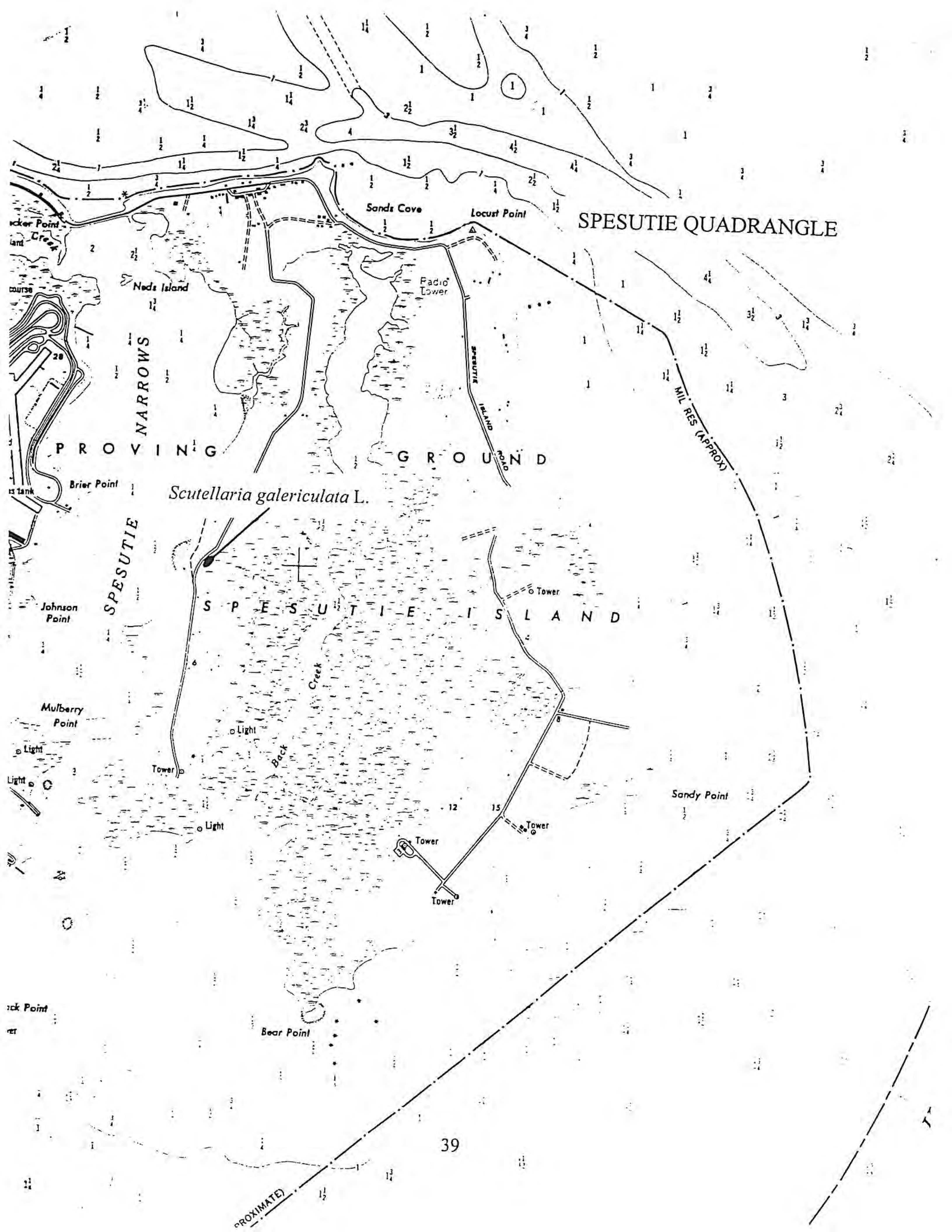

EDGEWOOD QUADI
Potamogeton foliosus Raf.
ARMY CHEMICAL CENTER
Covered reservoir
Trailer Park
Branch
Reservoir
Copenhaver Park
Magnolia
Foster
HARFORD CO
MORE CO
Gunpowder Falls
POWDER
FALLS
DAYS ISLAND
GUNPOWDER FALLS
STATE PARK
DAYS COVE
Westwood Range
Transformer stations
Water
Canal
Reardon Inlet
AMTRAK
TRACKS
MAGNOLIA
Piney Point
Hog Point
GUNPOWDER
RIVER
HARFORD CO
BALTIMORE CO
APPROX BDY
RIVER
BIRD
Iron Point
West Twin River
Harewood Park
Harewood
382 980 000 FEET
383
384
385
20′
386
ped by the Army Map Service
d and published by the Geological Survey
l by NOS/NOAA, USCE, and USGS
aphy by photogrammetric methods from aerial



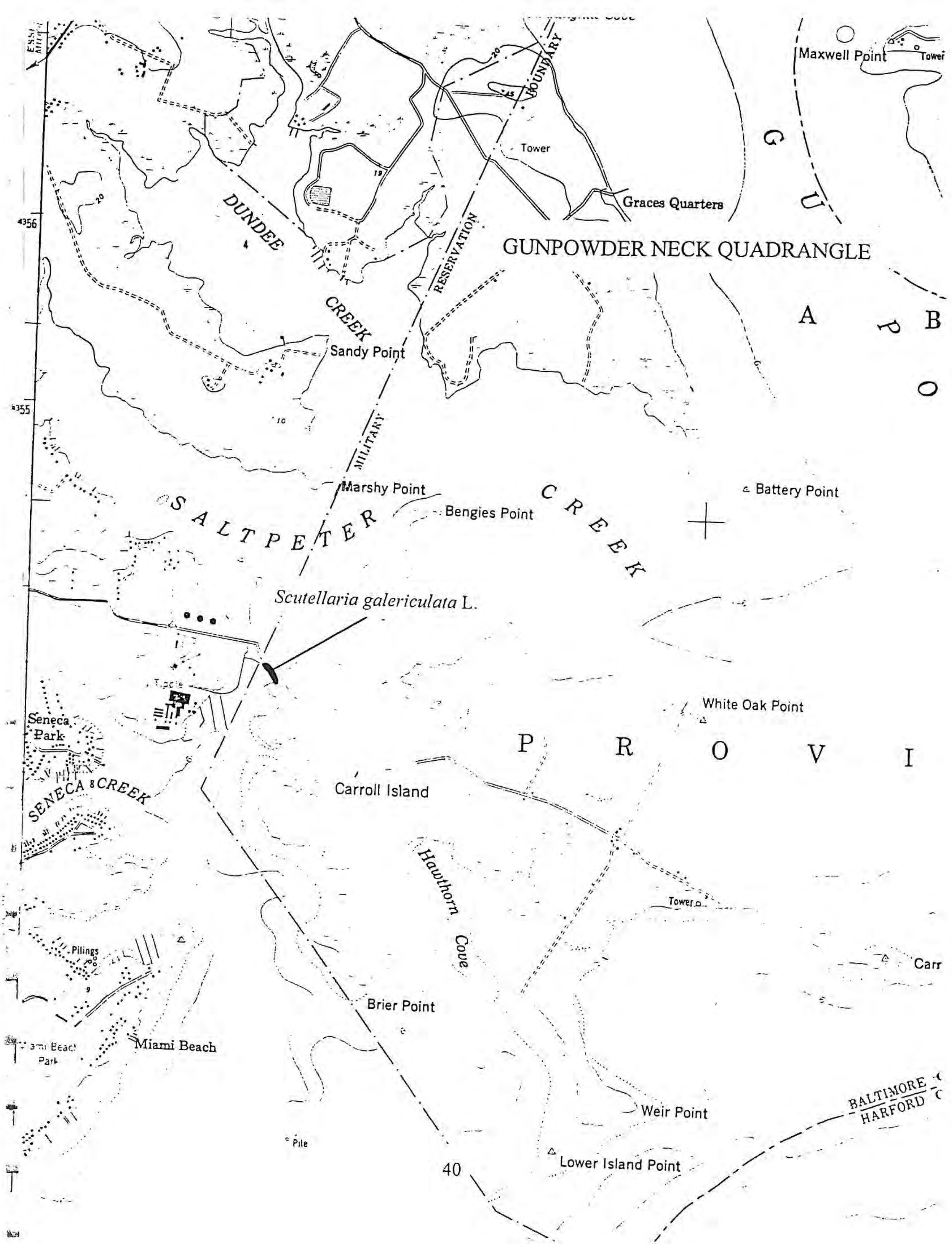
GUNPOWDER FALLS STATE PARK
Cunninghill Cove
Maxwell Point
Tower
GUNPOWDER NECK QUADRANGLE
Graces Quarters
DUNDEE CREEK
BOUNDARY
RESERVATION
MILITARY
Sandy Point
Marshy Point
Bengies Point
SALTPETER CREEK
Battery Point
Potamogeton pusillus L.
White Oak Point
PROVI
Carroll Island
Hawthorn Cove
Potamogeton pusillus L.
Carroll P
Pilings
Brier Point
Miami Beach
Weir Point
Lower Island Point
Pile
BALTIMORE CO
HARFORD CO

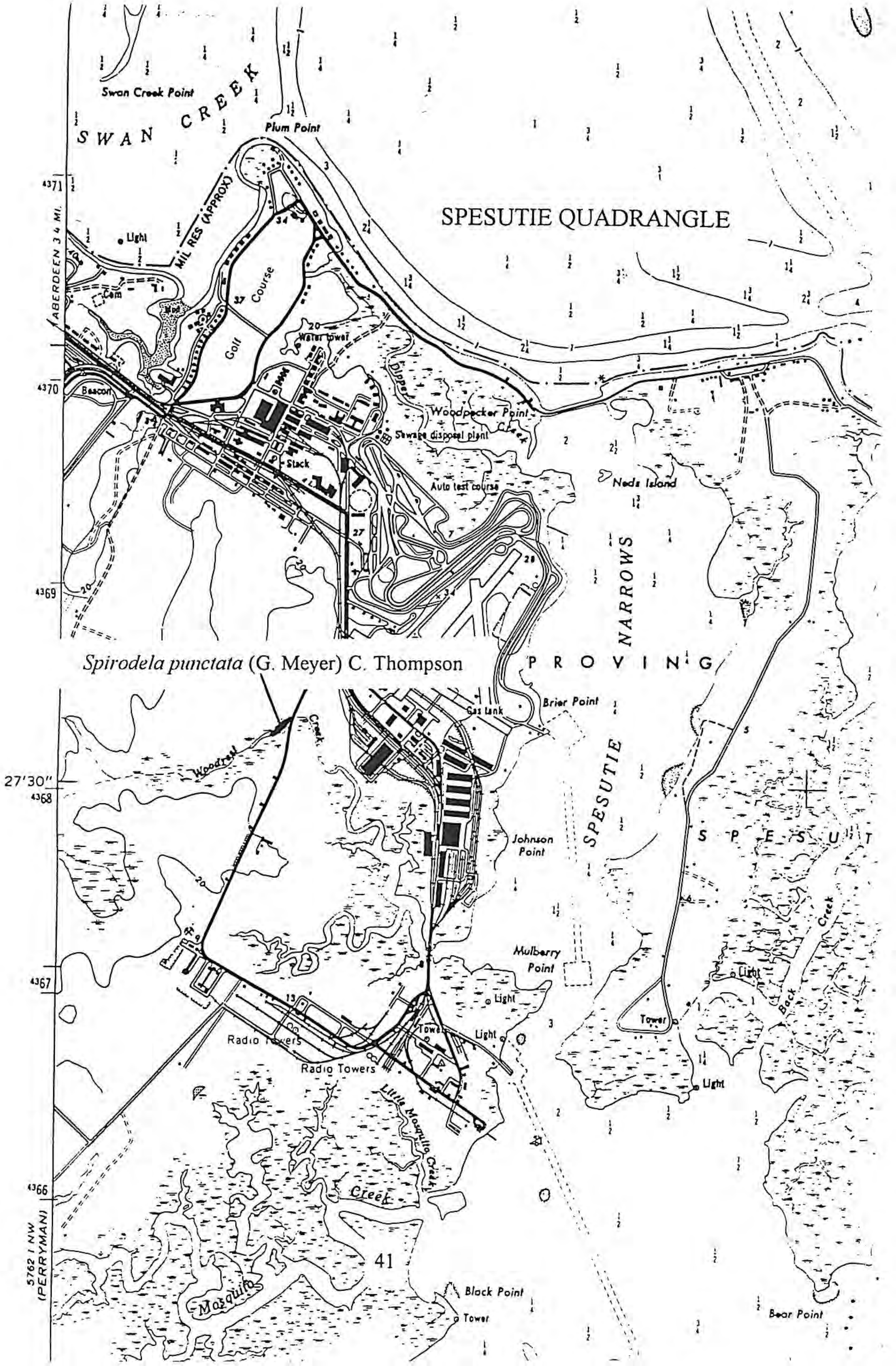

GUNPOWDER NECK QUADRANGLE
Rhynchospora globularis (Chapman) Small var. recognita Gale
Bush Point
Briery Point 21
Rifle range
Creek
Tower
Watson Creek
WATSON CREEK ROAD
POINT ROAD
RICKETT POINT ROAD
G U N P O W D E R N E C K
D E E N
G R O U N D
Sandy Point
Leges Point
Boone Creek
Fords Point
Ruins
Point
(HANESVILLE) 5762 I SW
4357
4356
4355
20′
4354
4353

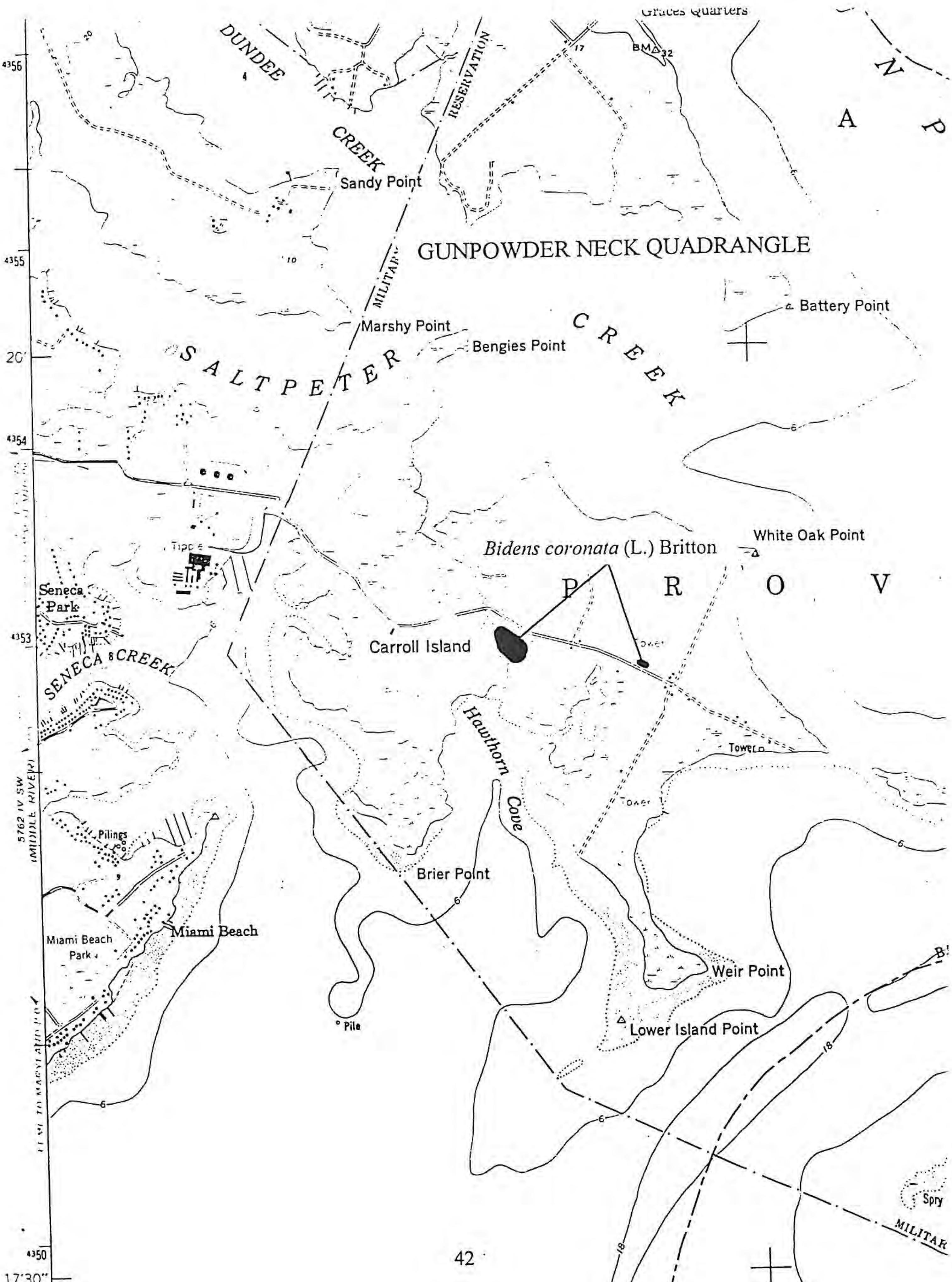
SPESUTIE QUADRANGLE



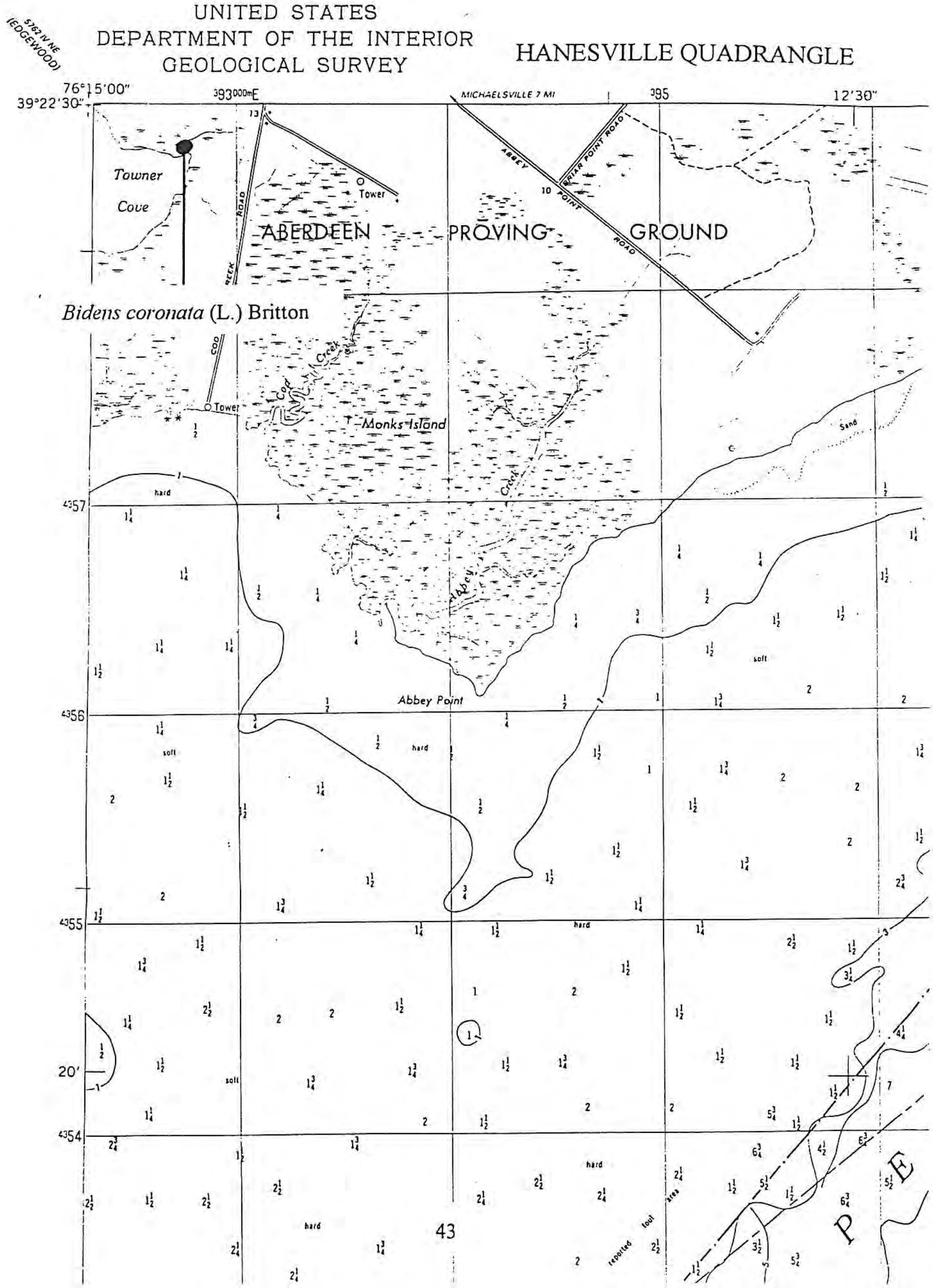
Scutellaria galericulata L.


GUNPOWDER NECK QUADRANGLE
Scutellaria galericulata L.
Maxwell Point
Tower
Tower
Graces Quarters
DUNDEE
CREEK
MILITARY
RESERVATION
BOUNDARY
Sandy Point
Marshy Point
Bengies Point
SALTPETER CREEK
Battery Point
White Oak Point
P R O V I
A P B O
Seneca Park
SENECA CREEK
Carroll Island
Hawthorn Cove
Tower
Pilings
Brier Point
Miami Beach
Weir Point
Lower Island Point
Pile
BALTIMORE
HARFORD

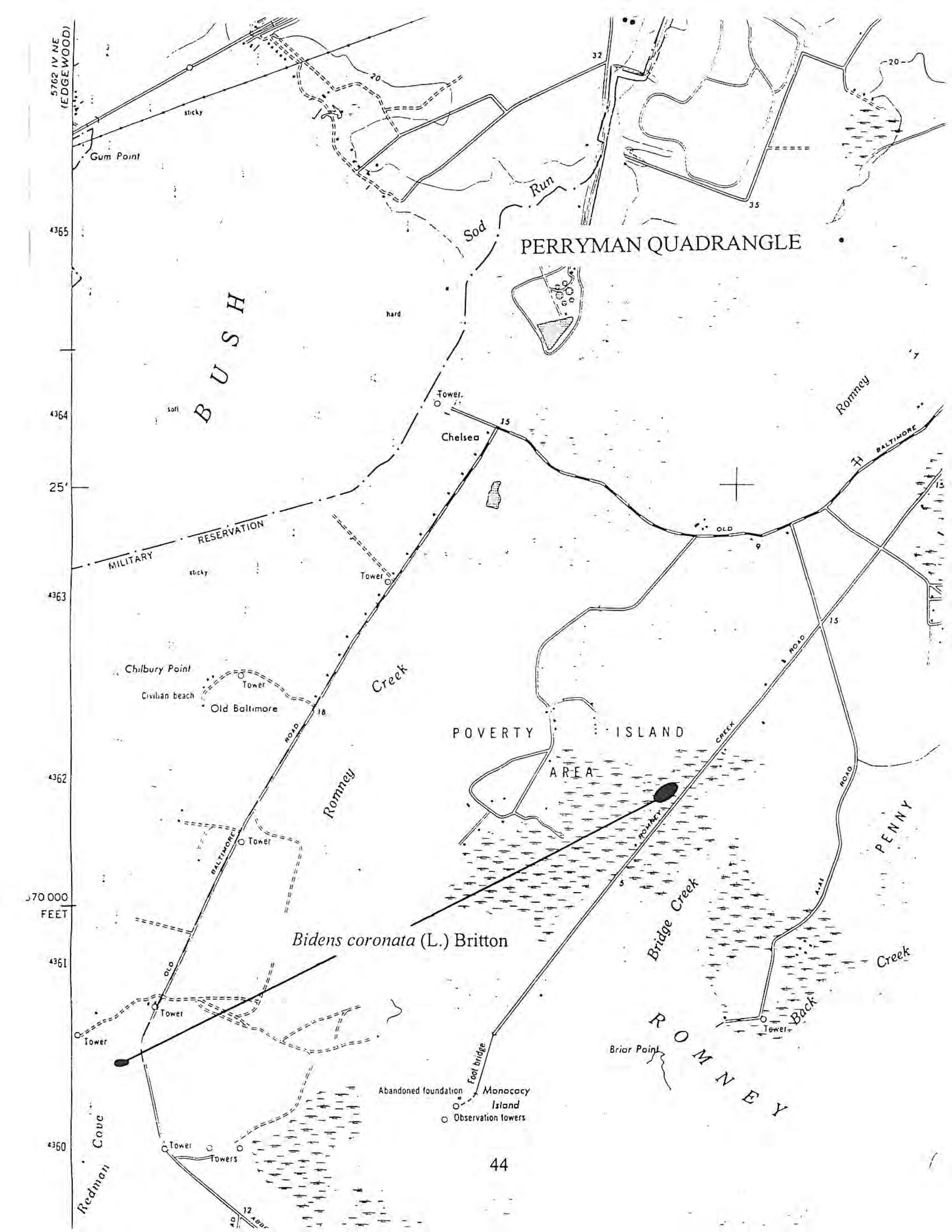

SPESUTIE QUADRANGLE
Spirodela punctata (G. Meyer) C. Thompson
Swan Creek Point
SWAN CREEK
Plum Point
MIL RES (APPROX)
Light
Golf Course
Water tower
Beacon
Woodpecker Point
Sewage disposal plant
Stack
Auto test course
Neds Island
NARROWS
PROVING
Brier Point
Gas tank
Woodrest
Creek
SPESUTIE
Johnson Point
Mulberry Point
Light
Radio Towers
Radio Towers
Tower
Little Mosquito Creek
Creek
Mosquito
Black Point
Tower
Bear Point
Back Creek
ABERDEEN 3.4 MI.
5762 I NW (PERRYMAN)
27'30"
4371
4370
4369
4368
4367
4366

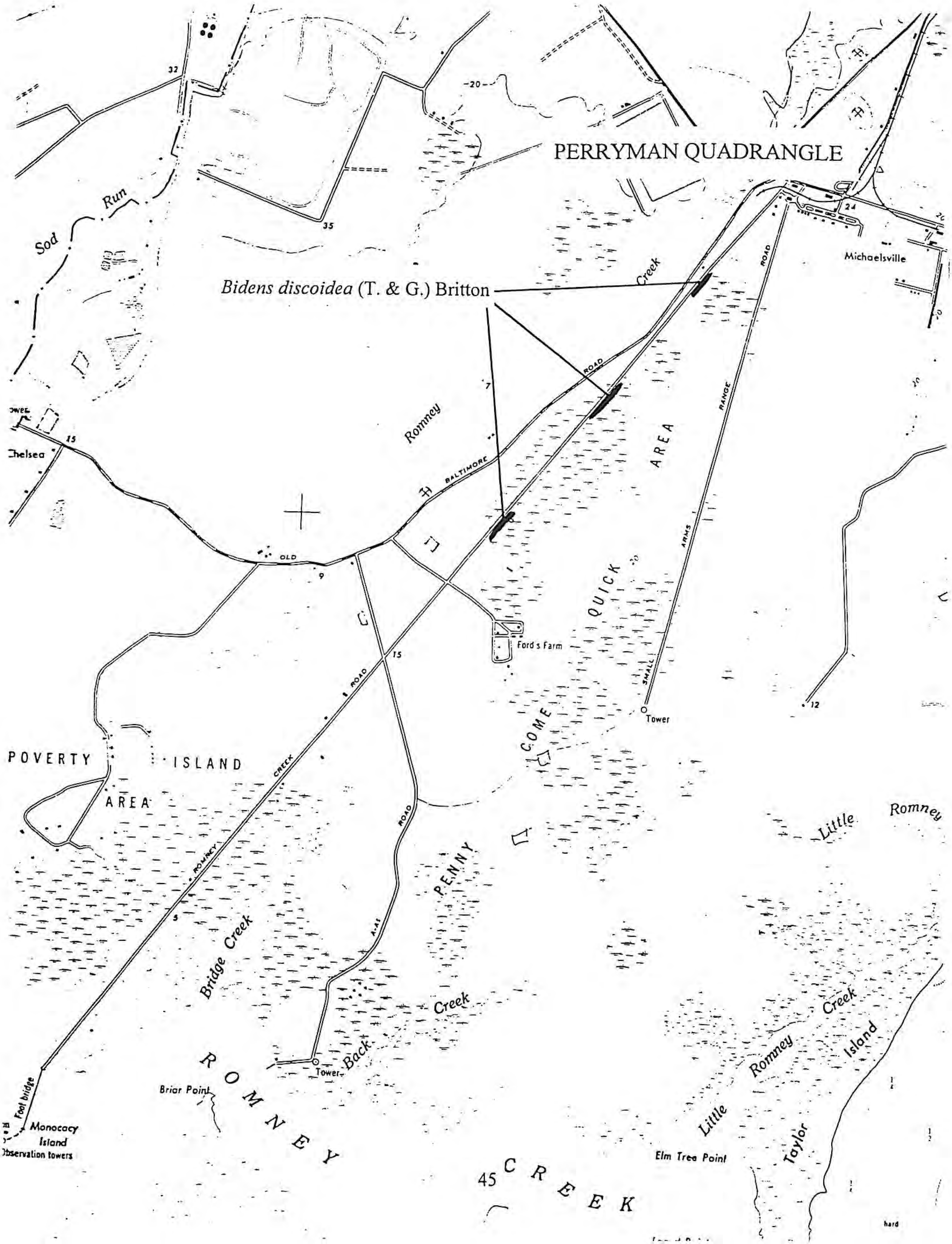


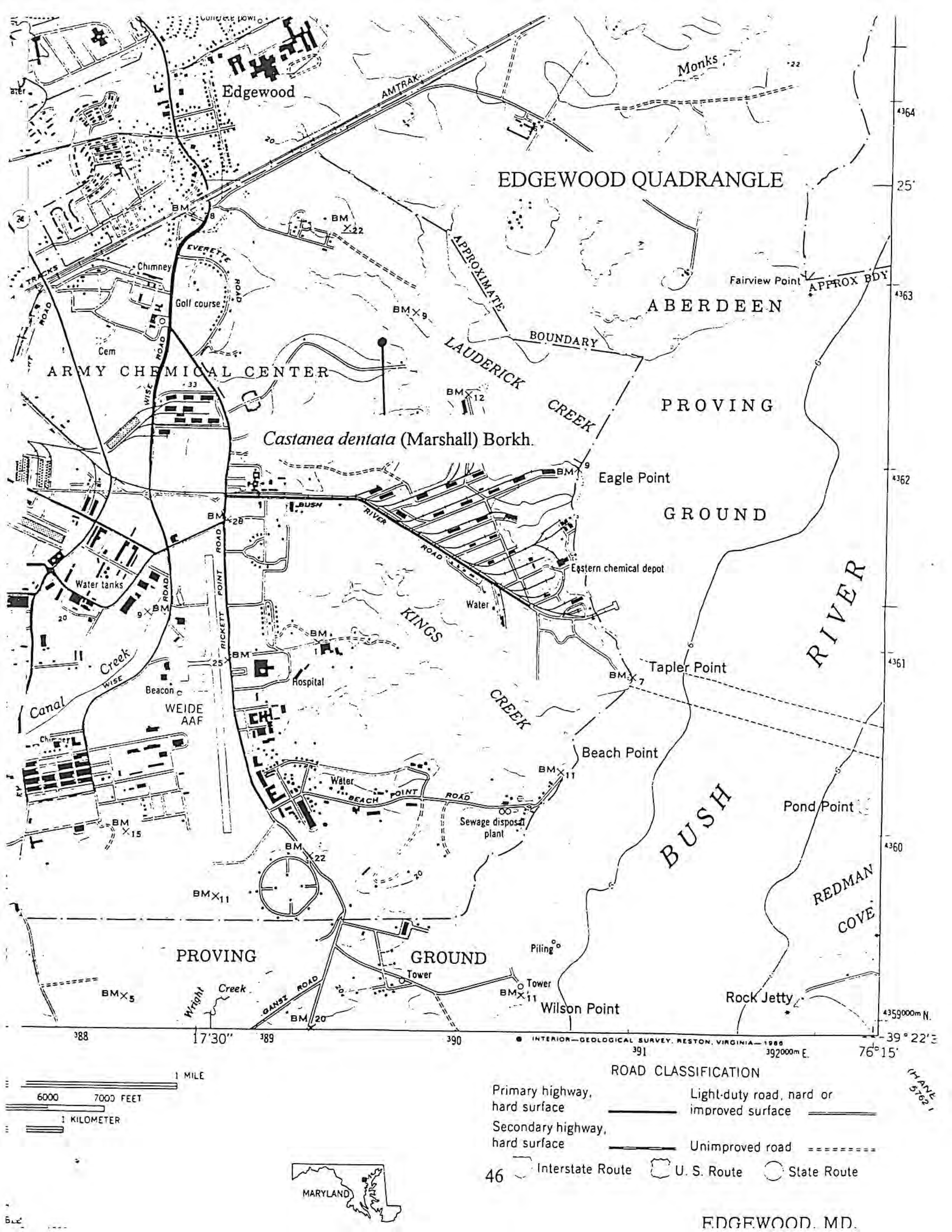
GUNPOWDER NECK QUADRANGLE
Bidens coronata (L.) Britton
Graces Quarters
DUNDEE
CREEK
RESERVATION
MILITARY
Sandy Point
Marshy Point
Bengies Point
Battery Point
SALTPETER
CREEK
White Oak Point
A P
P R O V
Tipple
Seneca Park
SENECA CREEK
Carroll Island
Tower
Hawthorn Cove
Pilings
Brier Point
Miami Beach
Miami Beach Park
Weir Point
Lower Island Point
Pile
Spry
MILITAR
5762 IV SW
(MIDDLE RIVER)
4356
4355
4354
4353
4350
20′
17′30″



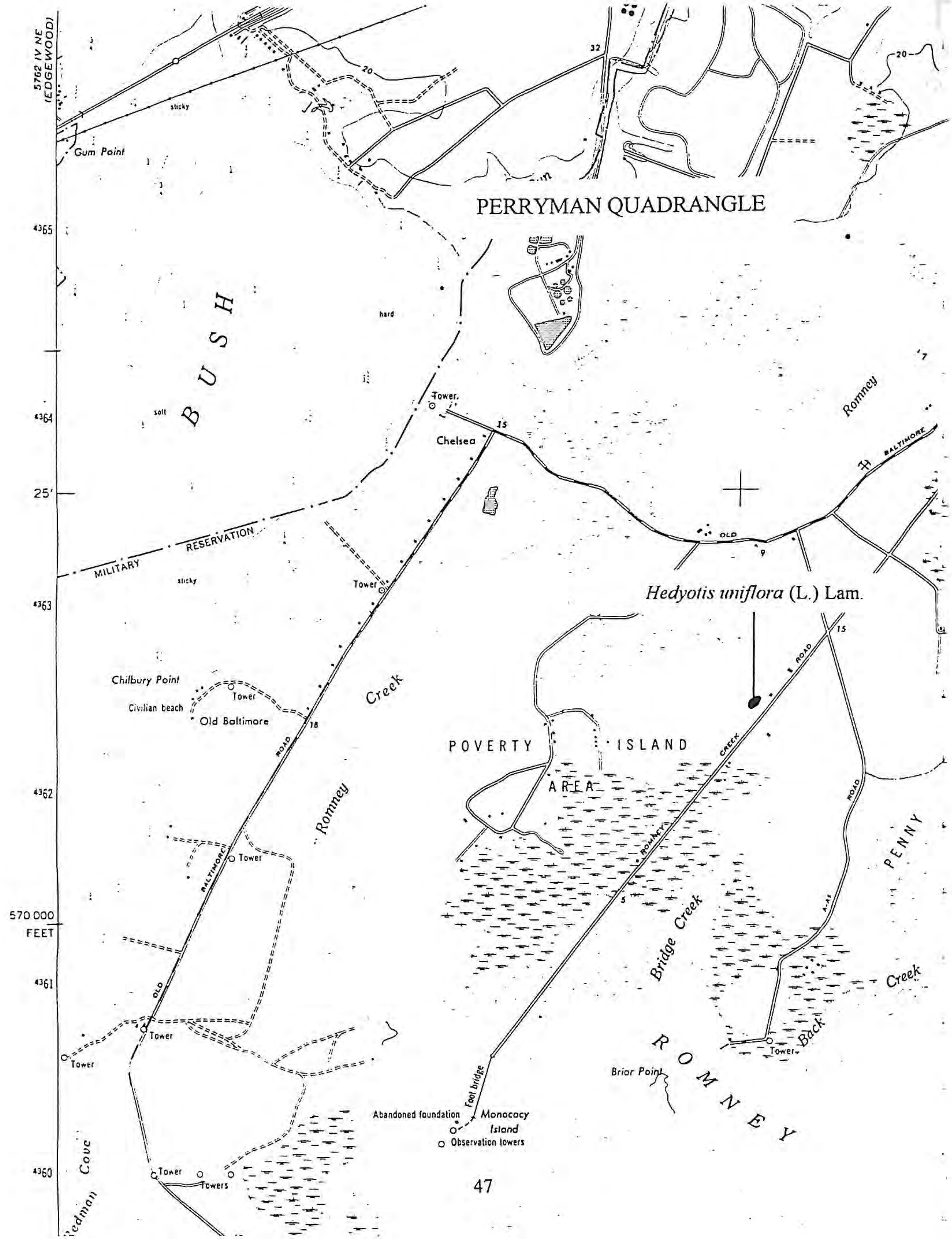
Bidens coronata (L.) Britton

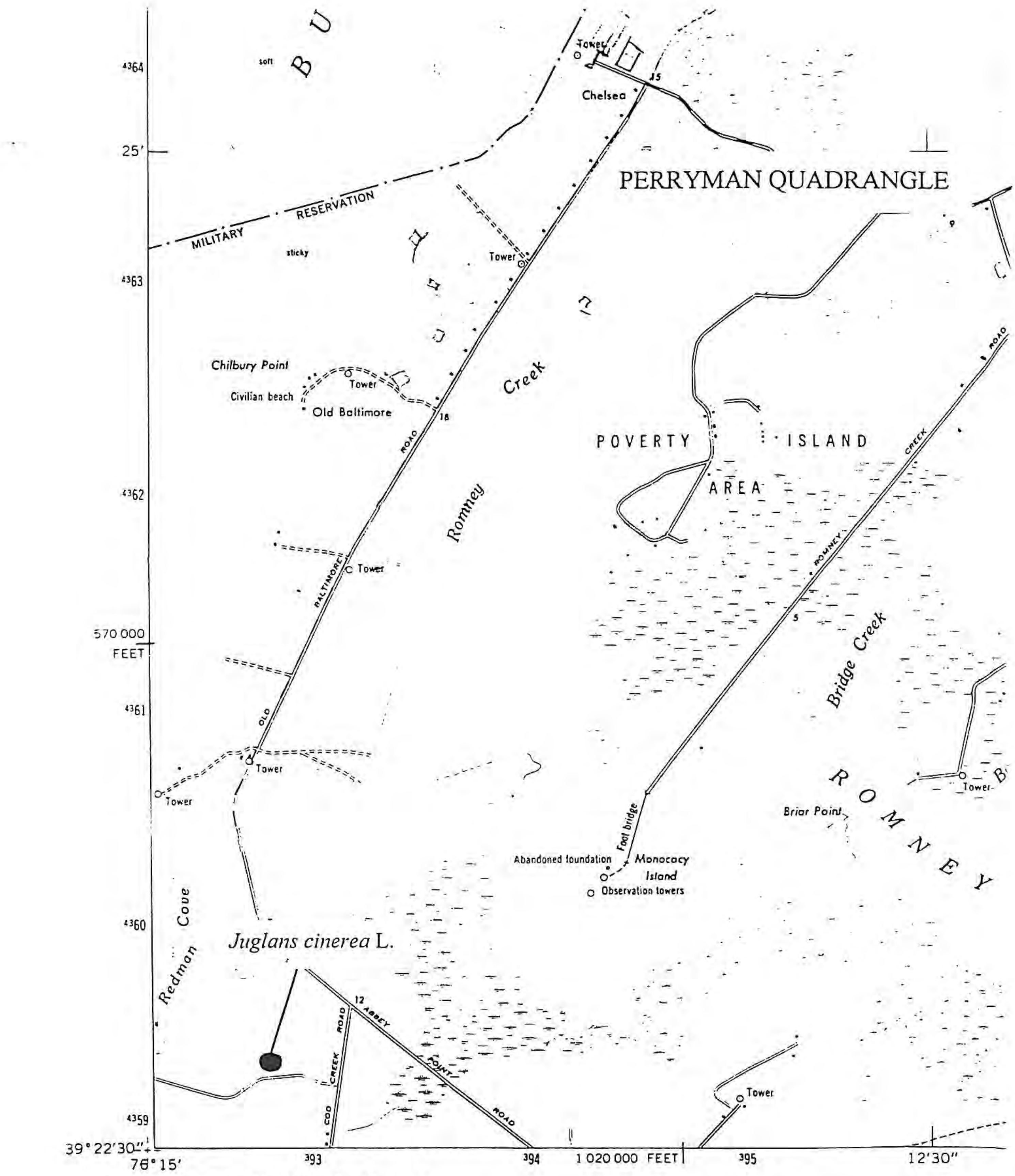

PERRYMAN QUADRANGLE
Bidens coronata (L.) Britton
5762 IV NE (EDGEWOOD)
Gum Point
Sod Run
BUSH
MILITARY RESERVATION
Chelsea
Tower
Chilbury Point
Civilian beach
Old Baltimore
Romney Creek
POVERTY ISLAND AREA
Bridge Creek
Back Creek
PENNY
ROMNEY
Briar Point
Foot bridge
Abandoned foundation
Monocacy Island
Observation towers
Towers
Redman Cove
Romney
OLD BALTIMORE ROAD
ROMNEY CREEK ROAD
570 000 FEET
25'


PERRYMAN QUADRANGLE
Bidens discoidea (T. & G.) Britton
Sod Run
Michaelsville
Creek
Romney
Chelsea
BALTIMORE
OLD
ROAD
SMALL ARMS RANGE ROAD
AREA
QUICK
COME
Ford's Farm
Tower
POVERTY ISLAND AREA
ROMNEY CREEK ROAD
PENNY
Little Romney
Bridge Creek
Back Creek
Tower
Briar Point
Foot bridge
Monocacy Island
Observation towers
ROMNEY CREEK
Little Romney Creek
Taylor Island
Elm Tree Point



EDGEWOOD QUADRANGLE
Castanea dentata (Marshall) Borkh.
Edgewood
AMTRAK
Monks
ABERDEEN
PROVING
GROUND
APPROXIMATE BOUNDARY
APPROX BDY
Fairview Point
LAUDERICK CREEK
ARMY CHEMICAL CENTER
Chimney
Golf course
EVERETTE ROAD
WISE ROAD
Cem
Eagle Point
BUSH RIVER ROAD
Eastern chemical depot
Water tanks
Water
KINGS CREEK
RICKETT POINT ROAD
Hospital
Tapler Point
Canal Creek
Beacon
WEIDE AAF
Beach Point
BEACH POINT ROAD
Sewage disposal plant
BUSH RIVER
Pond Point
REDMAN COVE
PROVING
GROUND
Piling
Tower
Wright Creek
GANSZ ROAD
Wilson Point
Rock Jetty
INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1986
17'30"
39°22'
76°15'
1 MILE
6000
7000 FEET
1 KILOMETER
ROAD CLASSIFICATION
Primary highway, hard surface
Light-duty road, hard or improved surface
Secondary highway, hard surface
Unimproved road
Interstate Route
U. S. Route
State Route
MARYLAND
EDGEWOOD, MD.


PERRYMAN QUADRANGLE
Hedyotis uniflora (L.) Lam.
5762 IV NE (EDGEWOOD)
Gum Point
sticky
20
32
4365
hard
BUSH
soft
Tower
4364
Chelsea
15
Romney
BALTIMORE
25'
MILITARY RESERVATION
OLD
9
Tower
4363
15
ROAD
Chilbury Point
Tower
Civilian beach
Old Baltimore
18
Creek
POVERTY ISLAND AREA
CREEK
4362
ROAD
Romney
ROMNEY
BALTIMORE
Tower
PENNY
570 000 FEET
5
Bridge Creek
A-AF
4361
OLD
Creek
Tower
Back
Tower
ROMNEY
Tower
Brior Point
Foot bridge
Abandoned foundation
Monocacy Island
Observation towers
4360
Cove
Tower
Towers



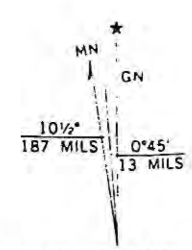
Mapped by the Army Map Service
Published for civil use by the Geological Survey

Control by NOS/NOAA

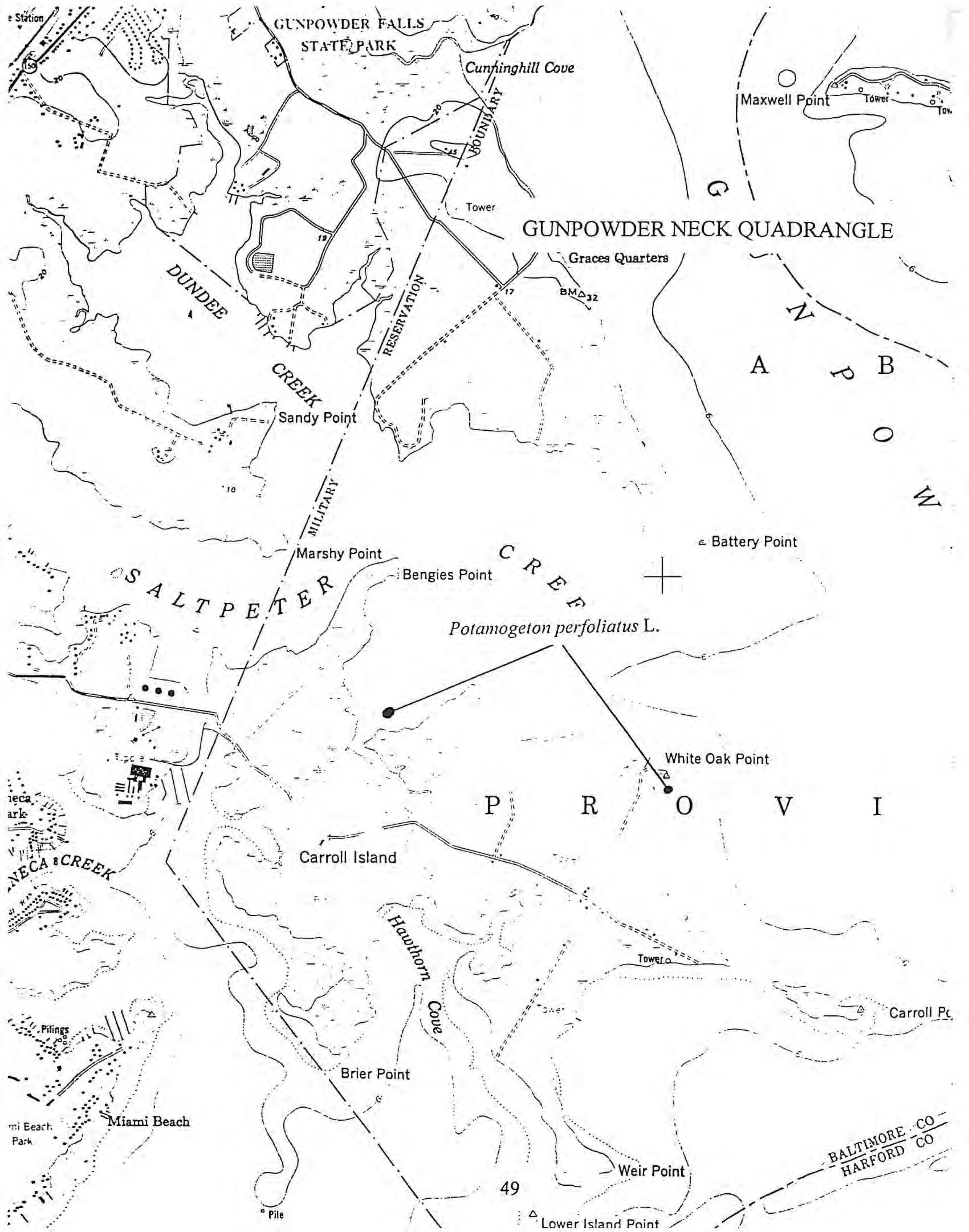
Planimetry by photogrammetric methods from aerial photographs taken 1943. Topography by planetable surveys 1944. Culture revised from aerial photographs taken 1947. Field checked 1948

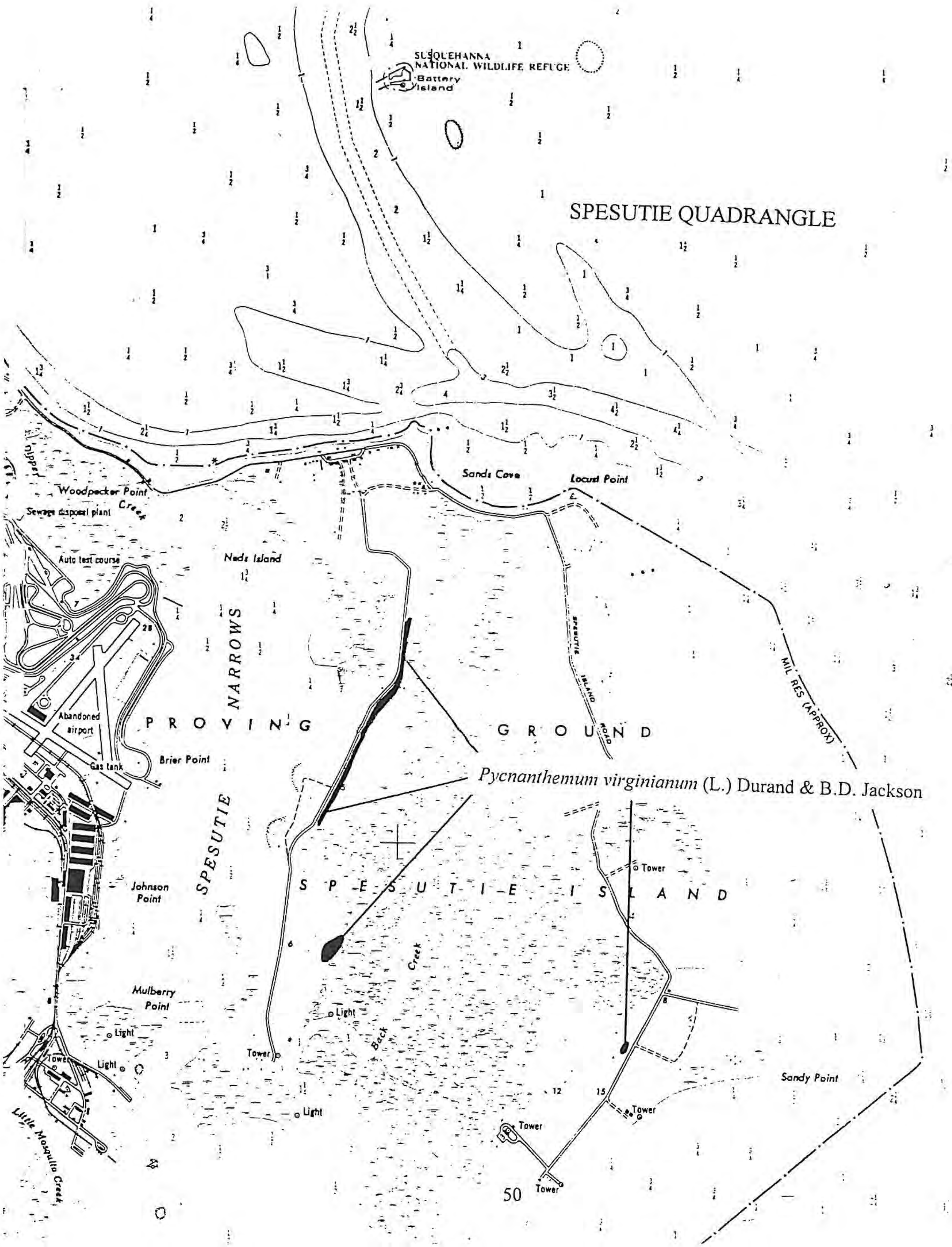
Selected hydrographic data compiled from NOS chart 572 (1947)
This information is not intended for navigational p s

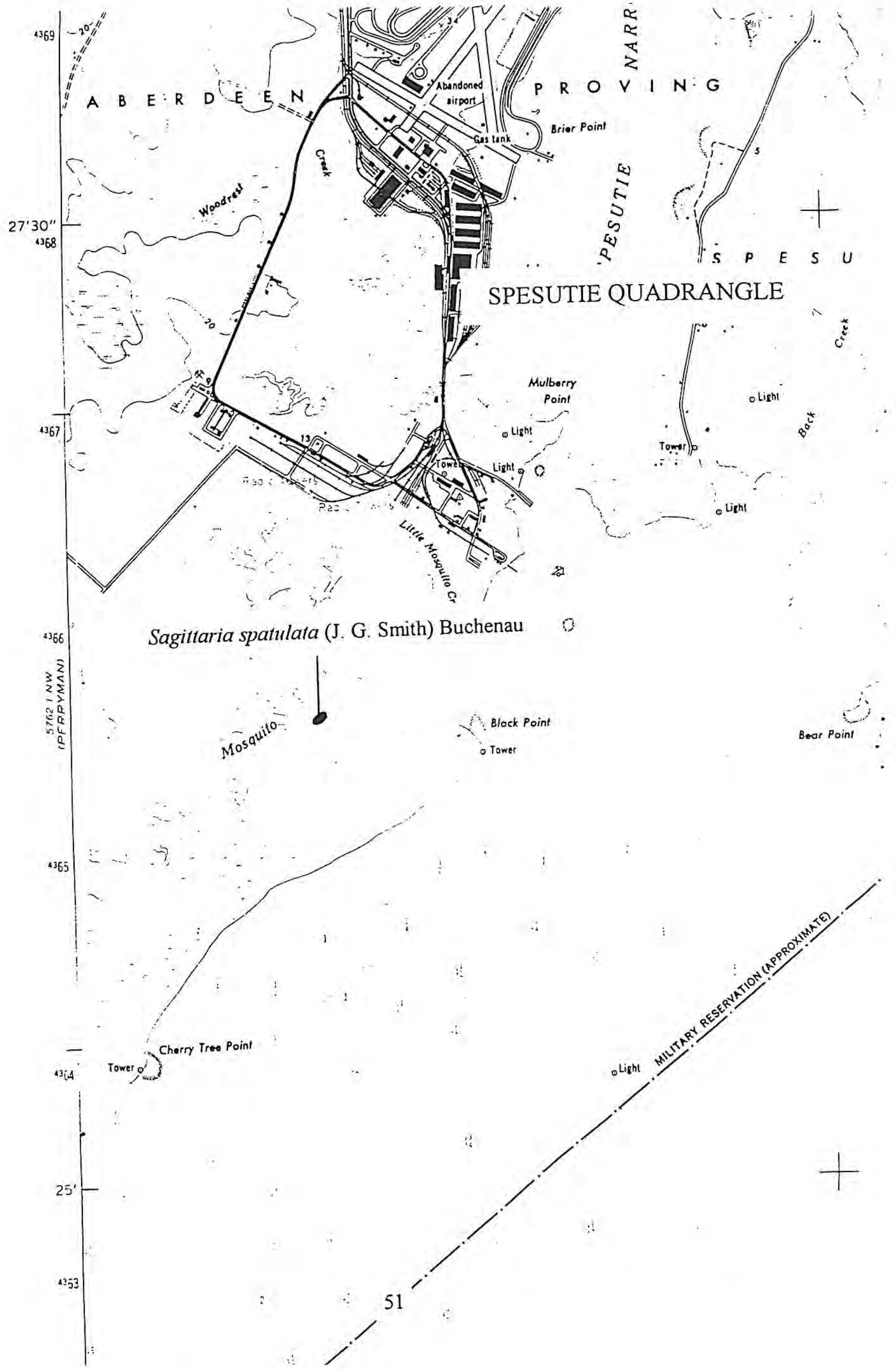
Polyconic projection. 10,000-foot grid ticks bas
Maryland coordinate system
1000-meter Universal Transverse Mercator grid ticks, zone 18, shown in blue
1927 North American Datum
To place on the predicted North American Datum 1983



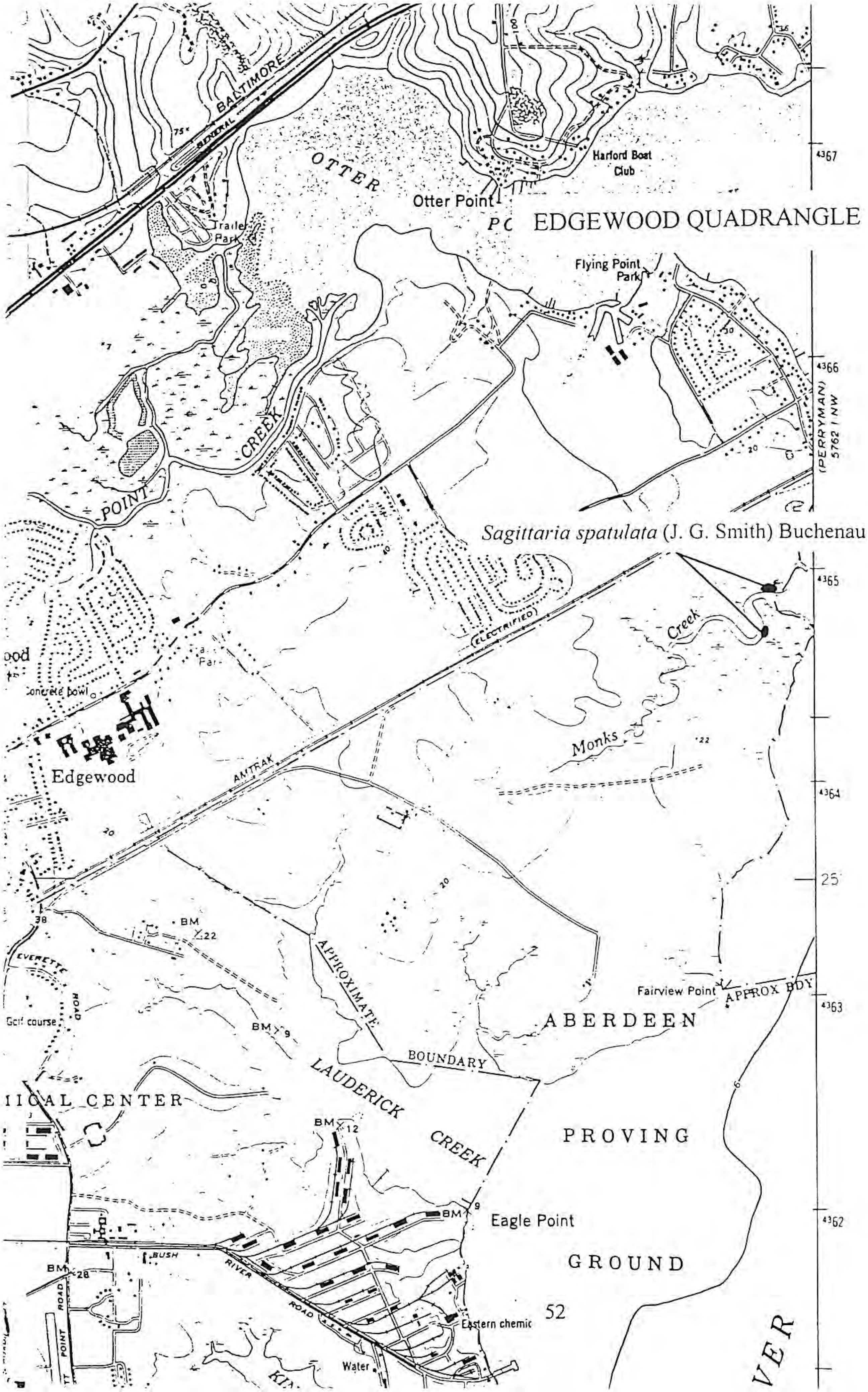
UTM GRID AND 1984 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

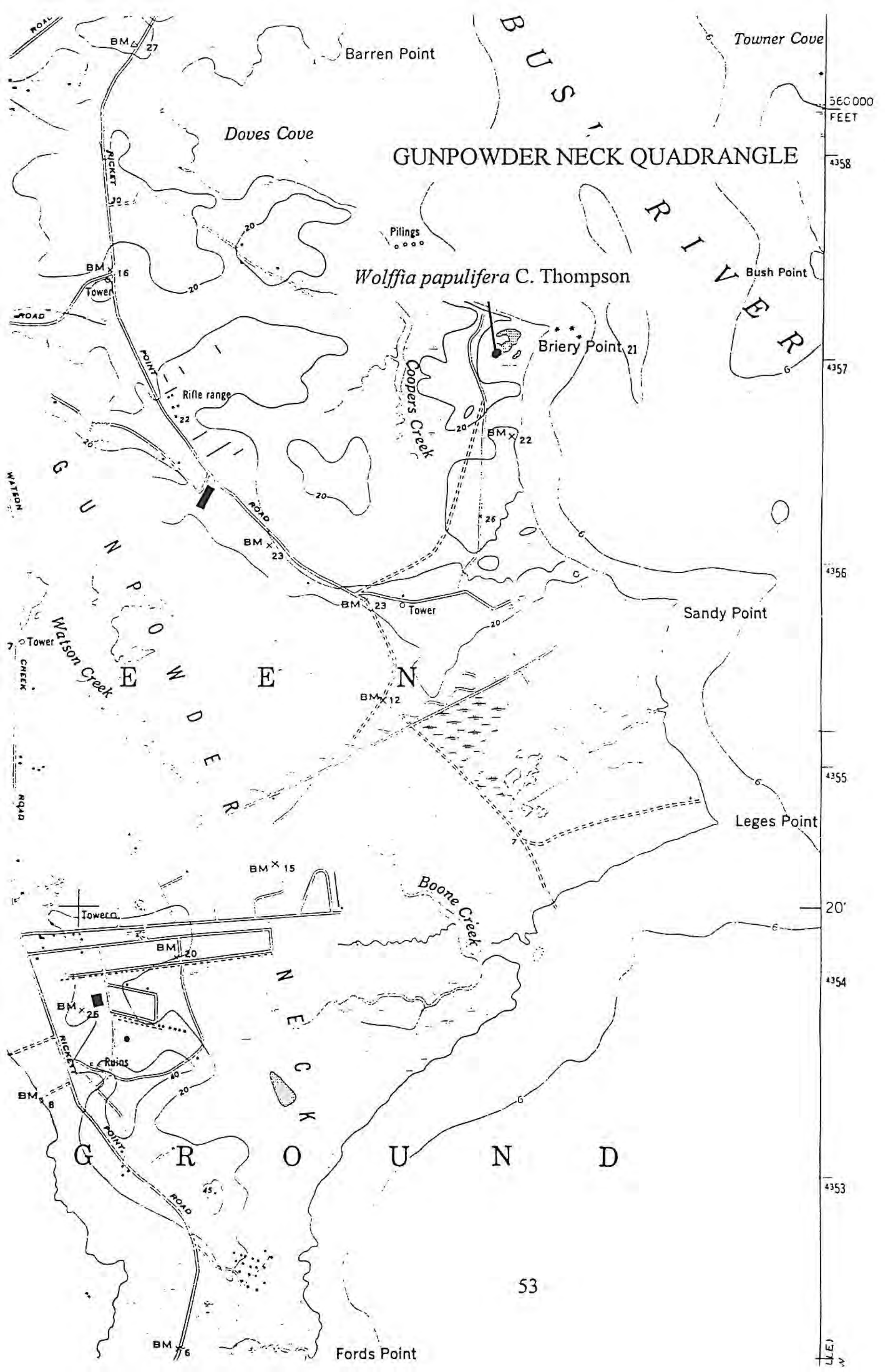

GUNPOWDER NECK QUADRANGLE
Potamogeton perfoliatus L.
GUNPOWDER FALLS
STATE PARK
Cunninghill Cove
BOUNDARY
RESERVATION
MILITARY
Maxwell Point
Tower
Graces Quarters
BM 32
DUNDEE
CREEK
Sandy Point
GUNPOWDER
Battery Point
Marshy Point
Bengies Point
SALTPETER CREEK
White Oak Point
PROVI
Carroll Island
SENECA CREEK
Hawthorn Cove
Tower
Carroll Pt
Pilings
Brier Point
Miami Beach
Weir Point
BALTIMORE CO
HARFORD CO
Pile
Lower Island Point

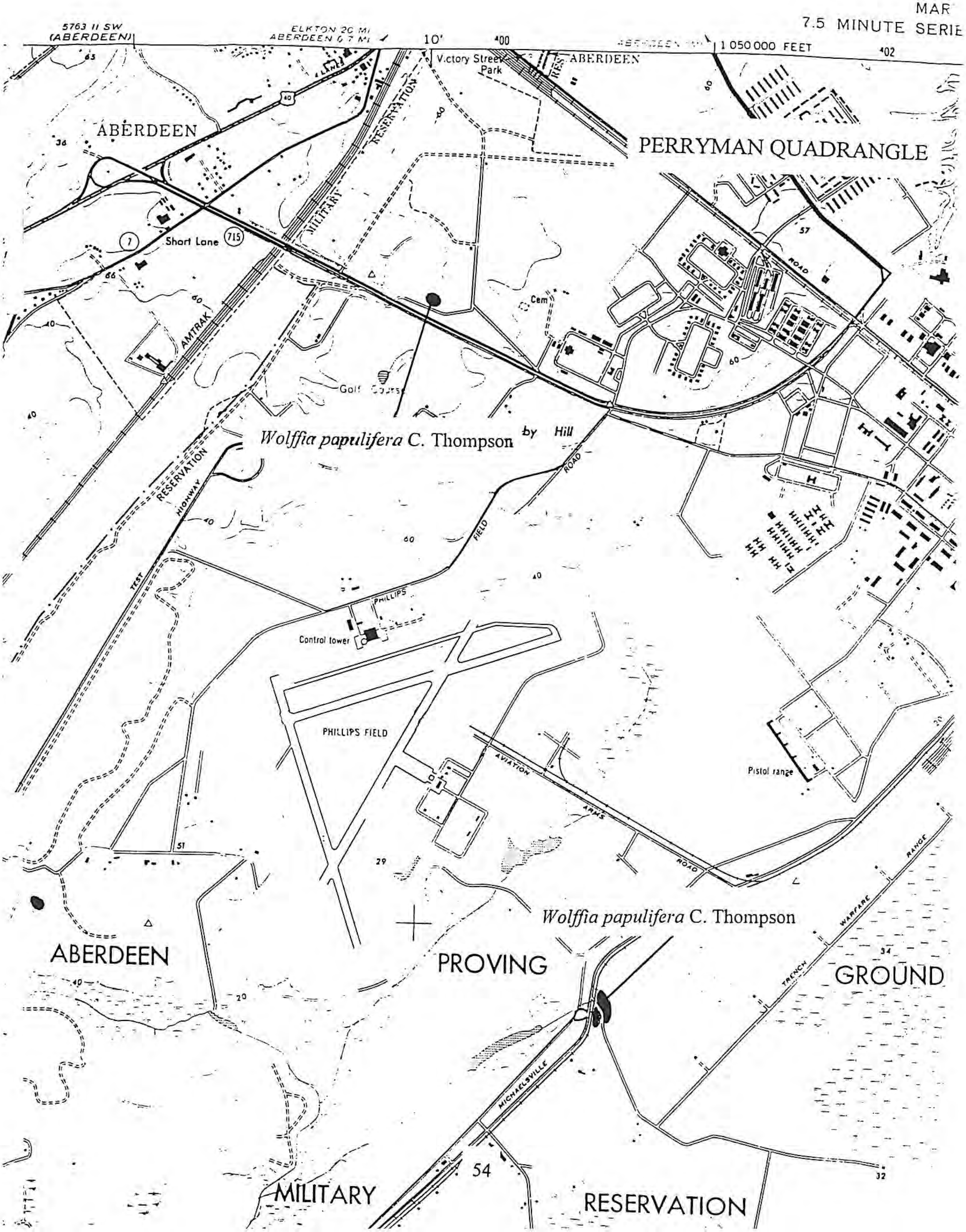

SPESUTIE QUADRANGLE
SUSQUEHANNA NATIONAL WILDLIFE REFUGE
Battery Island
Sands Cove
Locust Point
Woodpecker Point
Sewage disposal plant
Auto test course
Neds Island
Abandoned airport
PROVING GROUND
SPESUTIE NARROWS
Gas tank
Brier Point
SPESUTIE ISLAND ROAD
MIL RES (APPROX)
Pycnanthemum virginianum (L.) Durand & B.D. Jackson
Johnson Point
SPESUTIE ISLAND
Tower
Back Creek
Mulberry Point
Light
Sandy Point
Little Mosquito Creek



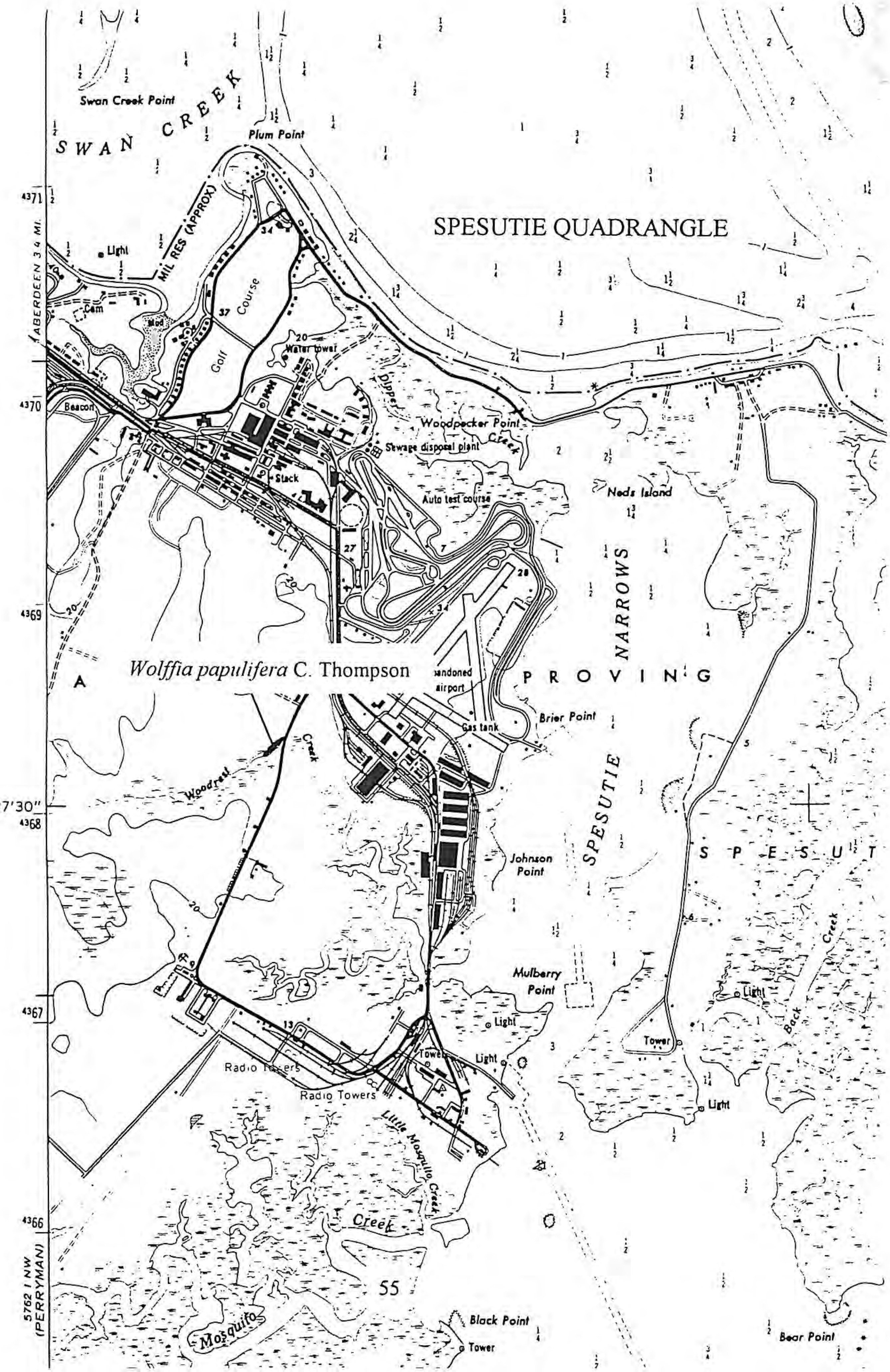
SPESUTIE QUADRANGLE
Sagittaria spatulata (J. G. Smith) Buchenau
ABERDEEN
PROVING
Abandoned airport
Gas tank
Brier Point
SPESUTIE
NARR
SPESU
Woodrest
Creek
Mulberry Point
Light
Tower
Back
Little Mosquito Cr
Mosquito
Black Point
Bear Point
Cherry Tree Point
MILITARY RESERVATION (APPROXIMATE)
27'30"
25'
5762 I NW (PERRYMAN)
4369
4368
4367
4366
4365
4364
4363


EDGEWOOD QUADRANGLE
Sagittaria spatulata (J. G. Smith) Buchenau
BALTIMORE
OTTER
Otter Point
Harford Boat Club
Trailer Park
Flying Point Park
POINT
CREEK
(PERRYMAN) 5762 I NW
(ELECTRIFIED)
Monks Creek
AMTRAK
Edgewood
Concrete bowl
APPROXIMATE BOUNDARY
LAUDERICK CREEK
Fairview Point
APPROX BDY
ABERDEEN
PROVING
GROUND
Eagle Point
BUSH RIVER ROAD
Eastern chemic
Water
Golf course
EVERETTE ROAD
POINT ROAD
ICAL CENTER


GUNPOWDER NECK QUADRANGLE
Wolffia papulifera C. Thompson
BUSH RIVER
GUNPOWDER NECK GROUND
Towner Cove
Barren Point
Doves Cove
Pilings
Bush Point
Briery Point
Coopers Creek
Rifle range
Tower
Sandy Point
Watson Creek
Leges Point
Boone Creek
Ruins
Fords Point
RICKET POINT ROAD
560000 FEET
4358
4357
4356
4355
20'
4354
4353

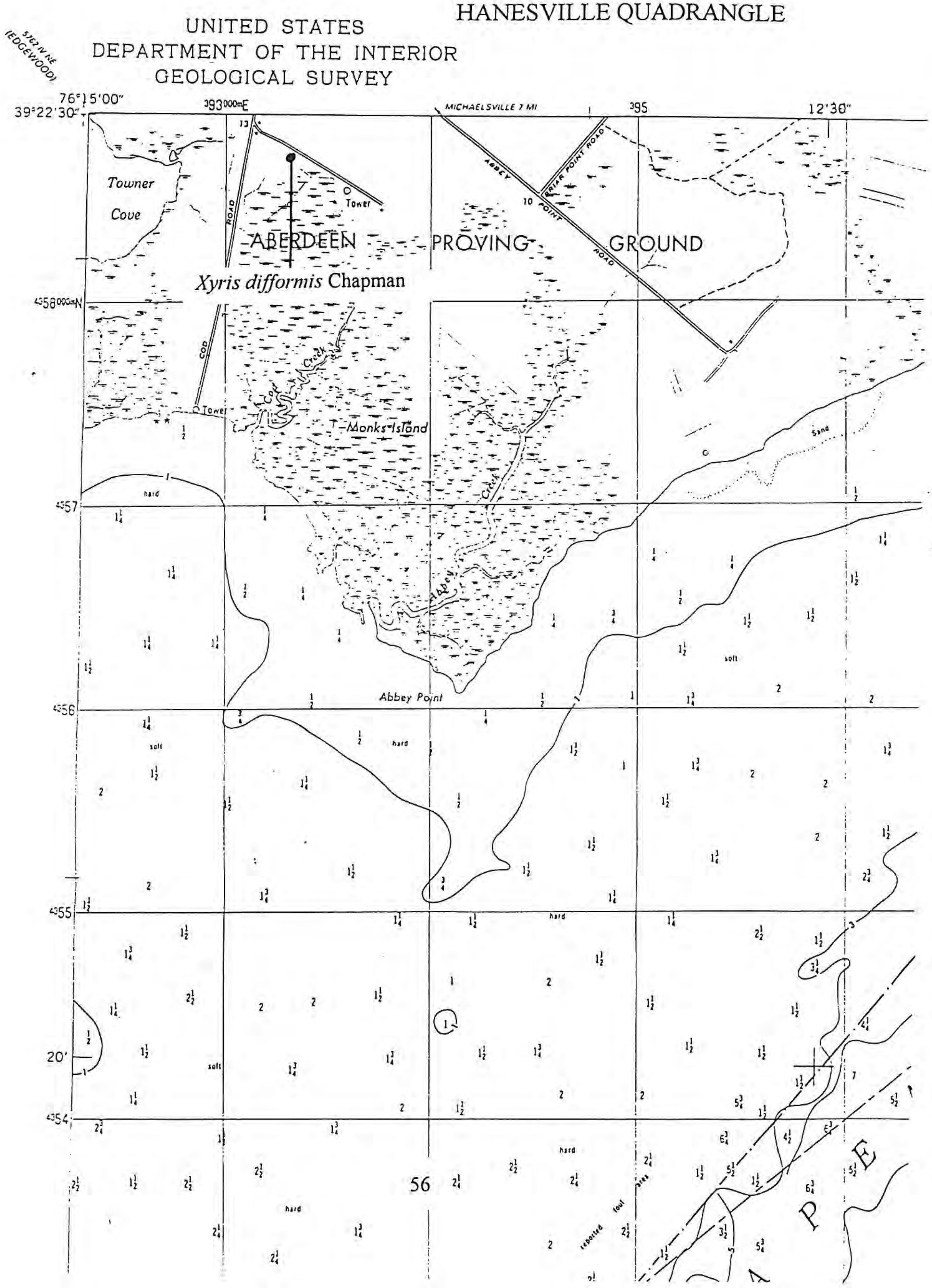

MAR
7.5 MINUTE SERIE
5763 II SW
(ABERDEEN)
ELKTON 20 MI
10'
400
1 050 000 FEET
402
Victory Street Park
ABERDEEN
PERRYMAN QUADRANGLE
ABERDEEN
Short Lane
AMTRAK
MILITARY
RESERVATION
Cem
Golf Course
ROAD
Wolffia papulifera C. Thompson
by Hill
RESERVATION
HIGHWAY
TEST
FIELD
PHILLIPS
Control tower
PHILLIPS FIELD
AVIATION
ARMS
ROAD
Pistol range
RANGE
WARFARE
TRENCH
Wolffia papulifera C. Thompson
ABERDEEN
PROVING
GROUND
MICHAELSVILLE
MILITARY
RESERVATION

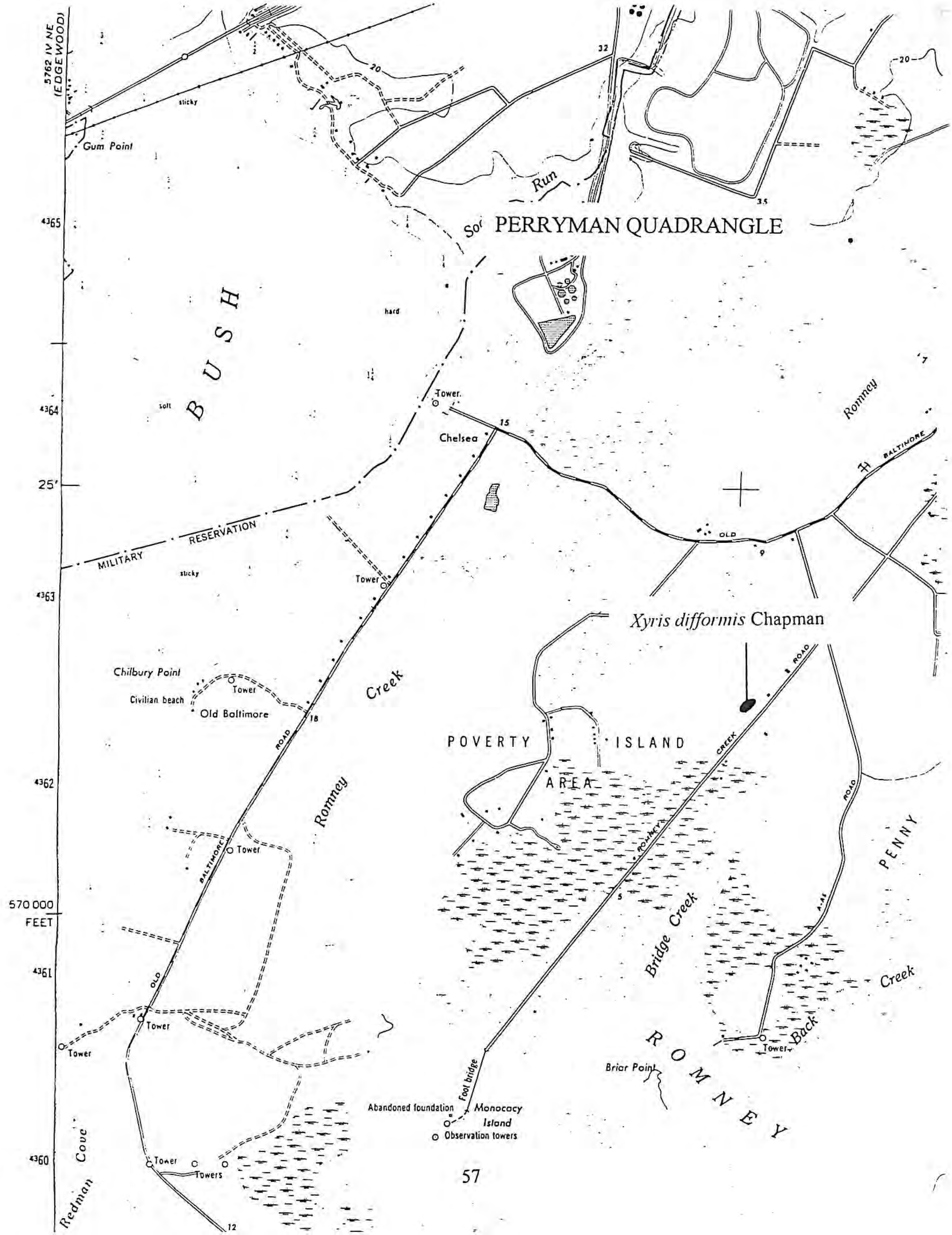
SPESUTIE QUADRANGLE

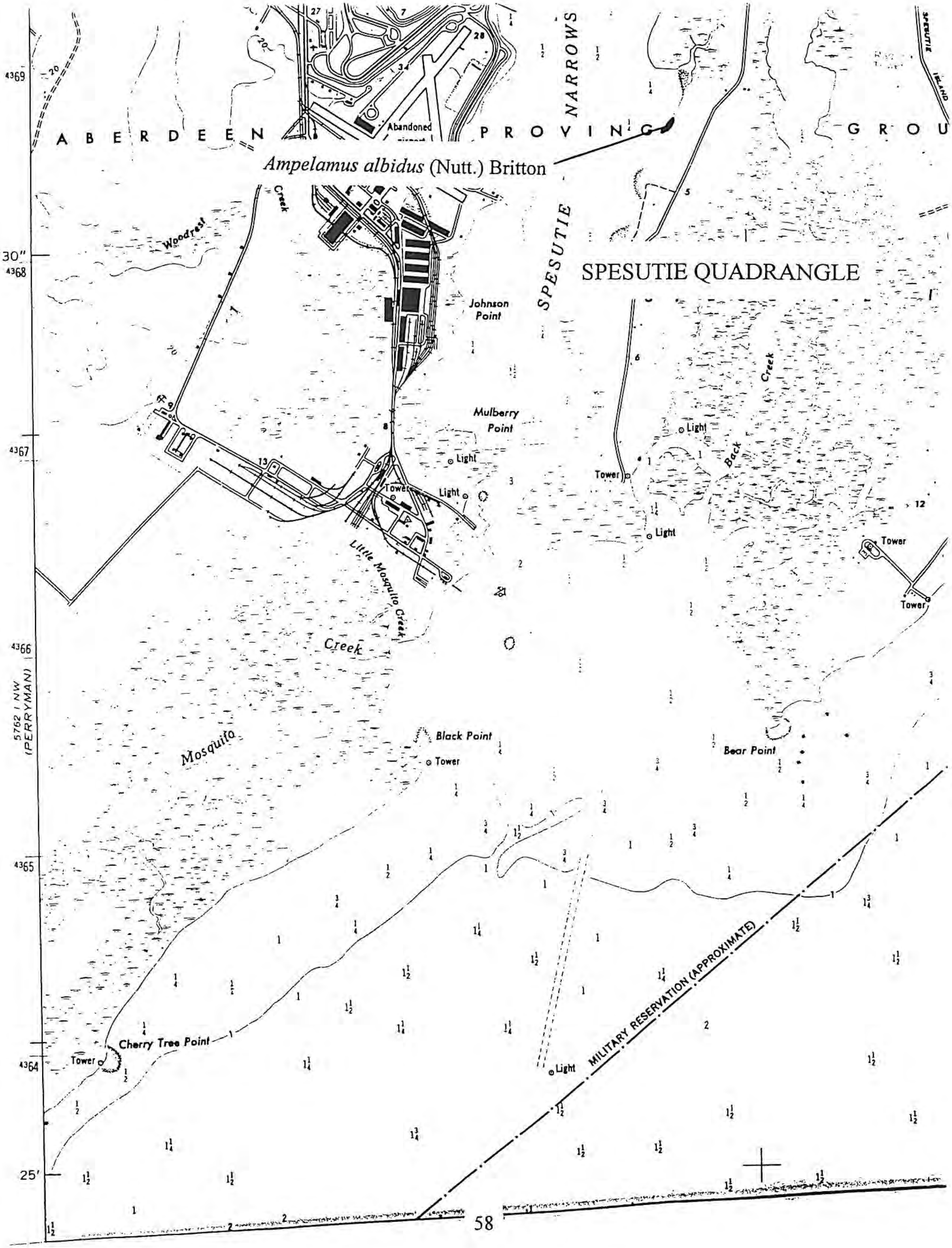


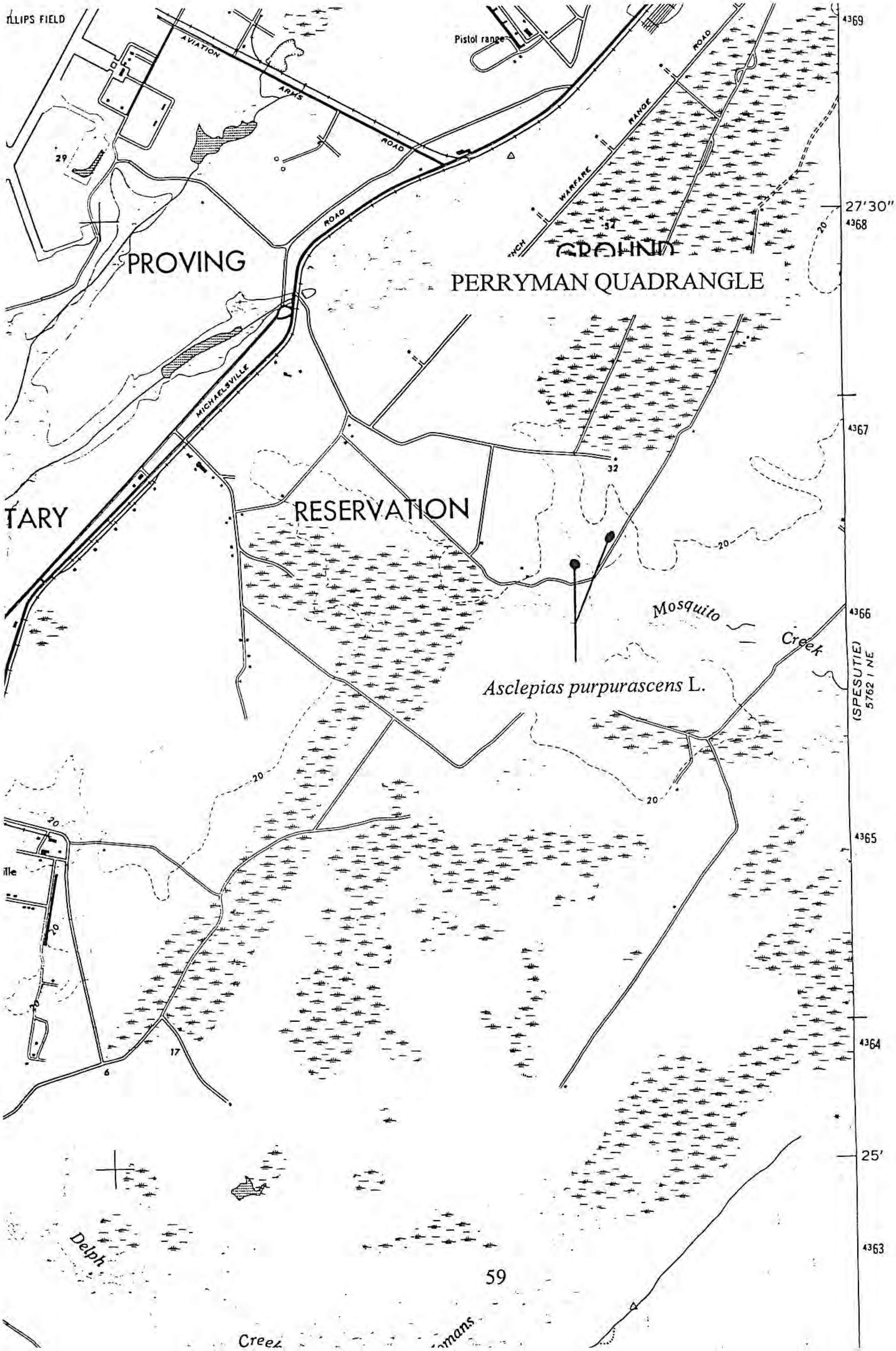
Wolffia papulifera C. Thompson

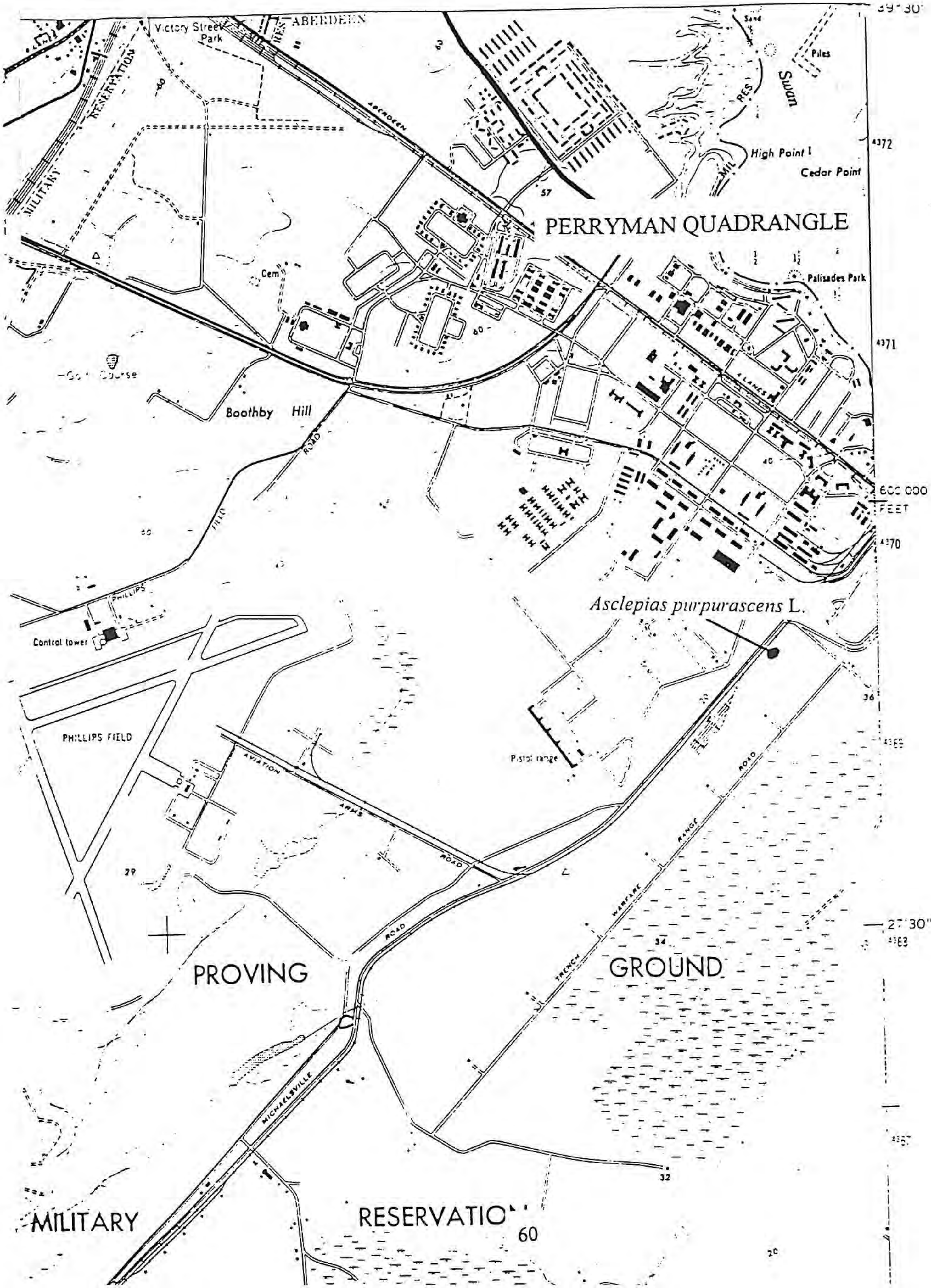
HANESVILLE QUADRANGLE



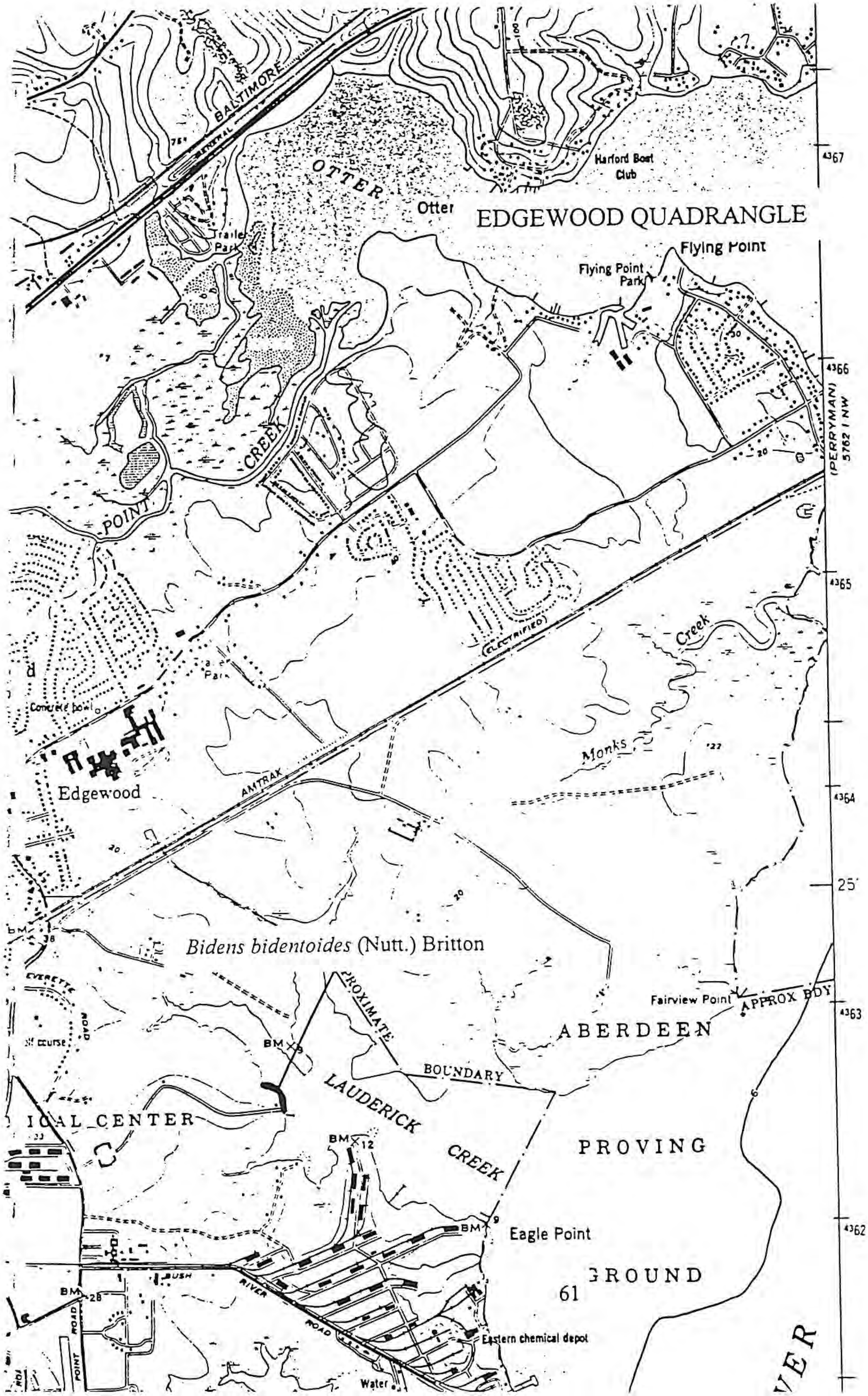

PERRYMAN QUADRANGLE
Xyris difformis Chapman
5762 IV NE (EDGEWOOD)
Gum Point
sticky
Run
BUSH
hard
soft
Tower
Chelsea
Romney
BALTIMORE
OLD
MILITARY RESERVATION
Tower
Chilbury Point
Civilian beach
Old Baltimore
Creek
ROAD
POVERTY ISLAND AREA
CREEK
ROMNEY
Romney
BALTIMORE
Tower
570 000 FEET
25′
Bridge Creek
PENNY
Creek
Back
Tower
Briar Point
ROMNEY
OLD
Tower
Foot bridge
Abandoned foundation
Monocacy Island
Observation towers
Tower
Towers
Redman Cove
4365
4364
4363
4362
4361
4360


Ampelamus albidus (Nutt.) Britton
SPESUTIE QUADRANGLE
ABERDEEN PROVING GROU
SPESUTIE NARROWS
SPESUTIE ISLAND
Abandoned
Woodrest
Creek
Johnson Point
Mulberry Point
Back Creek
Little Mosquito Creek
Mosquito Creek
Black Point
Bear Point
Cherry Tree Point
MILITARY RESERVATION (APPROXIMATE)
Tower
Light
5762 I NW (PERRYMAN)
27'30"
25'
4369
4368
4367
4366
4365
4364

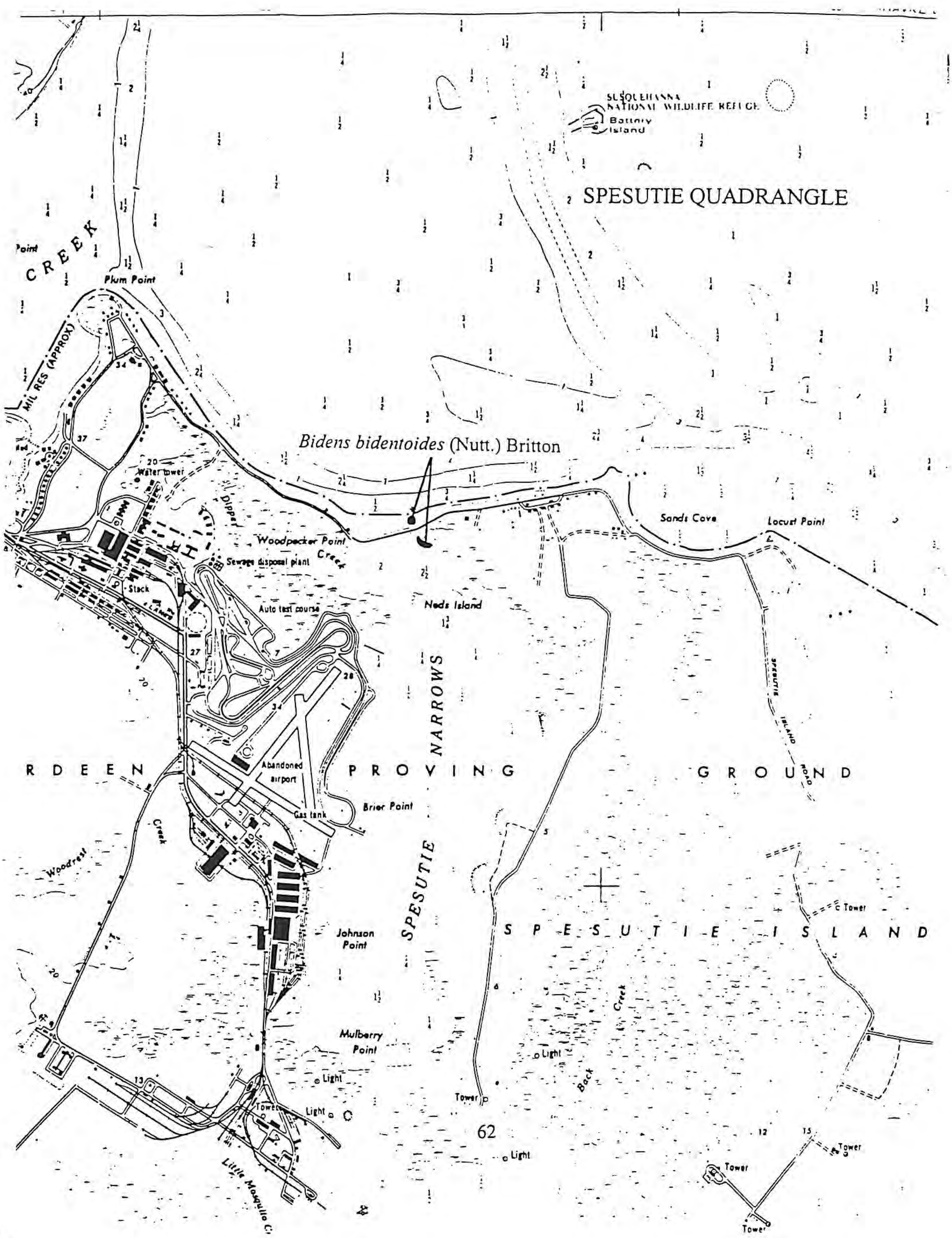

PERRYMAN QUADRANGLE
Asclepias purpurascens L.
PROVING
GROUND
RESERVATION
TARY
AVIATION
ARMS
ROAD
MICHAELSVILLE
RANGE
WARFARE
Pistol range
Mosquito
Creek
Delph
Creek
(SPESUTIE)
5762 I NE
27′30″
25′
4369
4368
4367
4366
4365
4364
4363

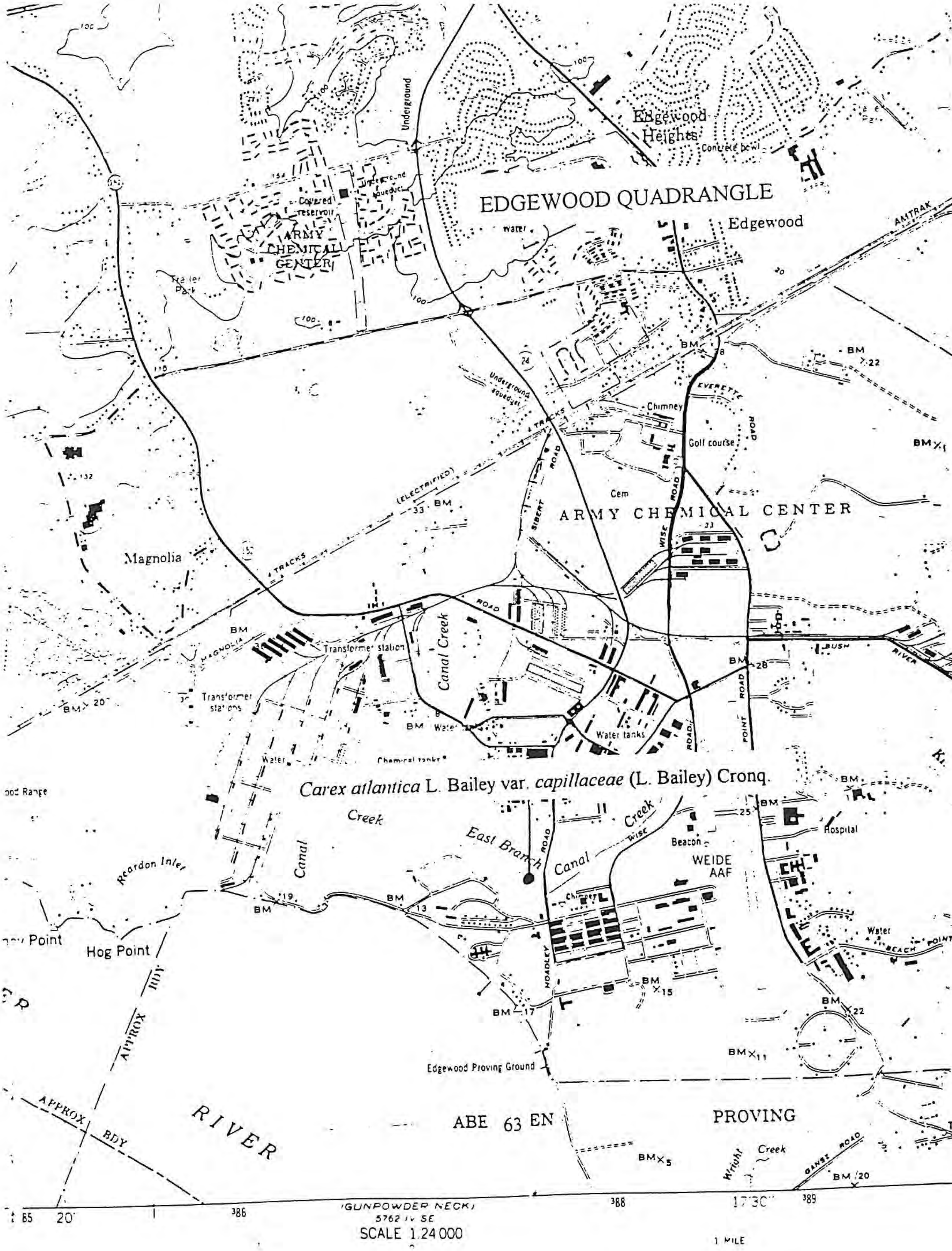

PERRYMAN QUADRANGLE
Asclepias purpurascens L.
ABERDEEN
Victory Street Park
MILITARY RESERVATION
Sand
Piles
Swan
High Point
Cedar Point
Palisades Park
Cem
Golf Course
Boothby Hill
ROAD
PHILLIPS
Control tower
PHILLIPS FIELD
Pistol range
AVIATION
ARMS
ROAD
TRENCH
WARFARE
RANGE
ROAD
MICHAELSVILLE
PROVING
GROUND
MILITARY
RESERVATIO
600 000 FEET
39°30'
27'30"

EDGEWOOD QUADRANGLE



Bidens bidentoides (Nutt.) Britton

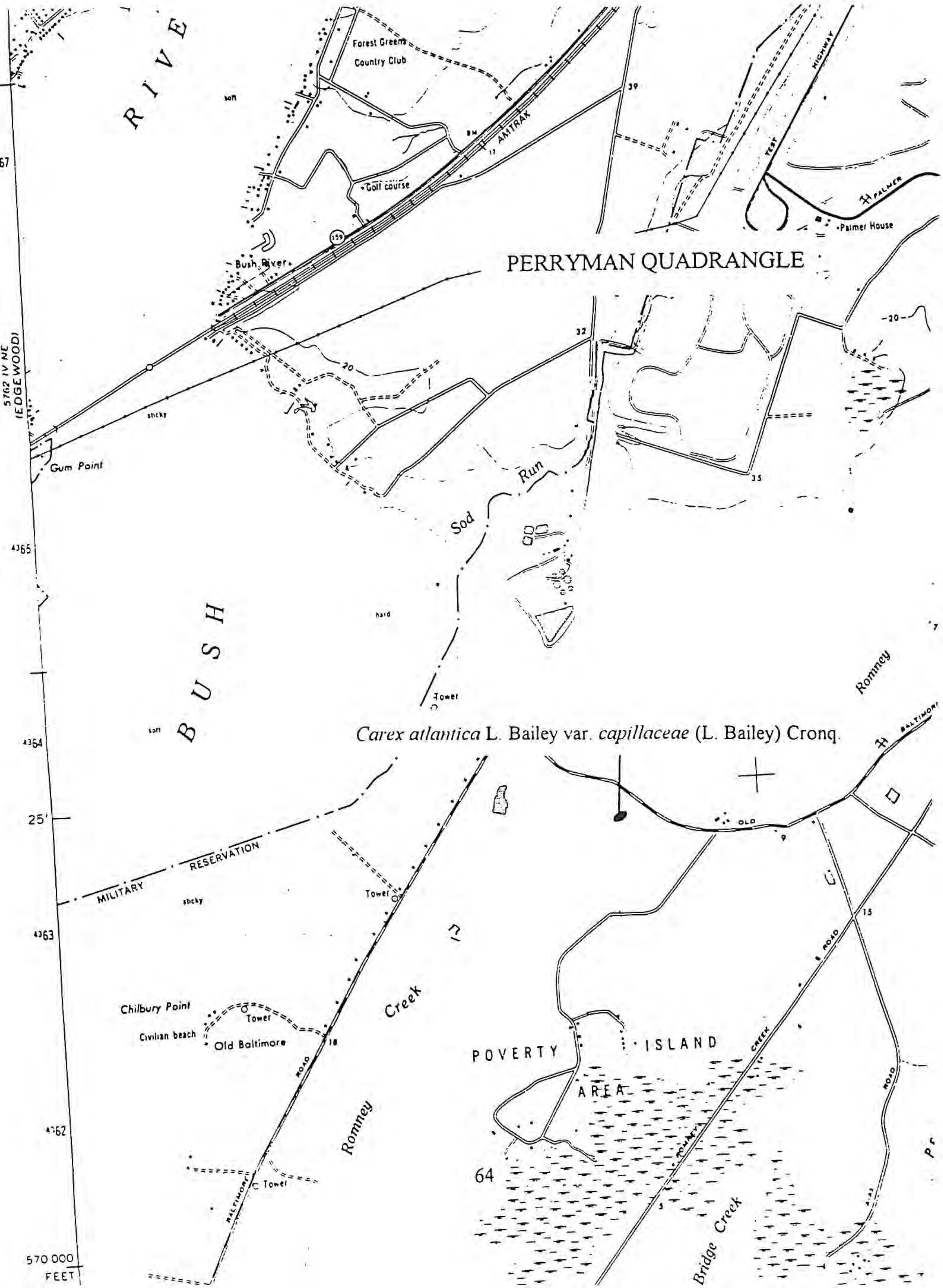

SPESUTIE QUADRANGLE
Bidens bidentoides (Nutt.) Britton
SUSQUEHANNA NATIONAL WILDLIFE REFUGE
Battery Island
CREEK
Plum Point
MIL RES (APPROX)
Water tower
Woodpecker Point
Dipper Creek
Sewage disposal plant
Stack
Auto test course
Neds Island
Sands Cove
Locust Point
SPESUTIE ISLAND ROAD
RDEEN PROVING GROUND
Abandoned airport
Gas tank
Brier Point
SPESUTIE NARROWS
Johnson Point
Mulberry Point
SPESUTIE ISLAND
Back Creek
Little Mosquito Cr
Woodrest Creek
Light
Tower



EDGEWOOD QUADRANGLE

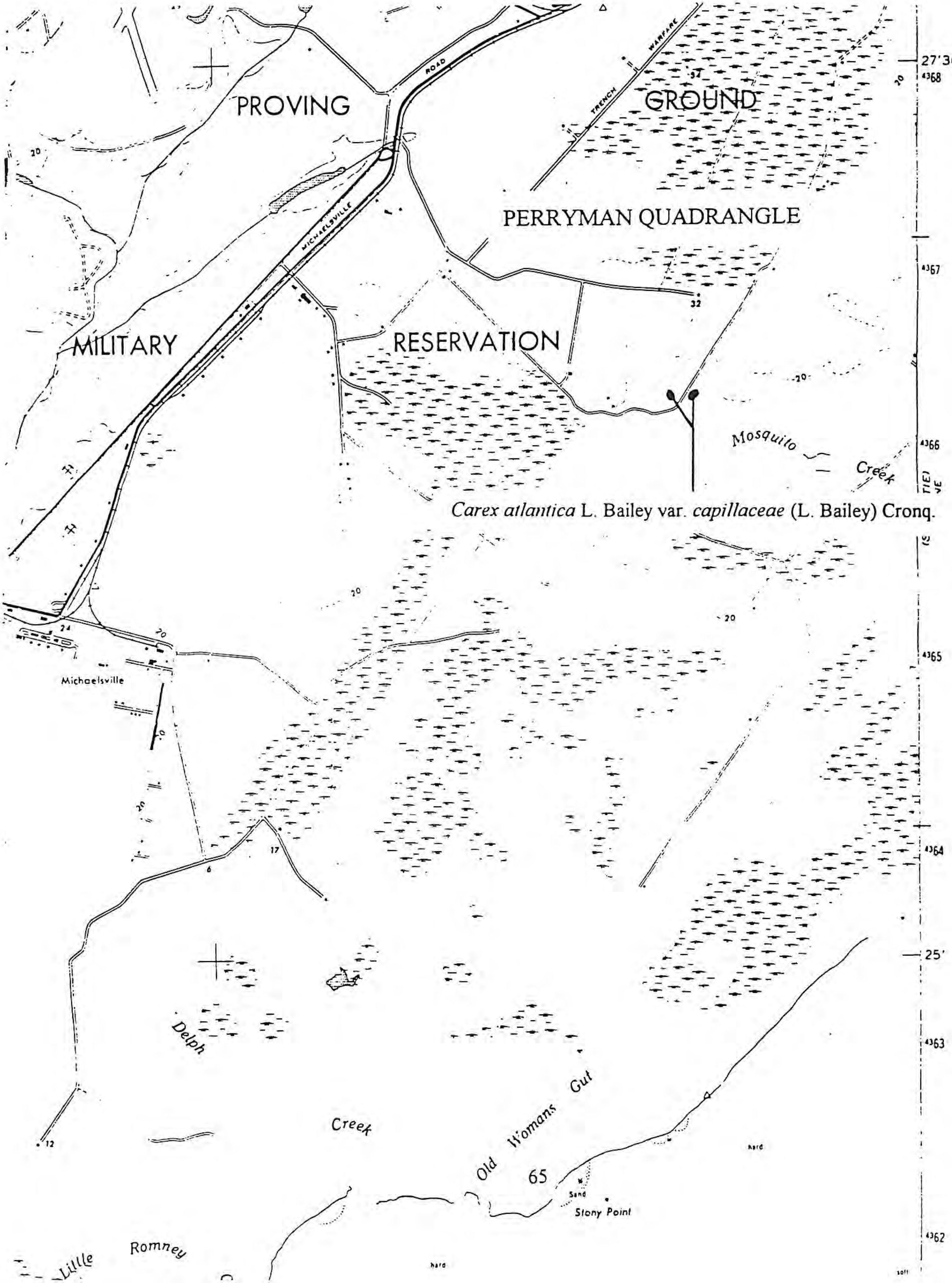
Carex atlantica L. Bailey var. *capillaceae* (L. Bailey) Cronq.

ABE 63 EN

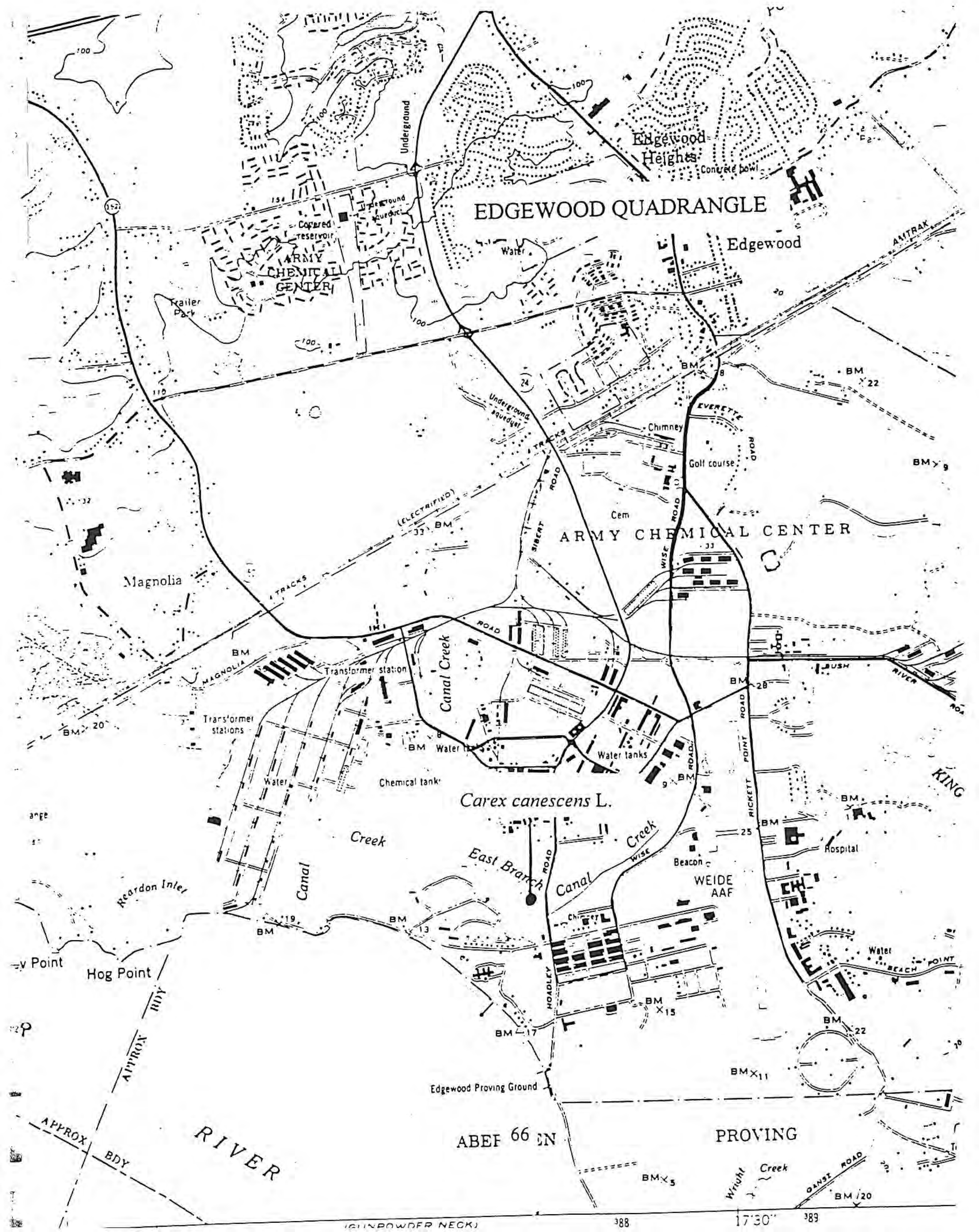


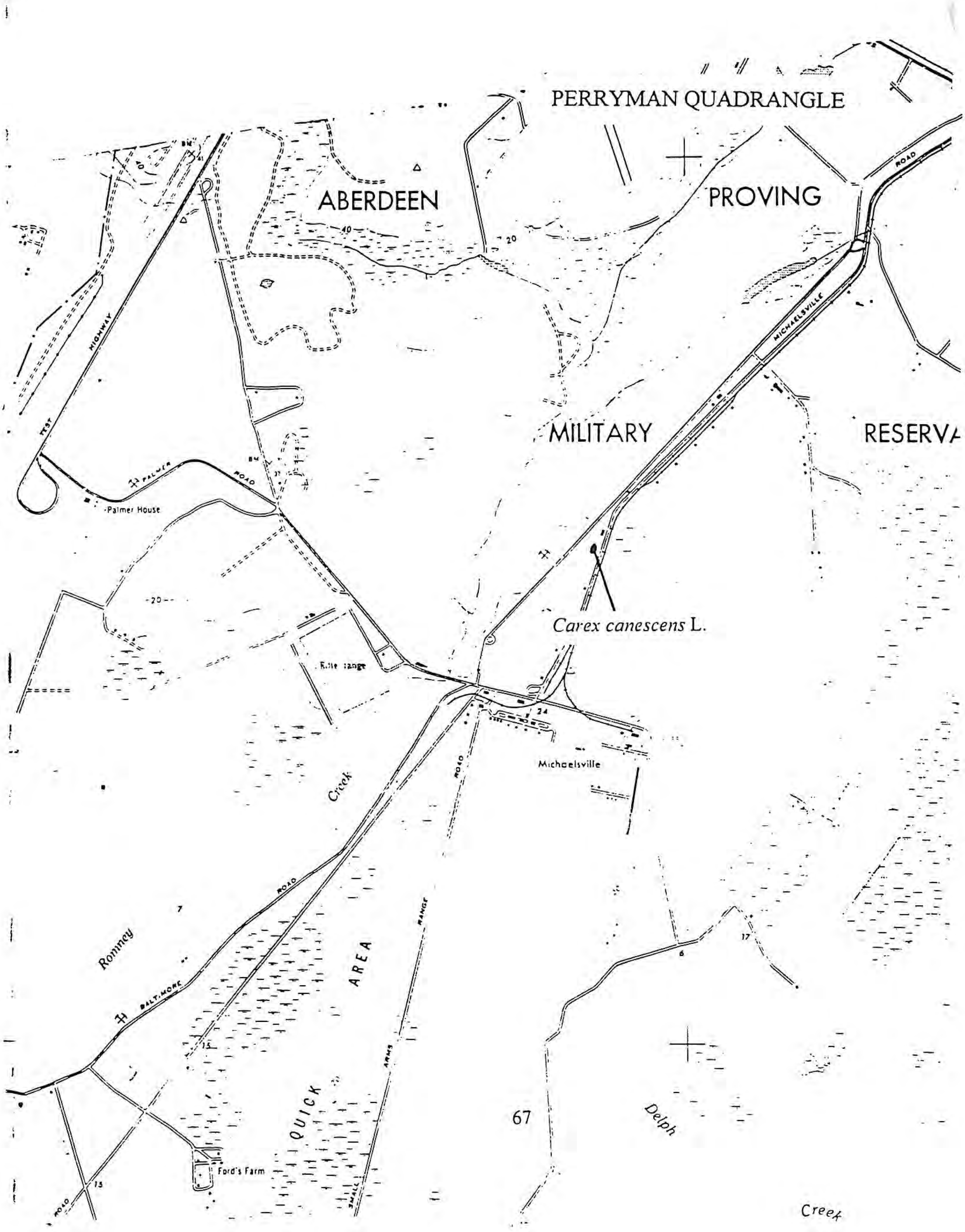
PERRYMAN QUADRANGLE

Carex atlantica L. Bailey var. *capillaceae* (L. Bailey) Cronq.

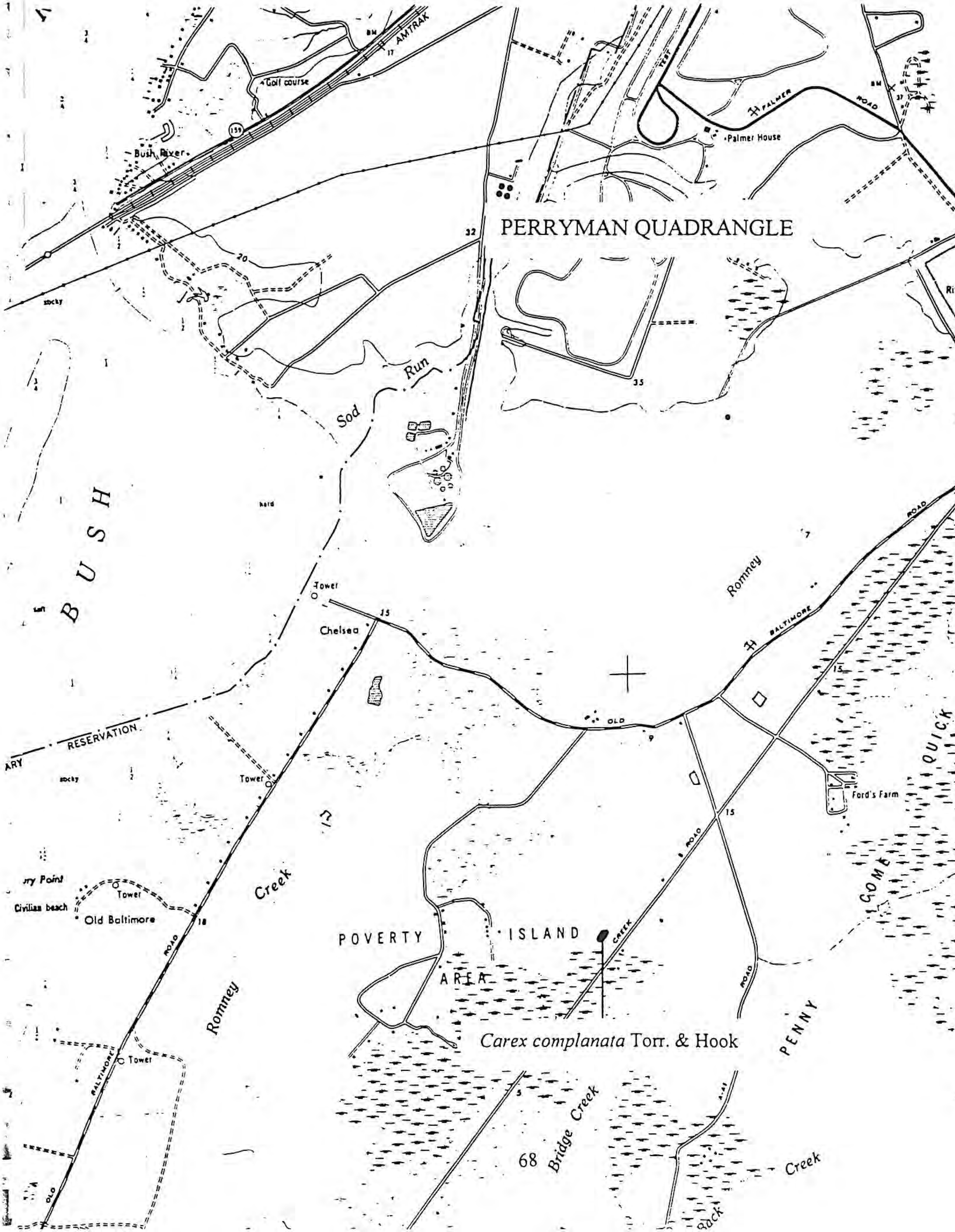


Carex atlantica L. Bailey var. *capillaceae* (L. Bailey) Cronq.

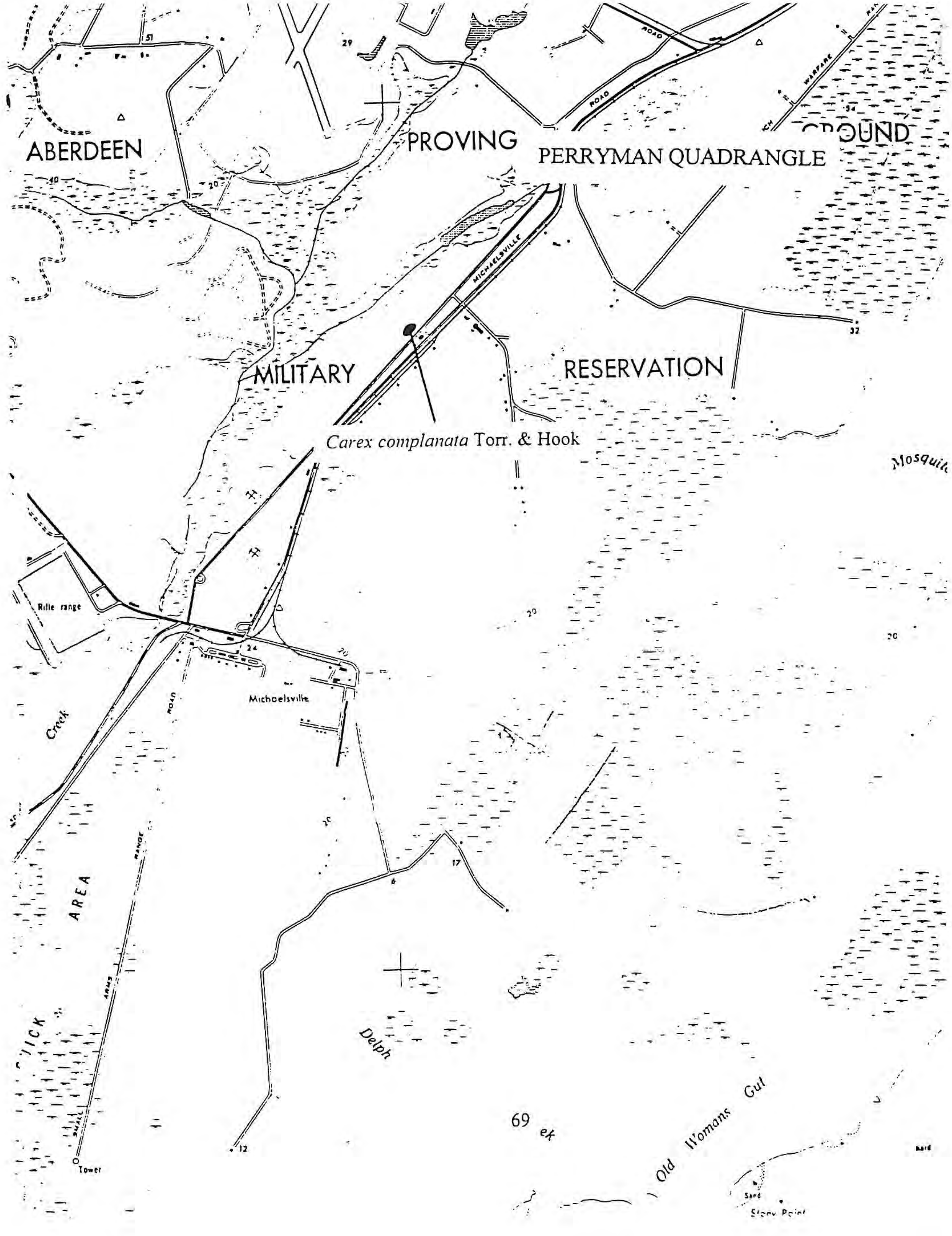

EDGEWOOD QUADRANGLE
Edgewood Heights
Concrete bowl
Edgewood
Underground
Underground aqueduct
Covered reservoir
ARMY CHEMICAL CENTER
Trailer Park
Water
AMTRAK
Underground aqueduct
EVERETTE ROAD
Chimney
Golf course
Cem
ARMY CHEMICAL CENTER
SIBERT ROAD
WISE ROAD
(ELECTRIFIED)
4 TRACKS
Magnolia
MAGNOLIA
ROAD
BUSH RIVER ROAD
Transformer station
Transformer stations
Canal Creek
Water tanks
Chemical tanks
Carex canescens L.
KING
RICKETT POINT ROAD
Hospital
Creek
East Branch
Canal Creek
WISE
Beacon
WEIDE AAF
Chimney
Reardon Inlet
Canal
Hog Point
HOADLEY ROAD
BEACH POINT
Water
Edgewood Proving Ground
APPROX BDY
RIVER
ABER 66 EN
PROVING
Wright Creek
GANST ROAD
(GUNPOWDER NECK)
388
17'30"
389


PERRYMAN QUADRANGLE
ABERDEEN
PROVING
MILITARY
RESERVA
HIGHWAY
TEST
PALMER
ROAD
Palmer House
Rifle range
MICHAELSVILLE
ROAD
Carex canescens L.
Michaelsville
Creek
Romney
BALTIMORE
ROAD
QUICK
AREA
SMALL
ARMS
RANGE
Ford's Farm
Delph
Creek

PERRYMAN QUADRANGLE

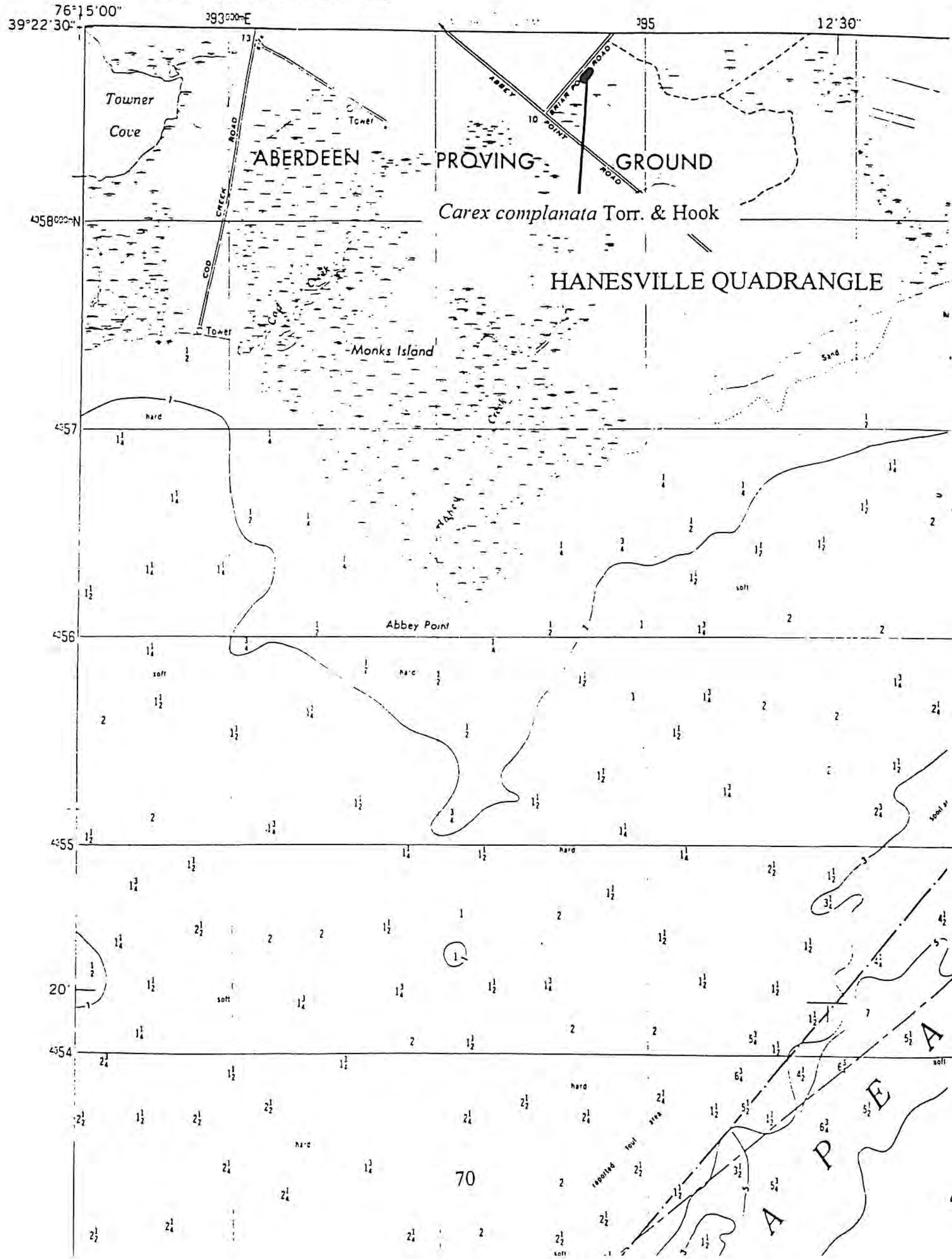


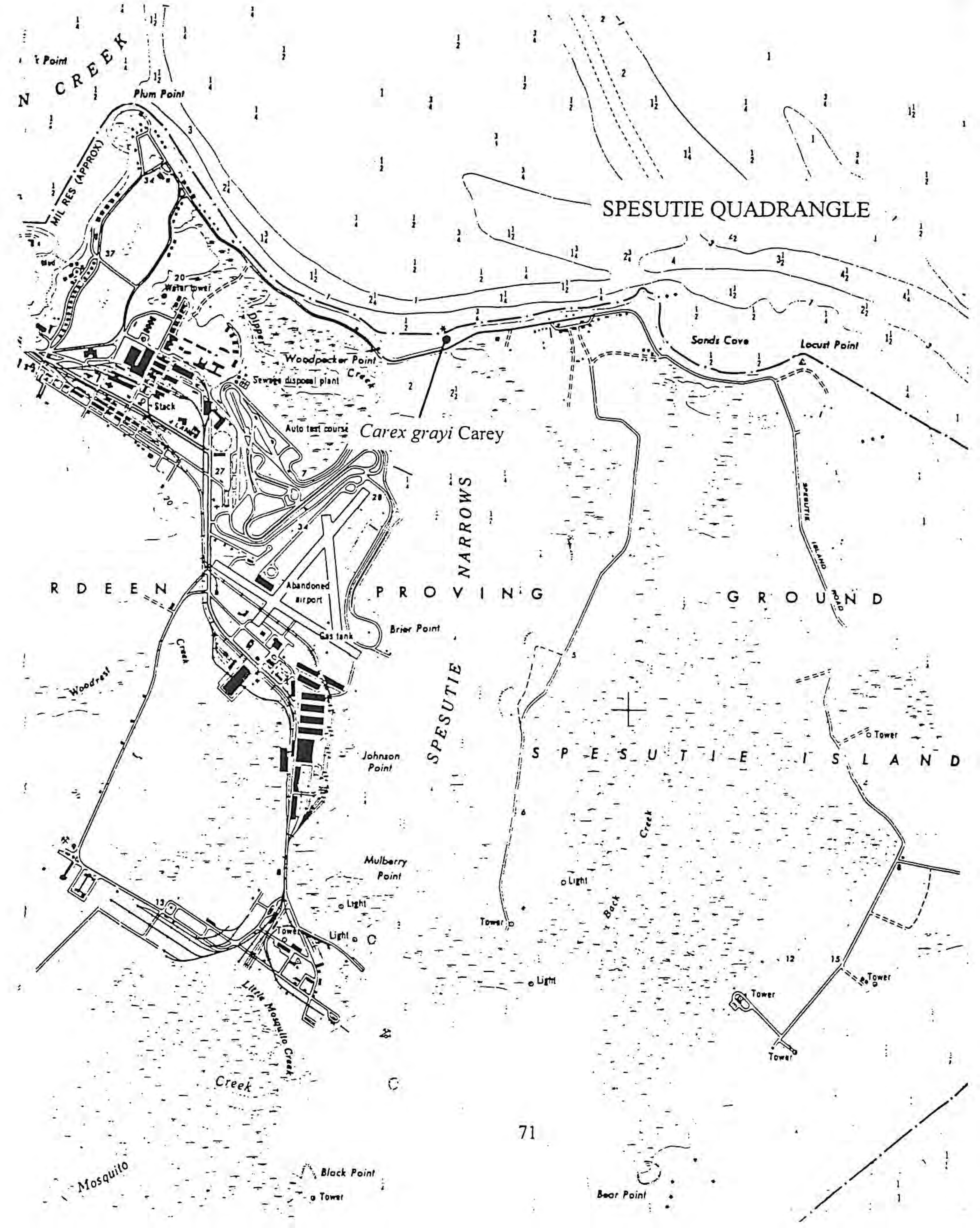
Carex complanata Torr. & Hook


ABERDEEN
PROVING
GROUND
PERRYMAN QUADRANGLE
MILITARY
RESERVATION
MICHAELSVILLE
ROAD
WARFARE
Carex complanata Torr. & Hook
Mosquito
Rifle range
Michaelsville
Creek
AREA
RANGE
ARMS
SMALL
Tower
Delph
Old Womans Gul
Sand
Stony Point

5762 IV NE
(EDGEWOOD)

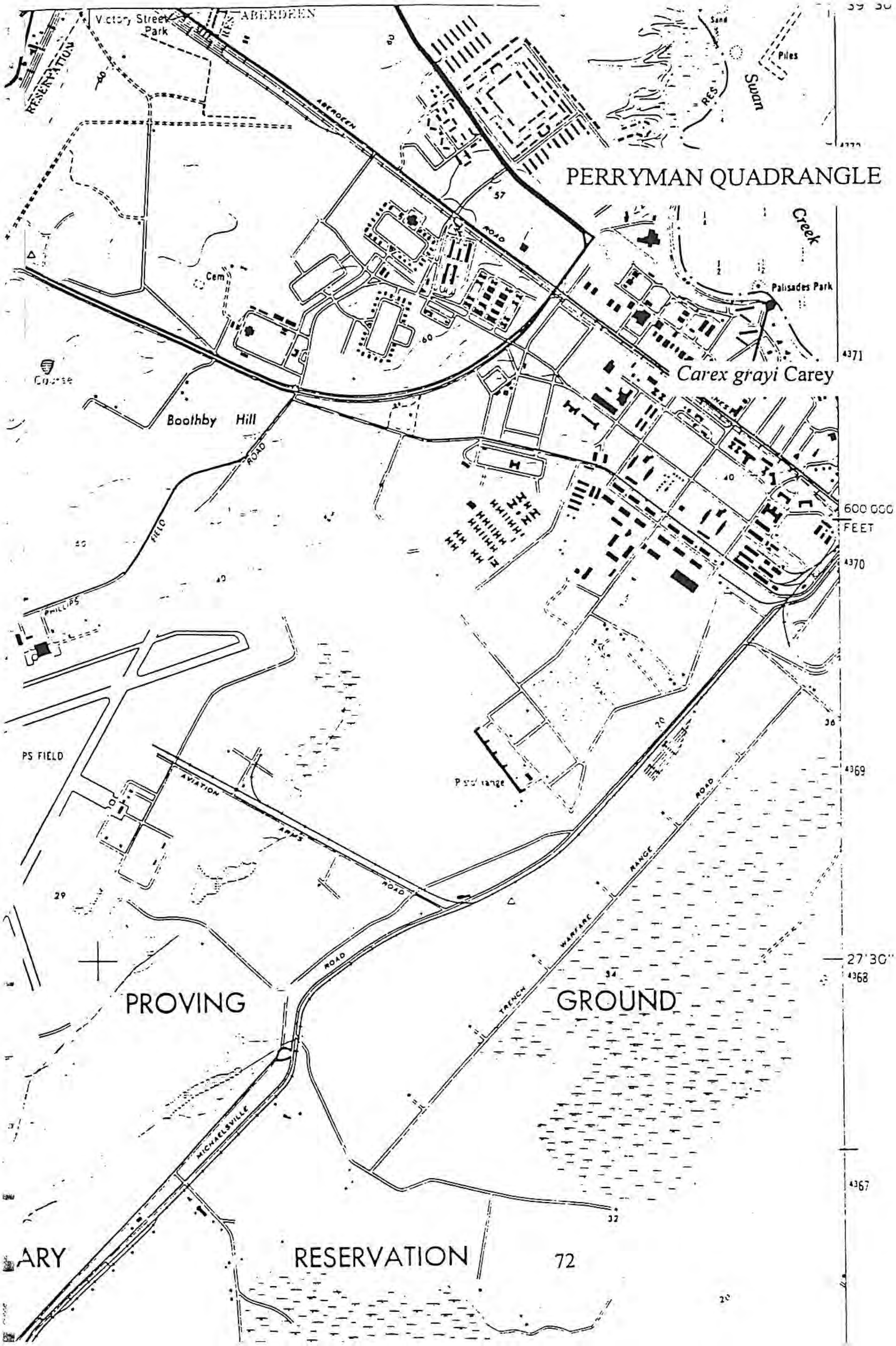
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

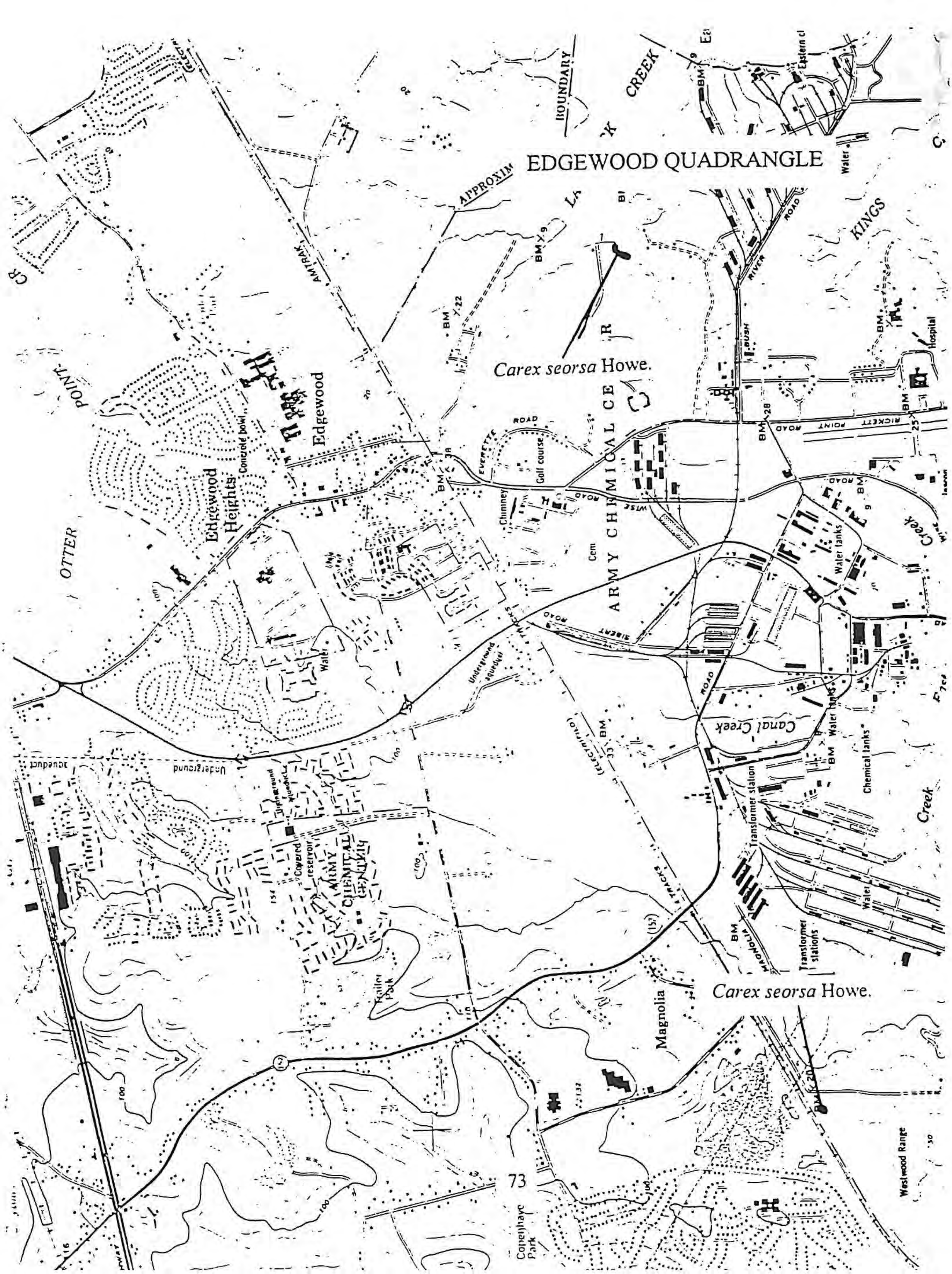



SPESUTIE QUADRANGLE
Carex grayi Carey
Plum Point
MIL RES (APPROX)
Water tower
Woodpecker Point
Sewage disposal plant
Stack
Auto test course
Abandoned airport
Brier Point
Gas tank
Johnson Point
Mulberry Point
Sands Cove
Locust Point
SPESUTIE NARROWS
RDEEN PROVING GROUND
SPESUTIE ISLAND
Light
Tower
Little Mosquito Creek
Creek
Mosquito
Black Point
Bear Point

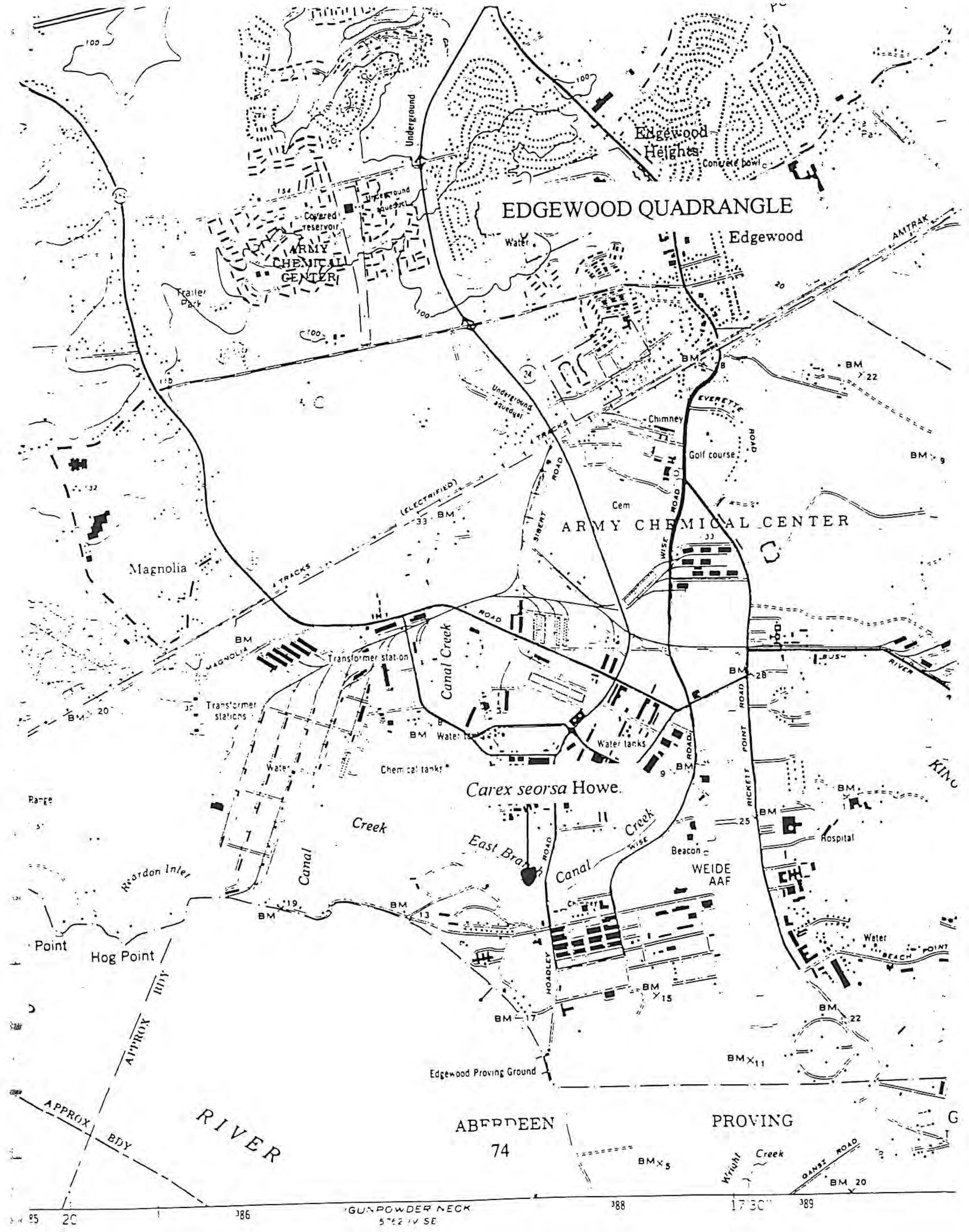
PERRYMAN QUADRANGLE

Carex grayi Carey




EDGEWOOD QUADRANGLE
Carex seorsa Howe.
Carex seorsa Howe.
Edgewood
Edgewood Heights
OTTER POINT
ARMY CHEMICAL CENTER
Magnolia
Canal Creek
AMTRAK
APPROXIMATE BOUNDARY
Golf course
Hospital
Westwood Range

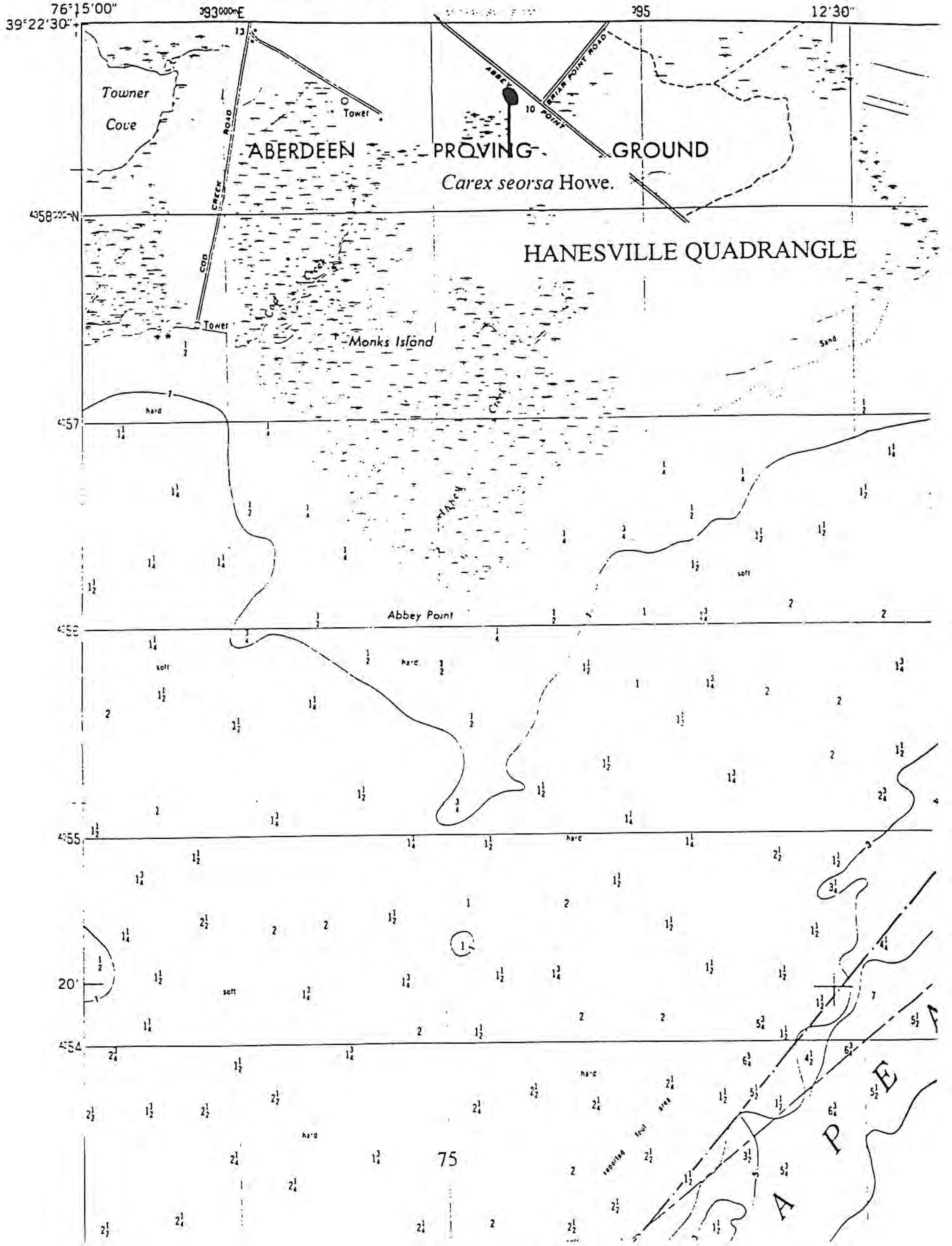
EDGEWOOD QUADRANGLE

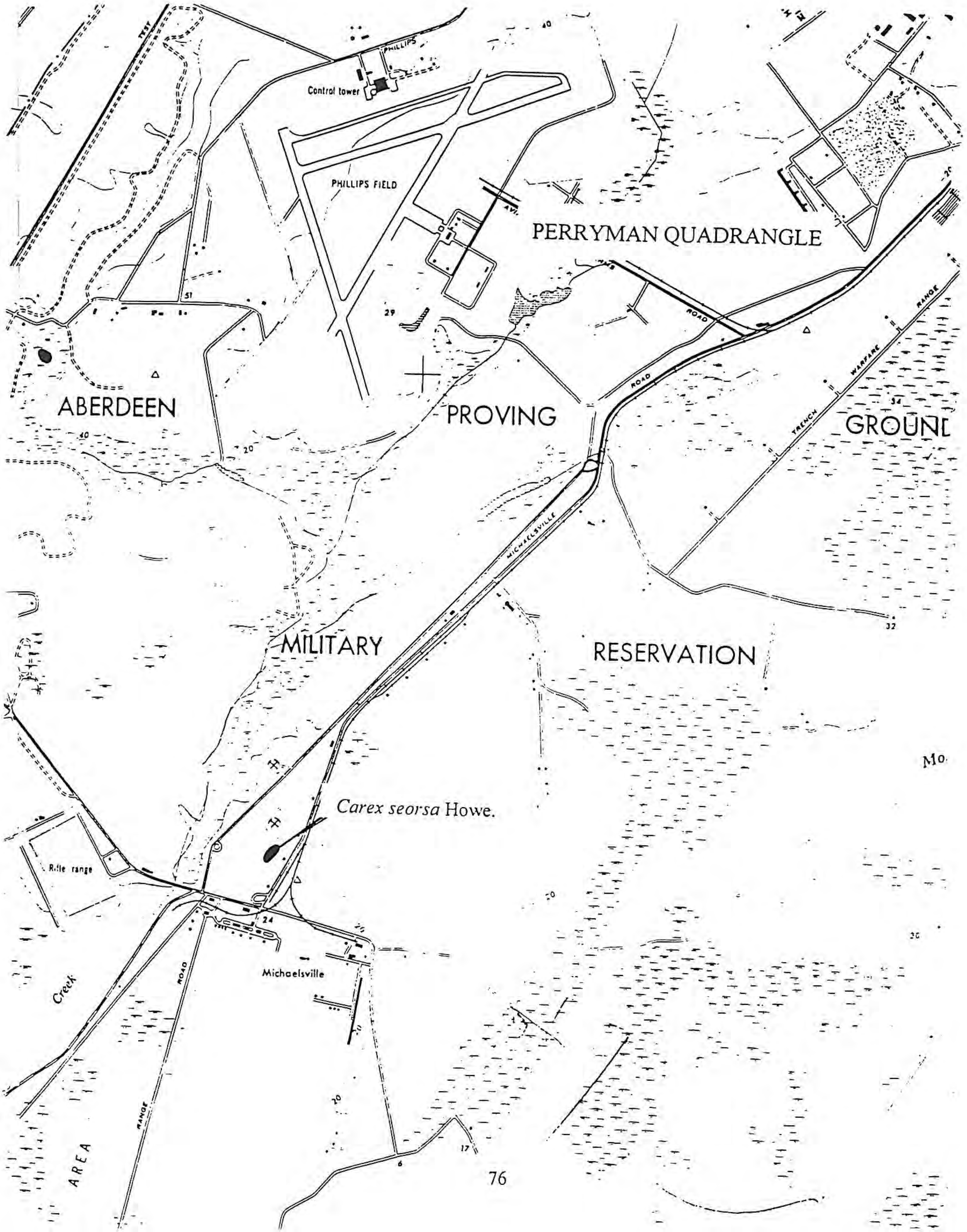


Carex seorsa Howe.

5762 IV NE
(EDGEWOOD)

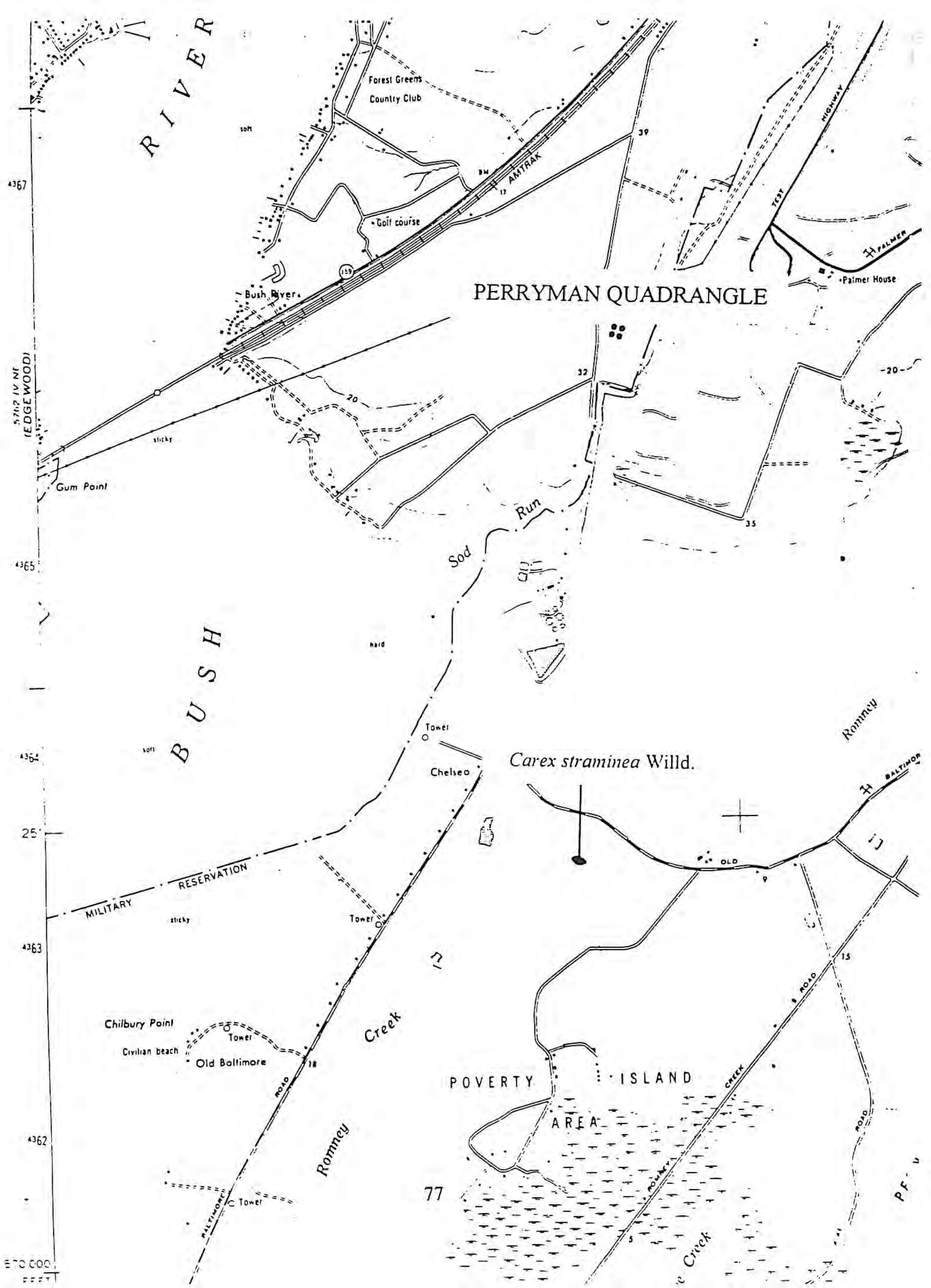
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

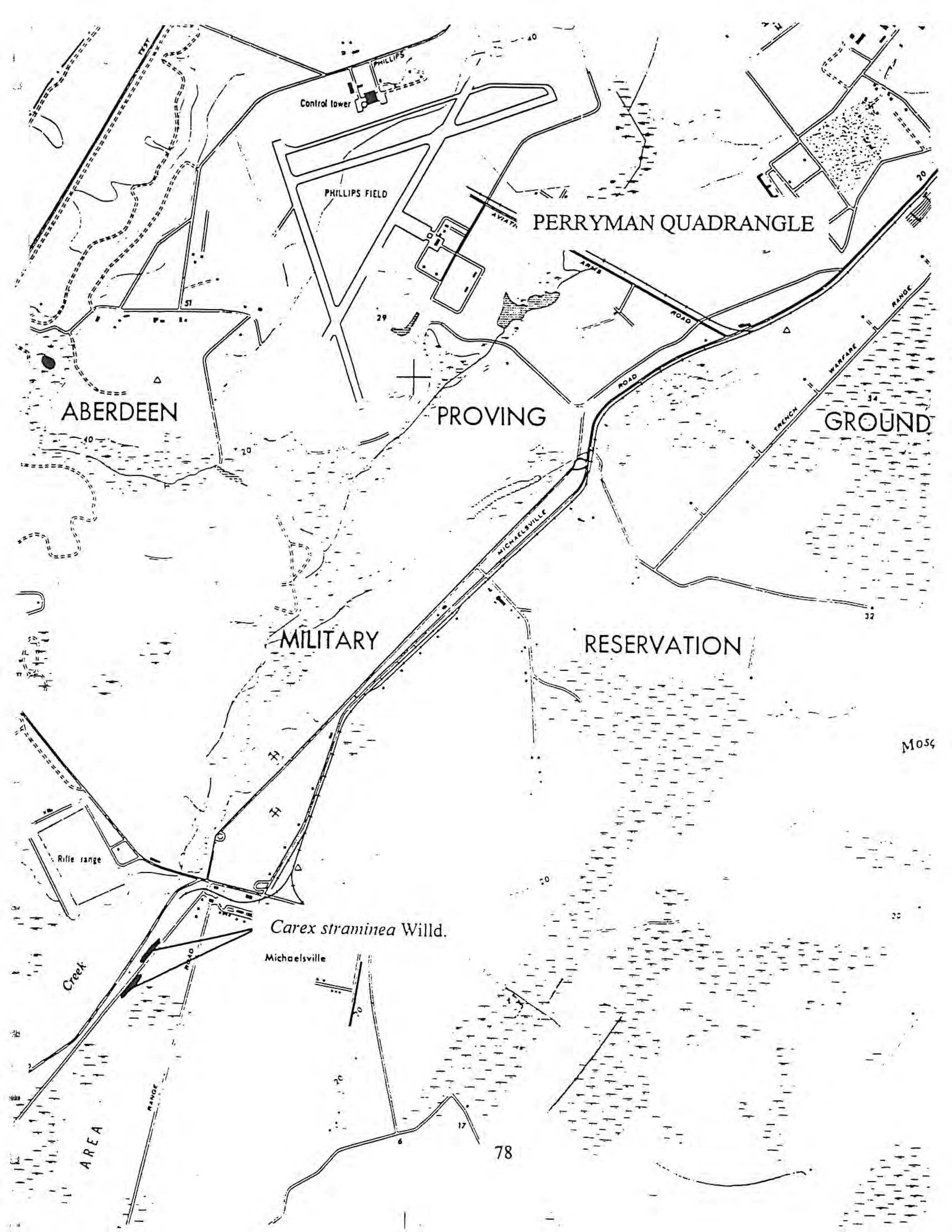



PERRYMAN QUADRANGLE
ABERDEEN
PROVING
GROUND
MILITARY
RESERVATION
Control tower
PHILLIPS FIELD
PHILLIPS
ROAD
MICHAELSVILLE
TRENCH
WARFARE
RANGE
Carex seorsa Howe.
Rifle range
Michaelsville
Creek
AREA

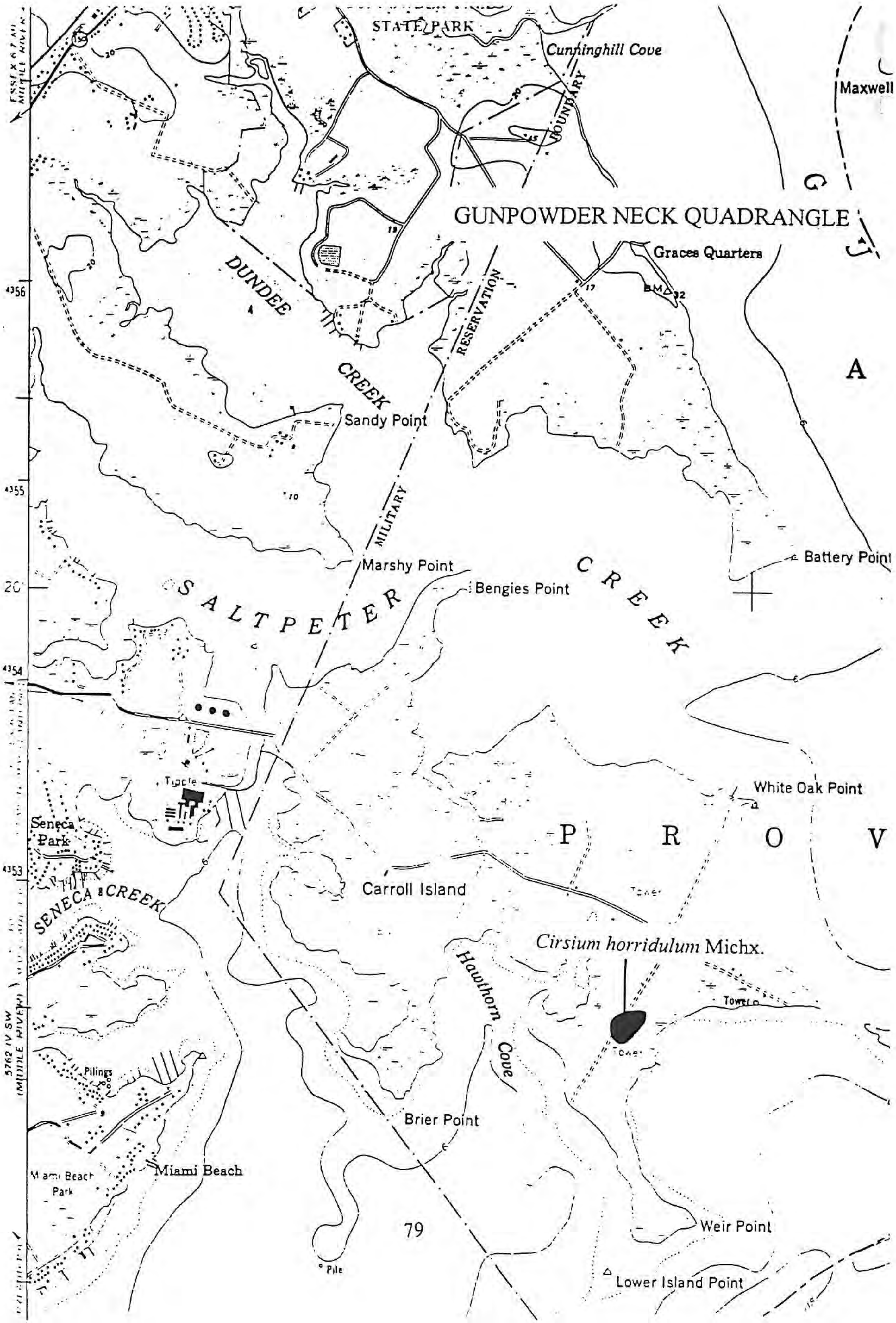
PERRYMAN QUADRANGLE

Carex straminea Willd.

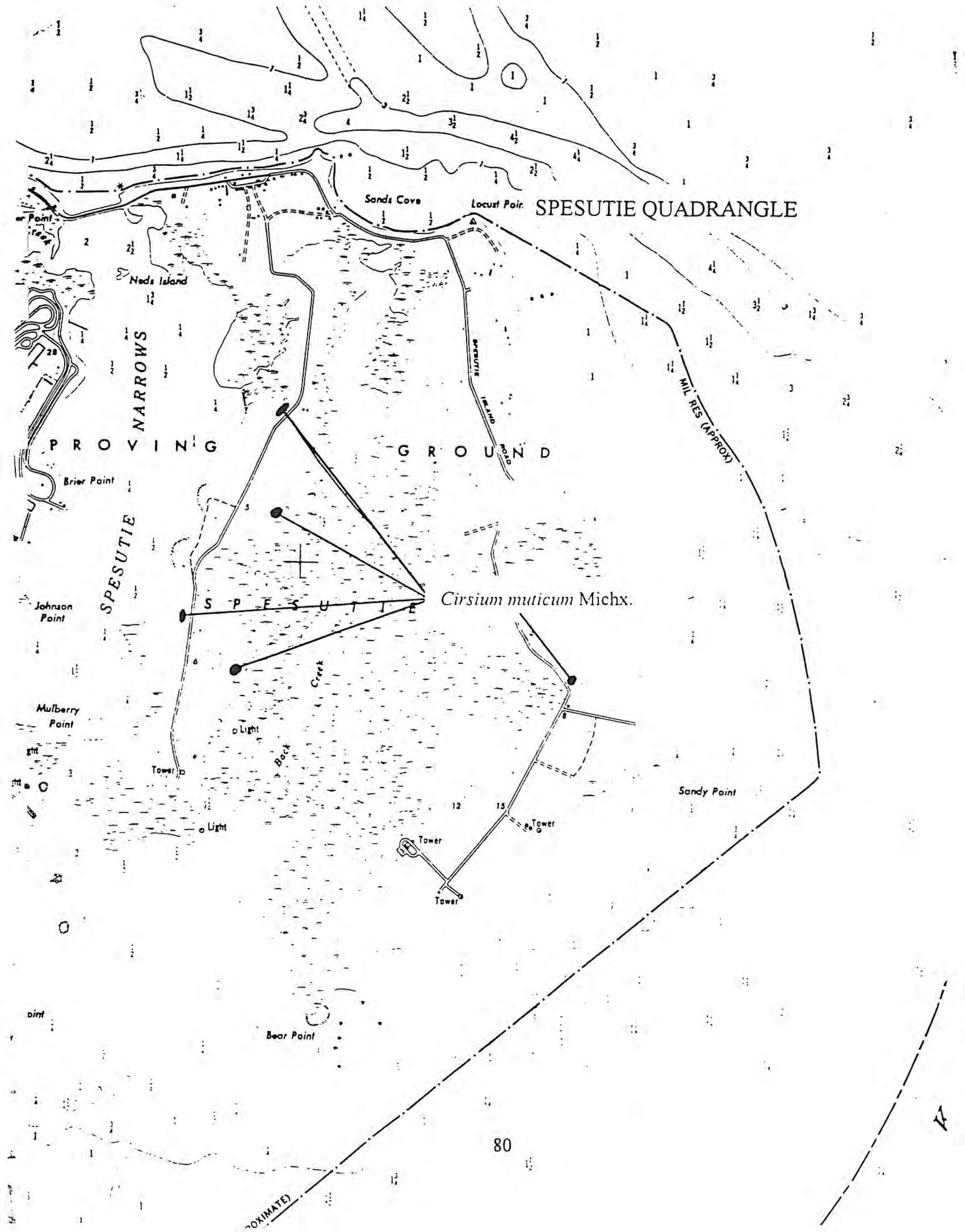


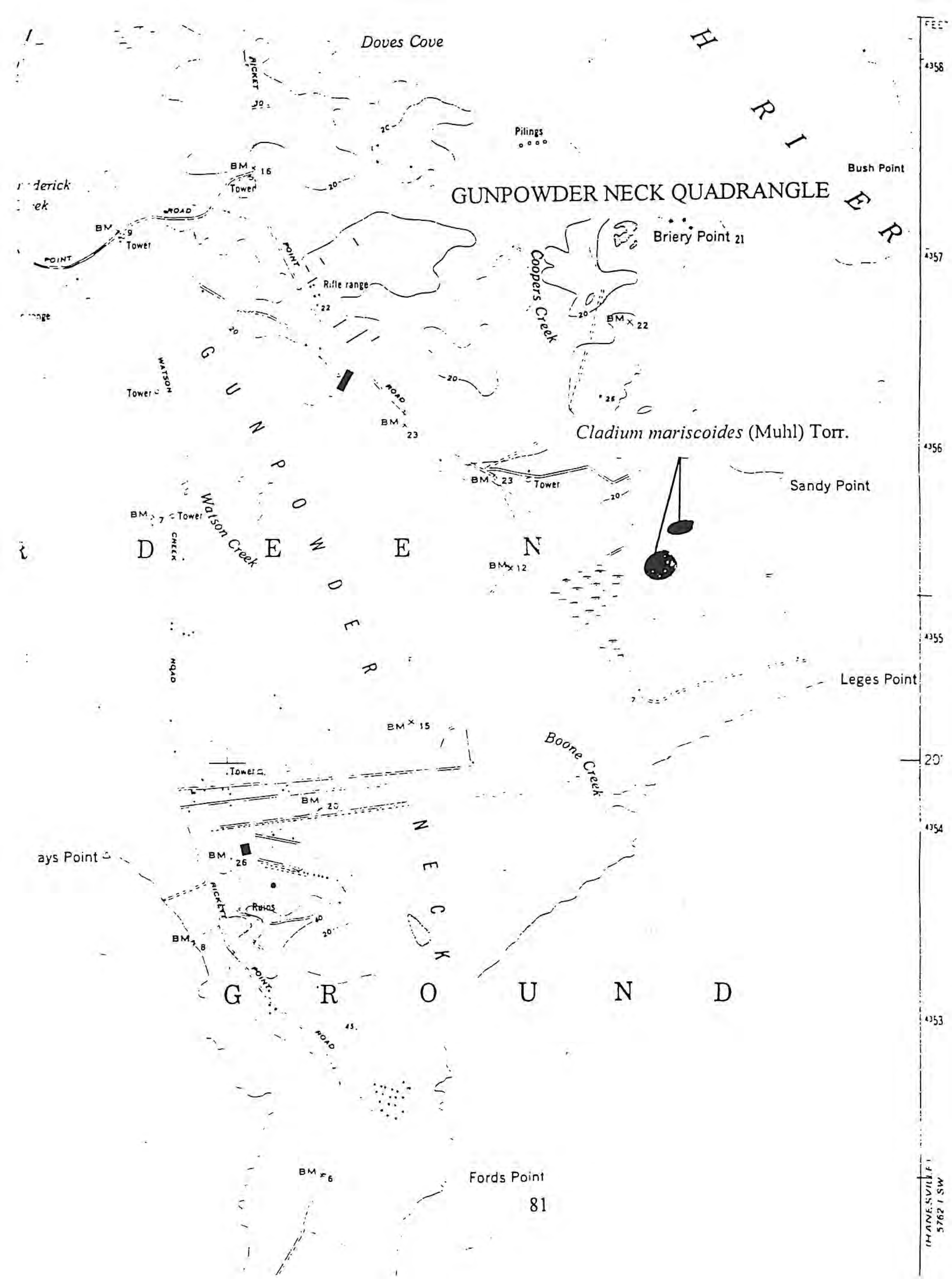


Carex straminea Willd.


GUNPOWDER NECK QUADRANGLE
STATE PARK
Cunninghill Cove
Maxwell
BOUNDARY
Graces Quarters
DUNDEE
CREEK
RESERVATION
MILITARY
Sandy Point
Marshy Point
Bengies Point
Battery Point
SALTPETER
CREEK
White Oak Point
P R O V
Seneca Park
SENECA CREEK
Carroll Island
Hawthorn Cove
Cirsium horridulum Michx.
Brier Point
Pilings
Miami Beach
Miami Beach Park
Weir Point
Lower Island Point
Pile
Tower
Tipple

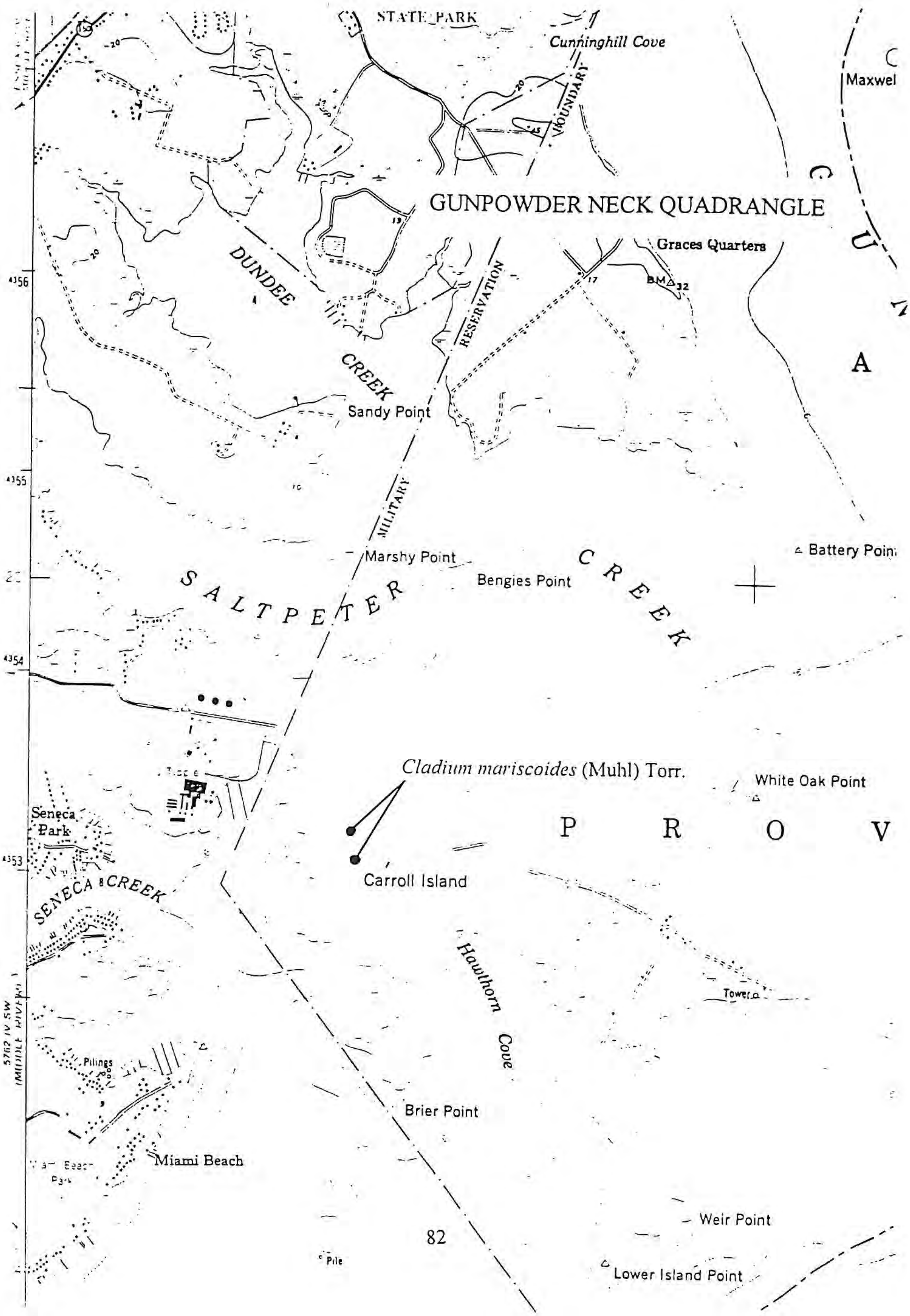
SPESUTIE QUADRANGLE

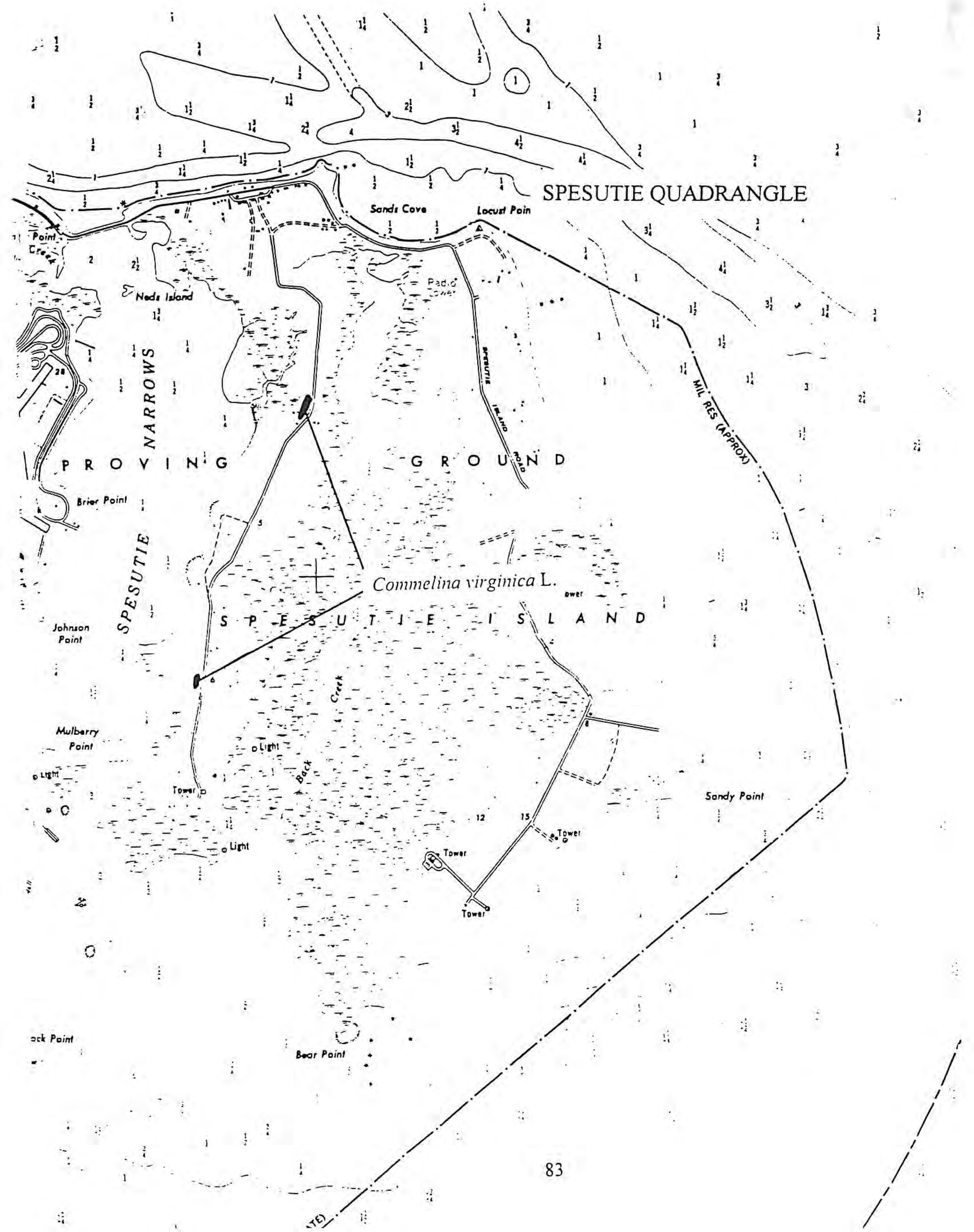


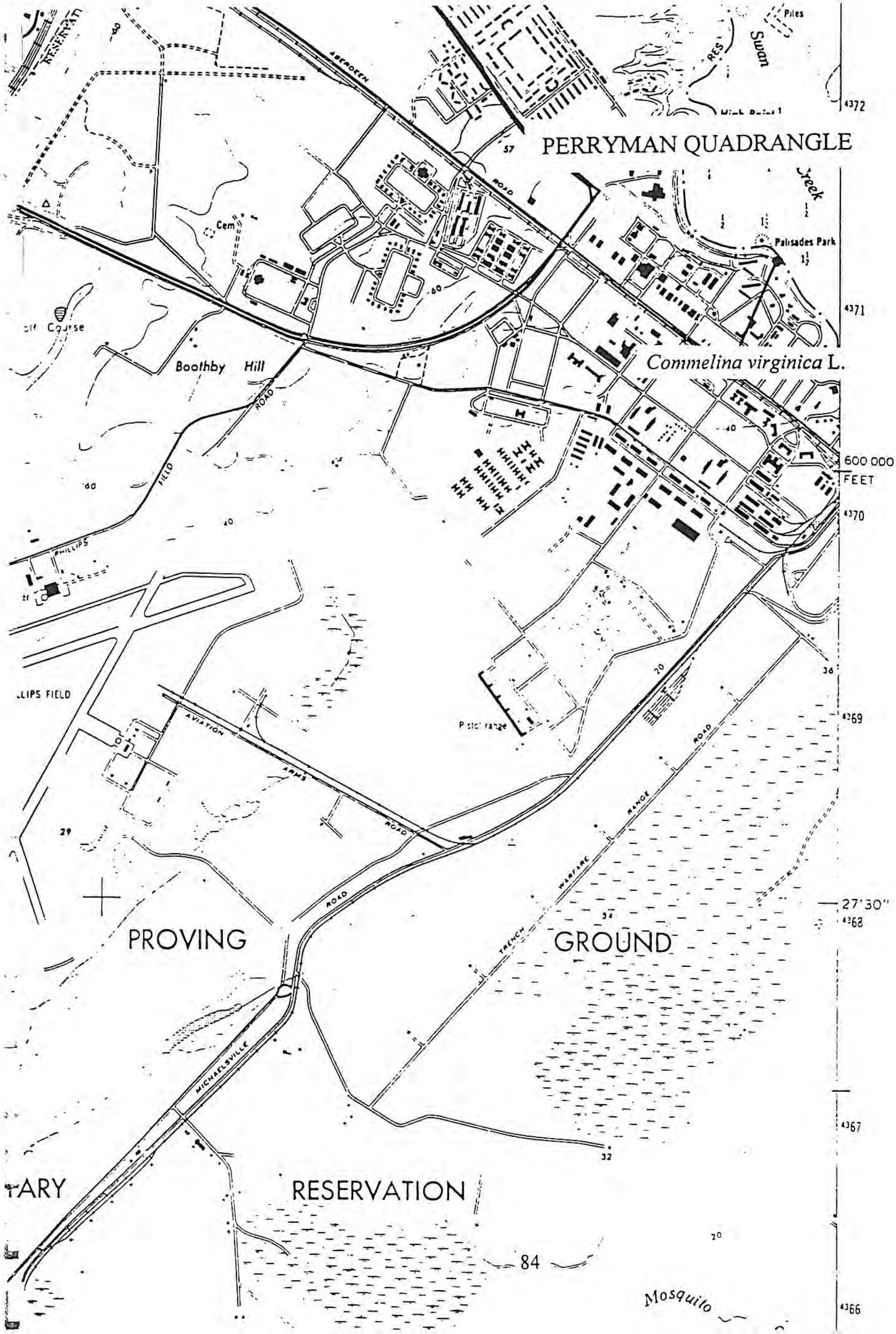


GUNPOWDER NECK QUADRANGLE

Cladium mariscoides (Muhl) Torr.

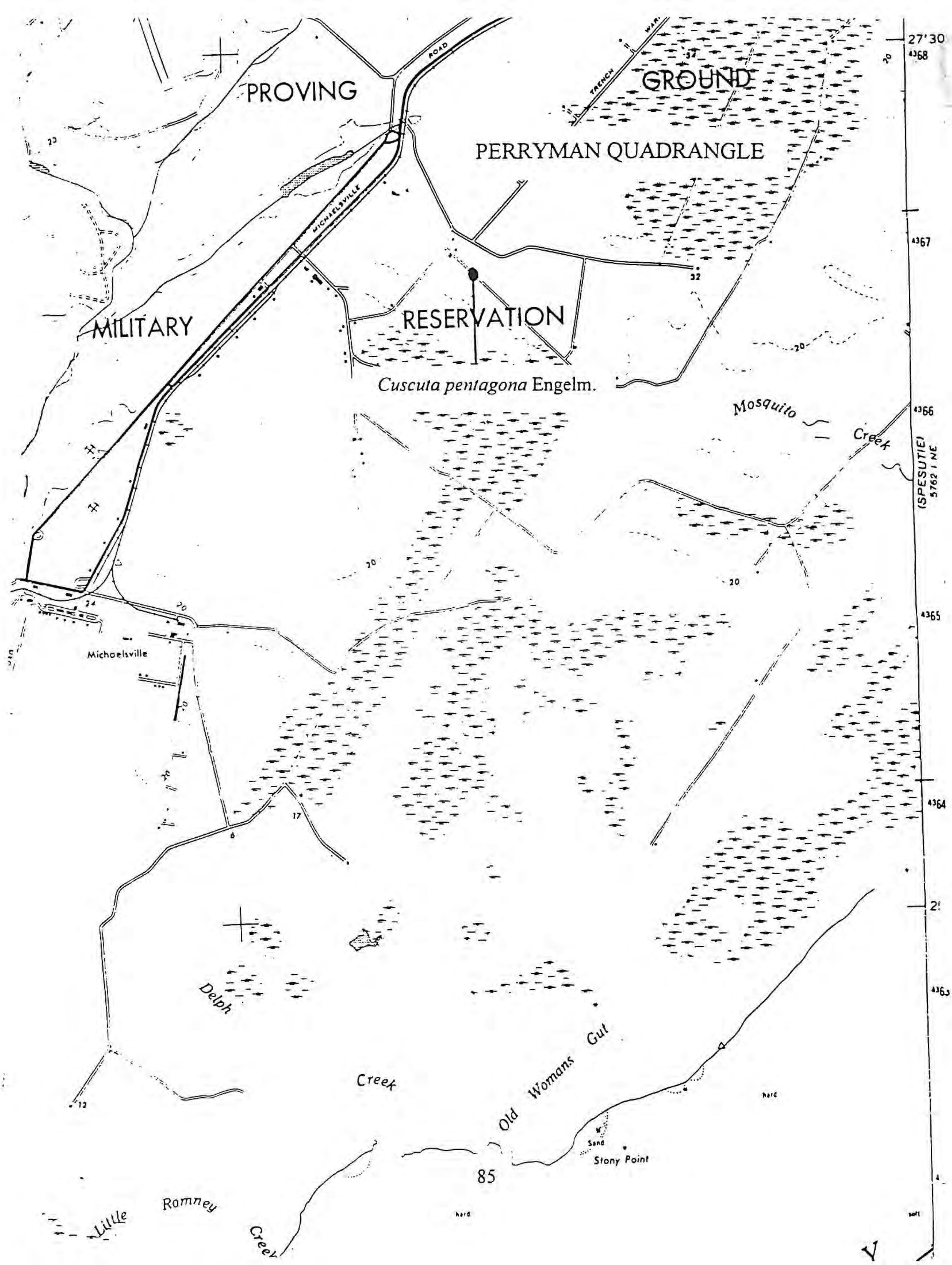

STATE PARK
Cunninghill Cove
Maxwel
BOUNDARY
GUNPOWDER NECK QUADRANGLE
Graces Quarters
DUNDEE
CREEK
RESERVATION
MILITARY
Sandy Point
Marshy Point
Bengies Point
SALTPETER
CREEK
Battery Point
Cladium mariscoides (Muhl) Torr.
White Oak Point
P R O V
Seneca Park
SENECA CREEK
Carroll Island
Hawthorn Cove
Tower
Pilings
Brier Point
Miami Beach
Weir Point
Pile
Lower Island Point
4356
4355
4354
4353
5762 IV SW
(MIDDLE RIVER)


SPESUTIE QUADRANGLE
Commelina virginica L.
Sands Cove
Locust Poin
Point Creek
Neds Island
NARROWS
PROVING GROUND
SPESUTIE ISLAND ROAD
MIL RES (APPROX)
Brier Point
SPESUTIE
SPESUTIE ISLAND
Johnson Point
Mulberry Point
Back Creek
Light
Tower
Sandy Point
Bear Point



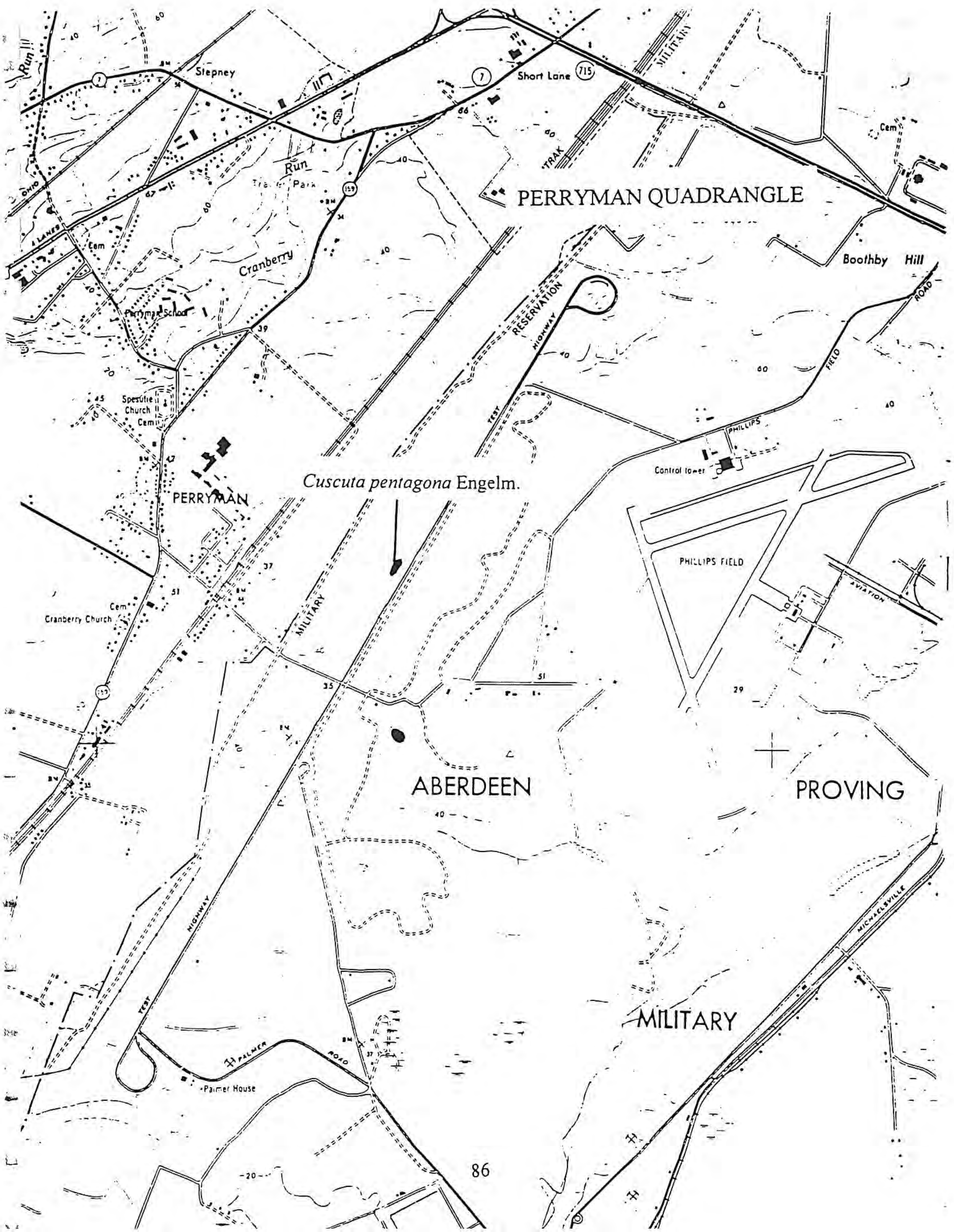
PERRYMAN QUADRANGLE

Commelina virginica L.

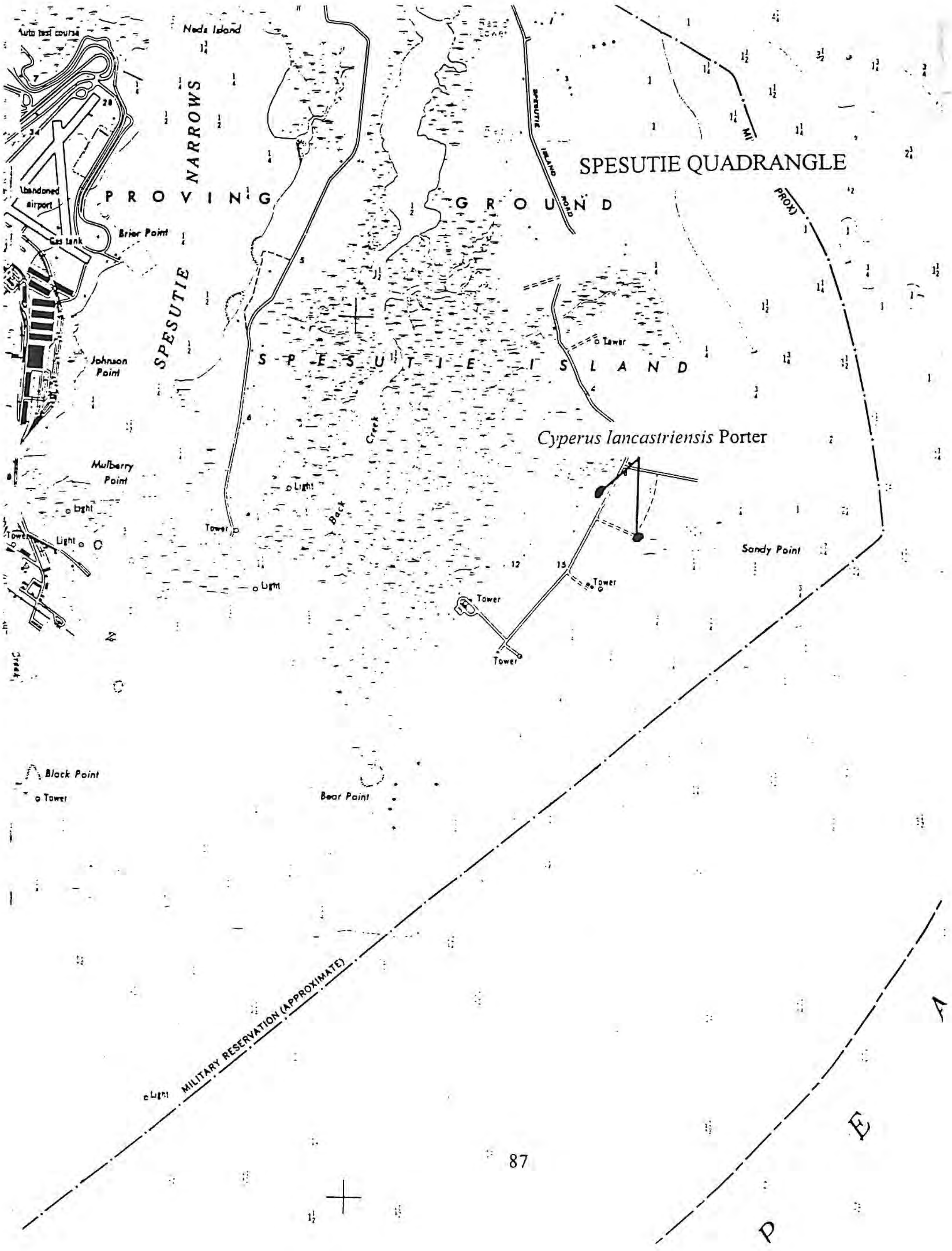


PERRYMAN QUADRANGLE

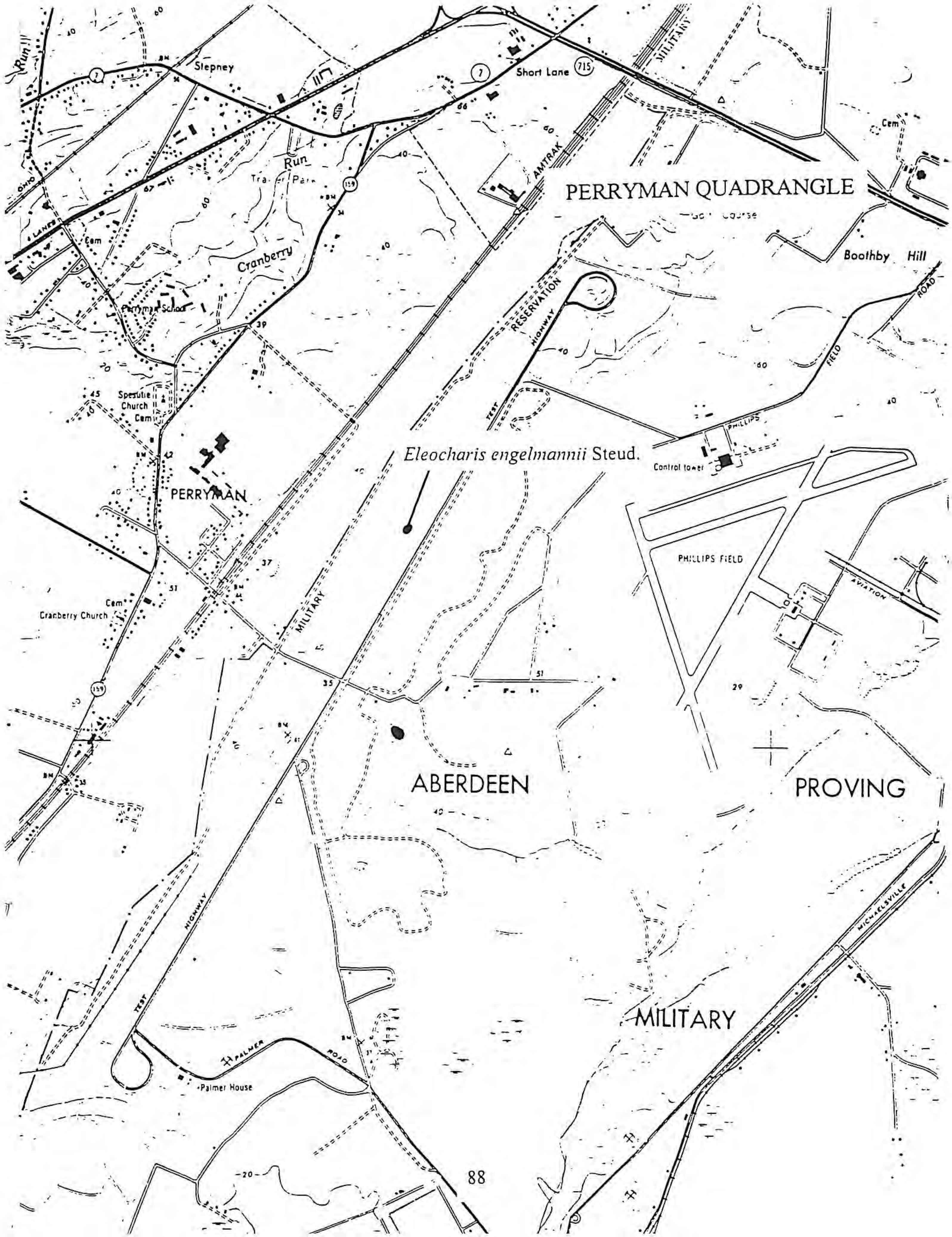
Cuscuta pentagona Engelm.

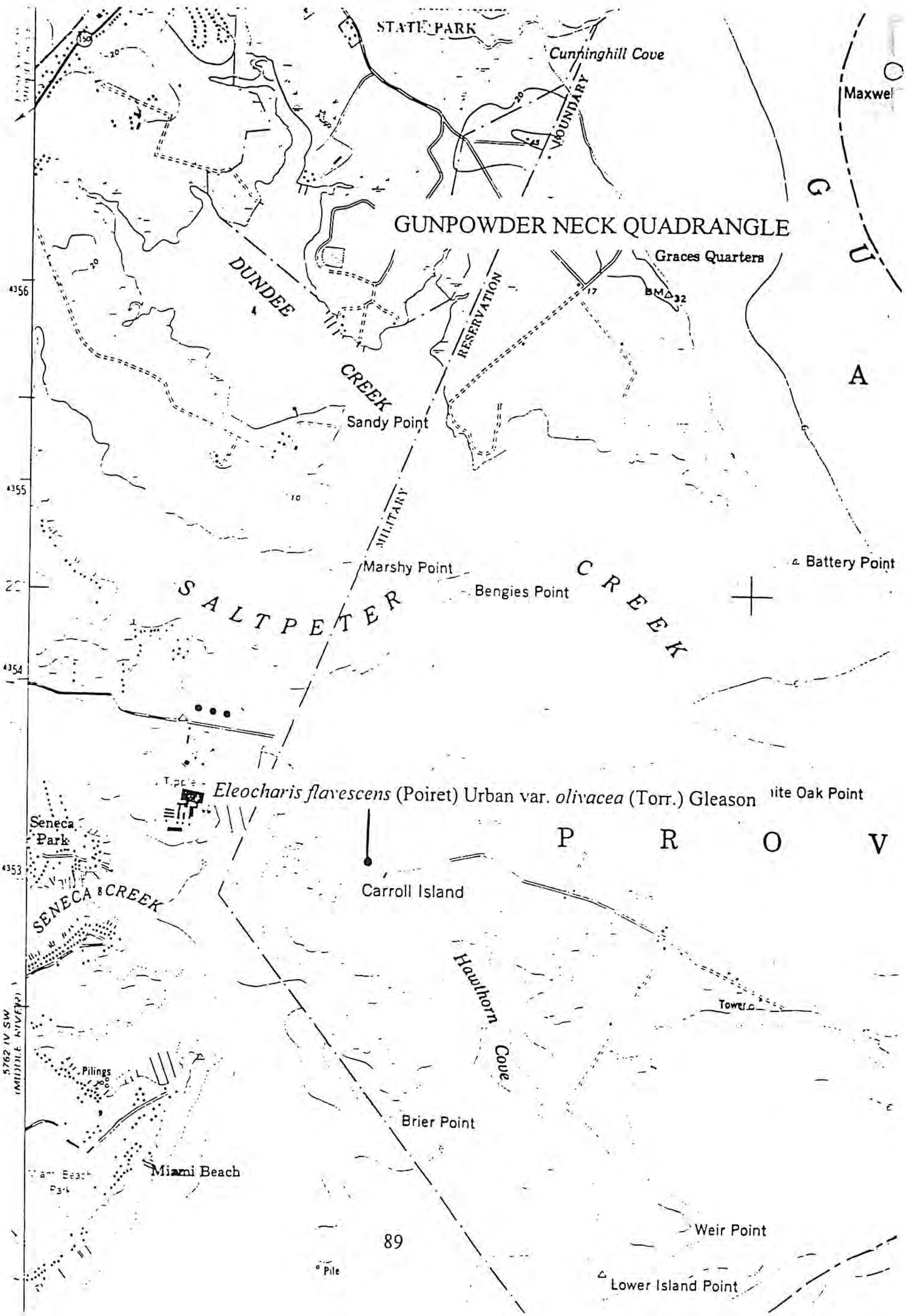


PERRYMAN QUADRANGLE
Cuscuta pentagona Engelm.
Stepney
Short Lane
Run
Cranberry
Trailer Park
Perryman School
Spesutie Church Cem
PERRYMAN
Cem
Cranberry Church
Boothby Hill
RESERVATION
HIGHWAY
TEST
MILITARY
Control tower
PHILLIPS
PHILLIPS FIELD
FIELD
ROAD
AVIATION
ABERDEEN
PROVING
MILITARY
MICHAELSVILLE
PALMER ROAD
Palmer House



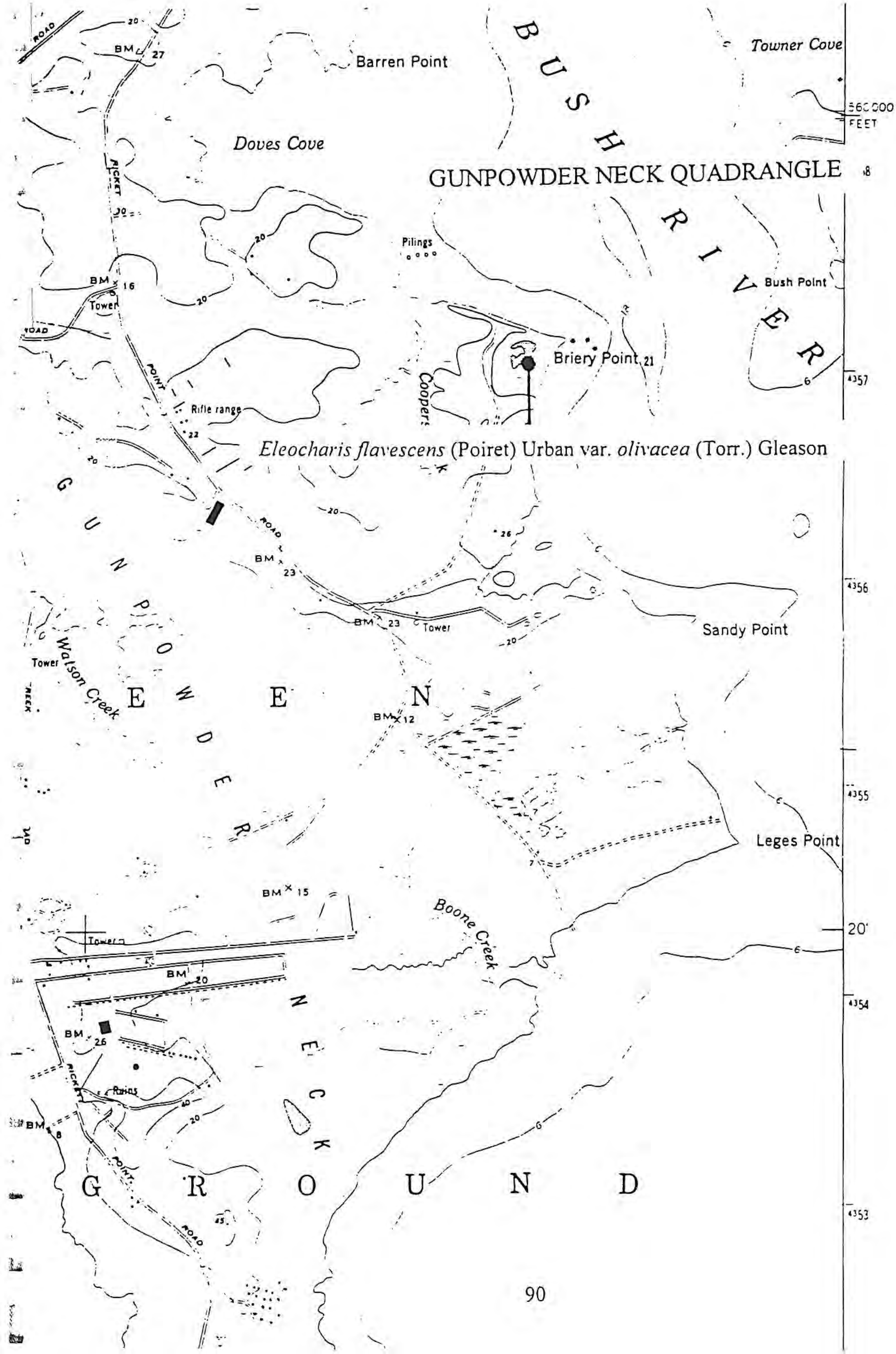
SPESUTIE QUADRANGLE
Cyperus lancastriensis Porter
Auto test course
Neds Island
NARROWS
SPESUTIE
PROVING GROUND
Abandoned airport
Brier Point
Gas tank
Johnson Point
Mulberry Point
SPESUTIE ISLAND
Back Creek
Tower
Light
Sandy Point
Black Point
Bear Point
MILITARY RESERVATION (APPROXIMATE)

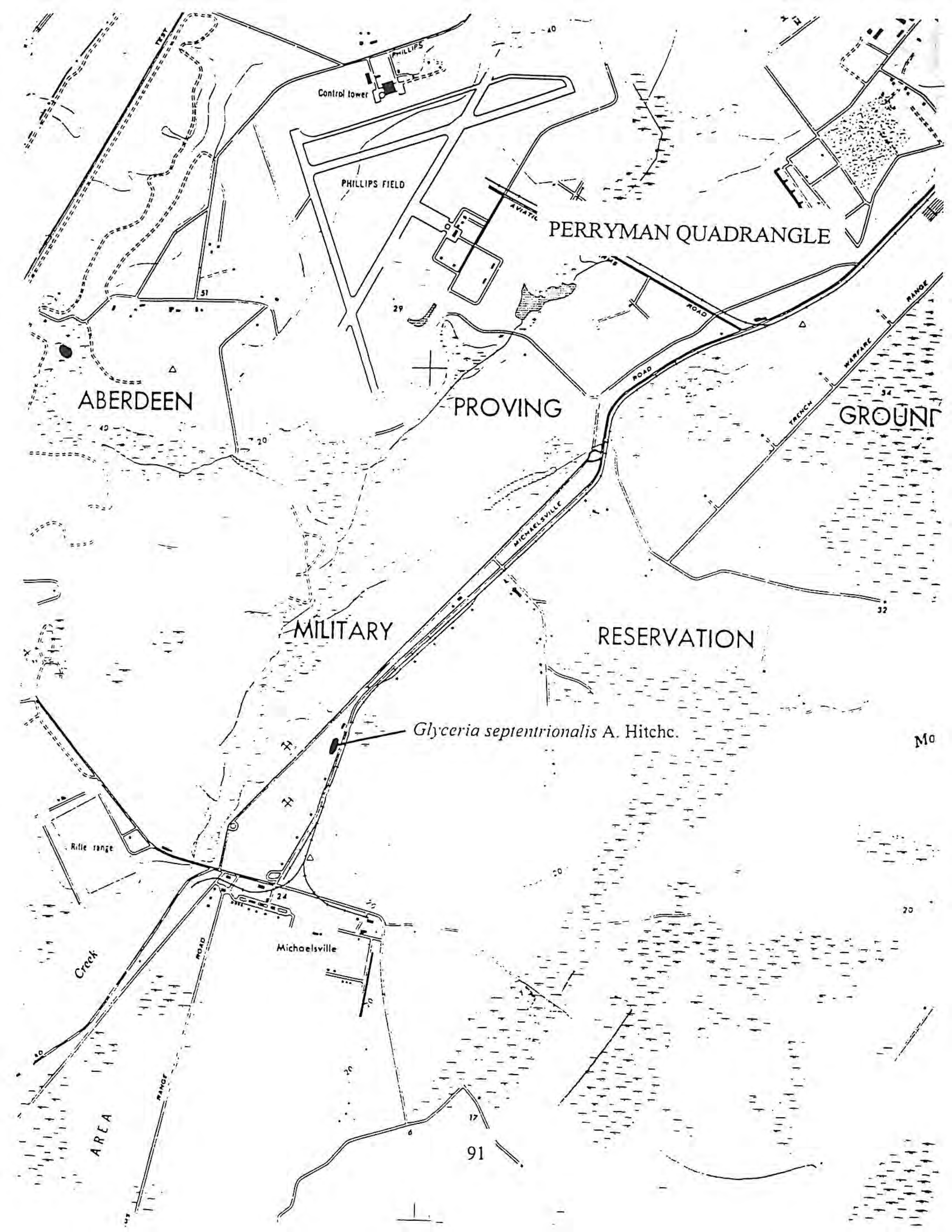

PERRYMAN QUADRANGLE
Eleocharis engelmannii Steud.
Stepney
Short Lane
Run
Trailer Park
Cranberry
Cem
Perryman School
Spesutie Church Cem
PERRYMAN
Cem
Cranberry Church
AMTRAK
MILITARY
RESERVATION
HIGHWAY
TEST
Boothby Hill
FIELD
ROAD
PHILLIPS
Control tower
PHILLIPS FIELD
AVIATION
ABERDEEN
PROVING
MILITARY
MICHAELSVILLE
PALMER
ROAD
Palmer House


GUNPOWDER NECK QUADRANGLE
Eleocharis flavescens (Poiret) Urban var. olivacea (Torr.) Gleason
STATE PARK
Cunninghill Cove
Maxwel
BOUNDARY
RESERVATION
MILITARY
Graces Quarters
DUNDEE
CREEK
Sandy Point
Marshy Point
Bengies Point
SALTPETER
CREEK
Battery Point
ite Oak Point
P R O V
Carroll Island
Seneca Park
SENECA CREEK
Hawthorn Cove
Tower
Pilings
Brier Point
Miami Beach
Weir Point
Lower Island Point
Pile
4356
4355
4354
4353
5762 IV SW (MIDDLE RIVER)

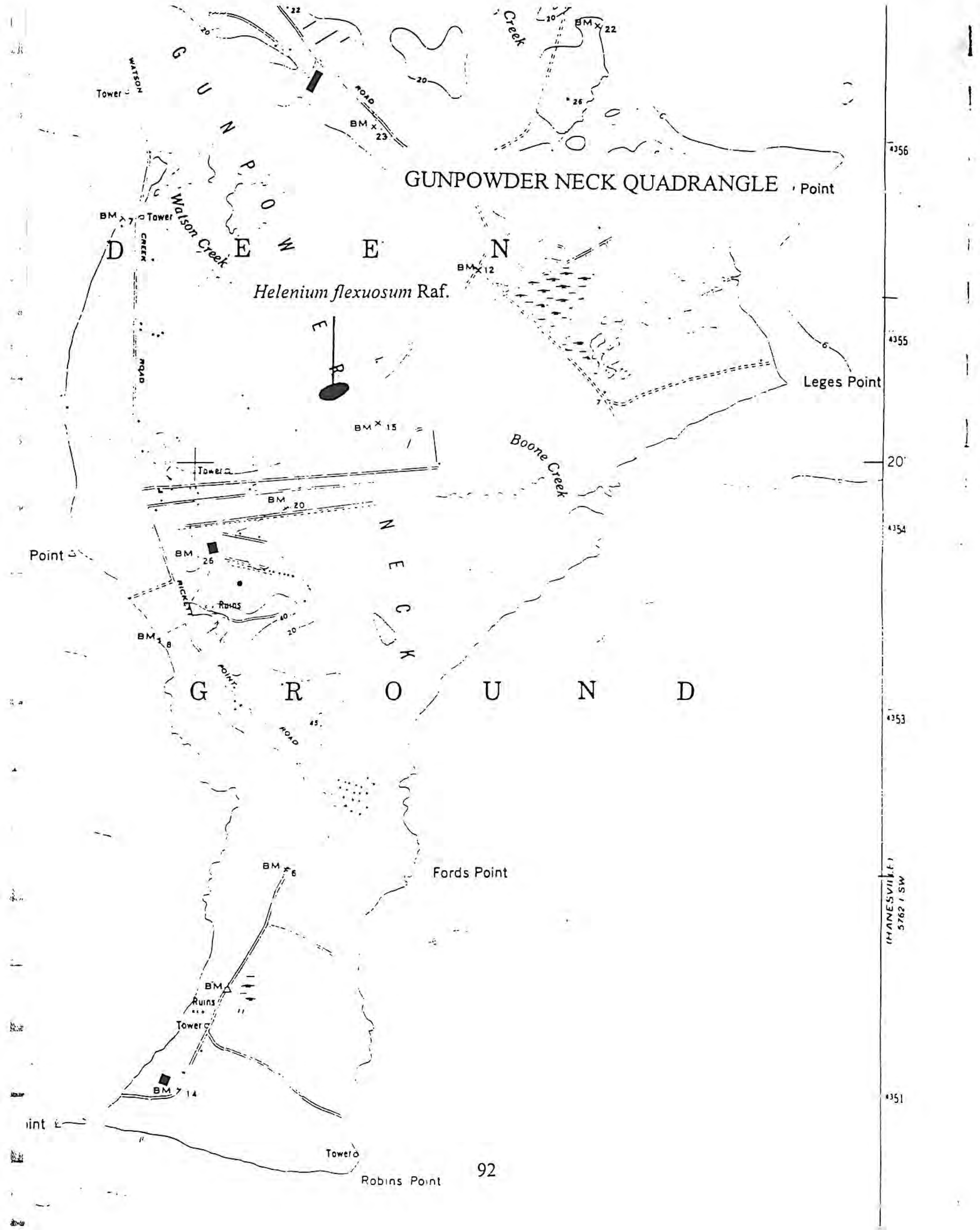
GUNPOWDER NECK QUADRANGLE

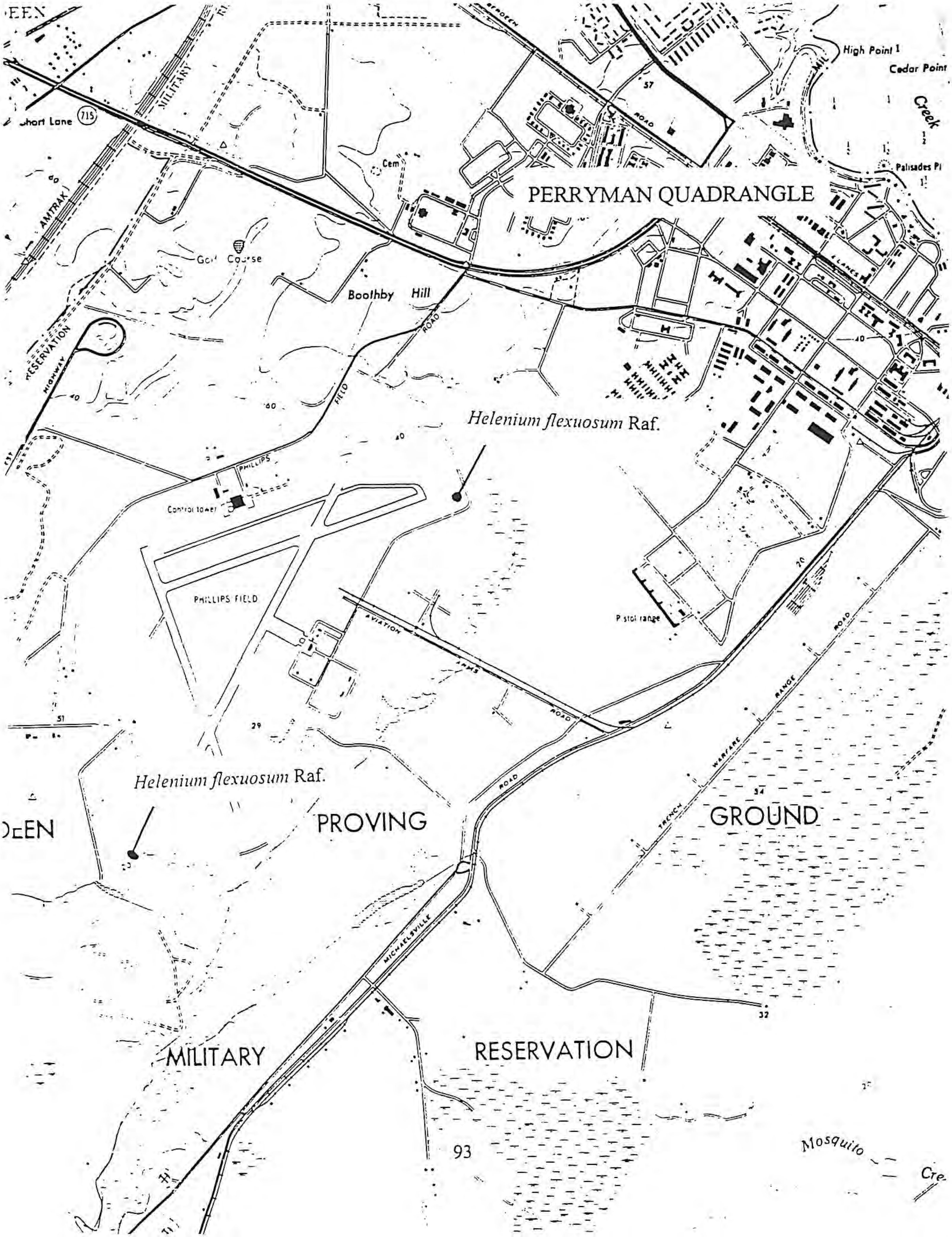
Eleocharis flavescens (Poiret) Urban var. *olivacea* (Torr.) Gleason

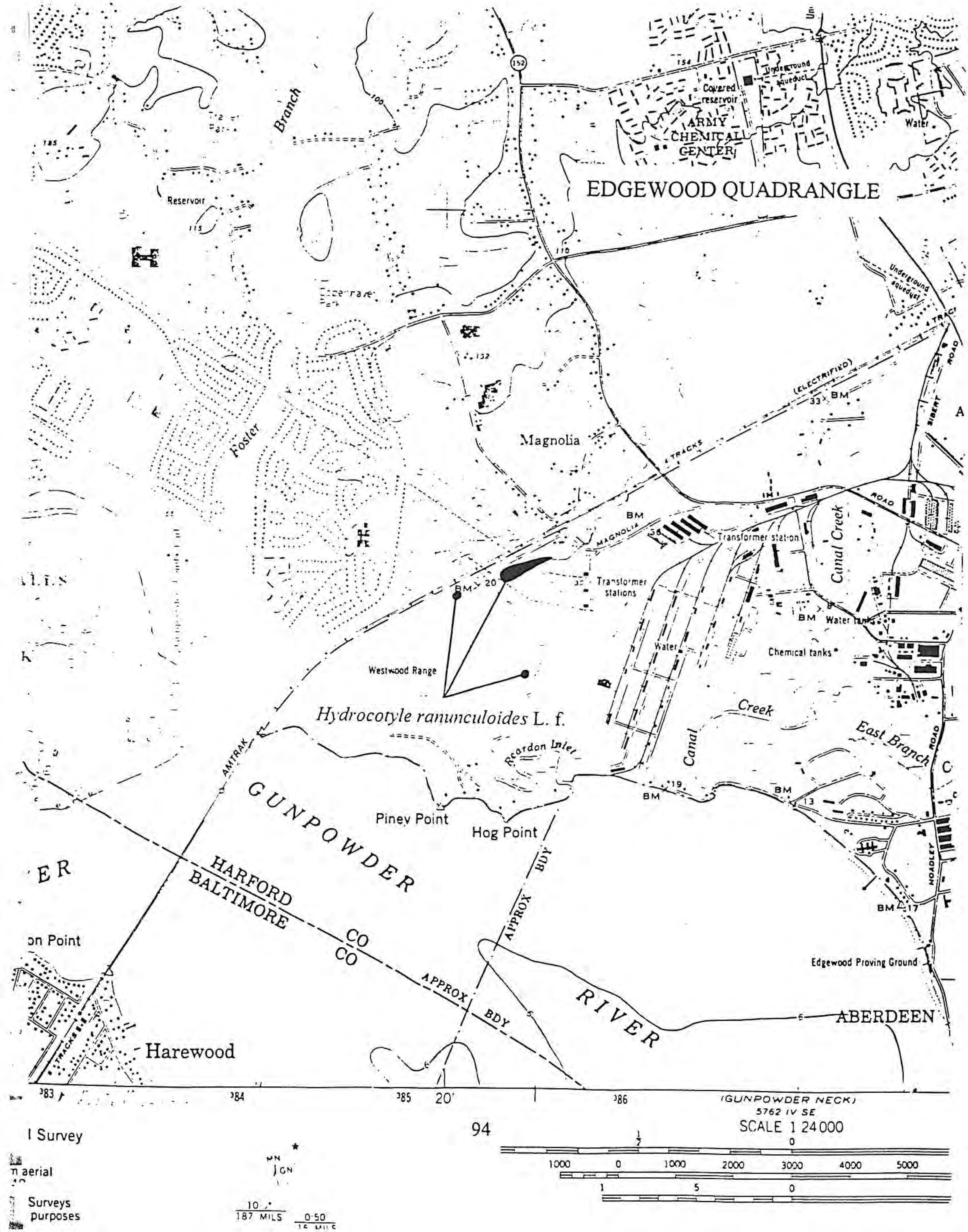




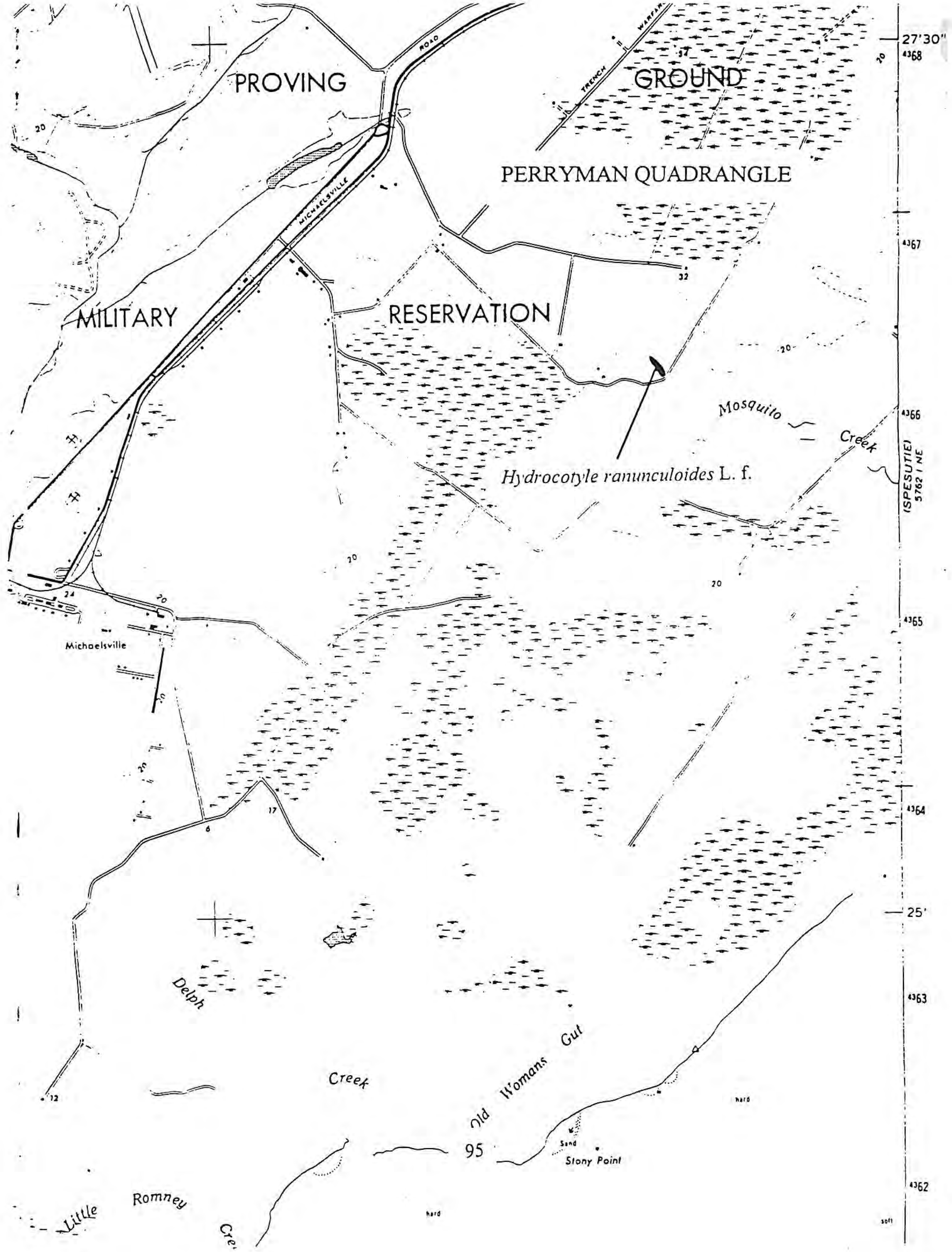
Control tower
PHILLIPS
PHILLIPS FIELD
AVIATION
PERRYMAN QUADRANGLE
ROAD
ABERDEEN
PROVING
GROUND
MICHAELSVILLE
ROAD
TRENCH
WARFARE
RANGE
MILITARY
RESERVATION
Glyceria septentrionalis A. Hitchc.
Rifle range
Michaelsville
Creek
ROAD
RANGE
AREA


GUNPOWDER NECK QUADRANGLE
Helenium flexuosum Raf.
GUNPOWDER
D E E N
NECK
G R O U N D
Watson Creek
WATSON CREEK ROAD
Boone Creek
Creek
Leges Point
Fords Point
Robins Point
Point
Tower
Ruins
RICKETT POINT ROAD
BM 22
BM 23
BM 12
BM 15
BM 20
BM 26
BM 8
BM 6
BM 14
4356
4355
4354
4353
4351
20'
HANESVILLE
5762 I SW

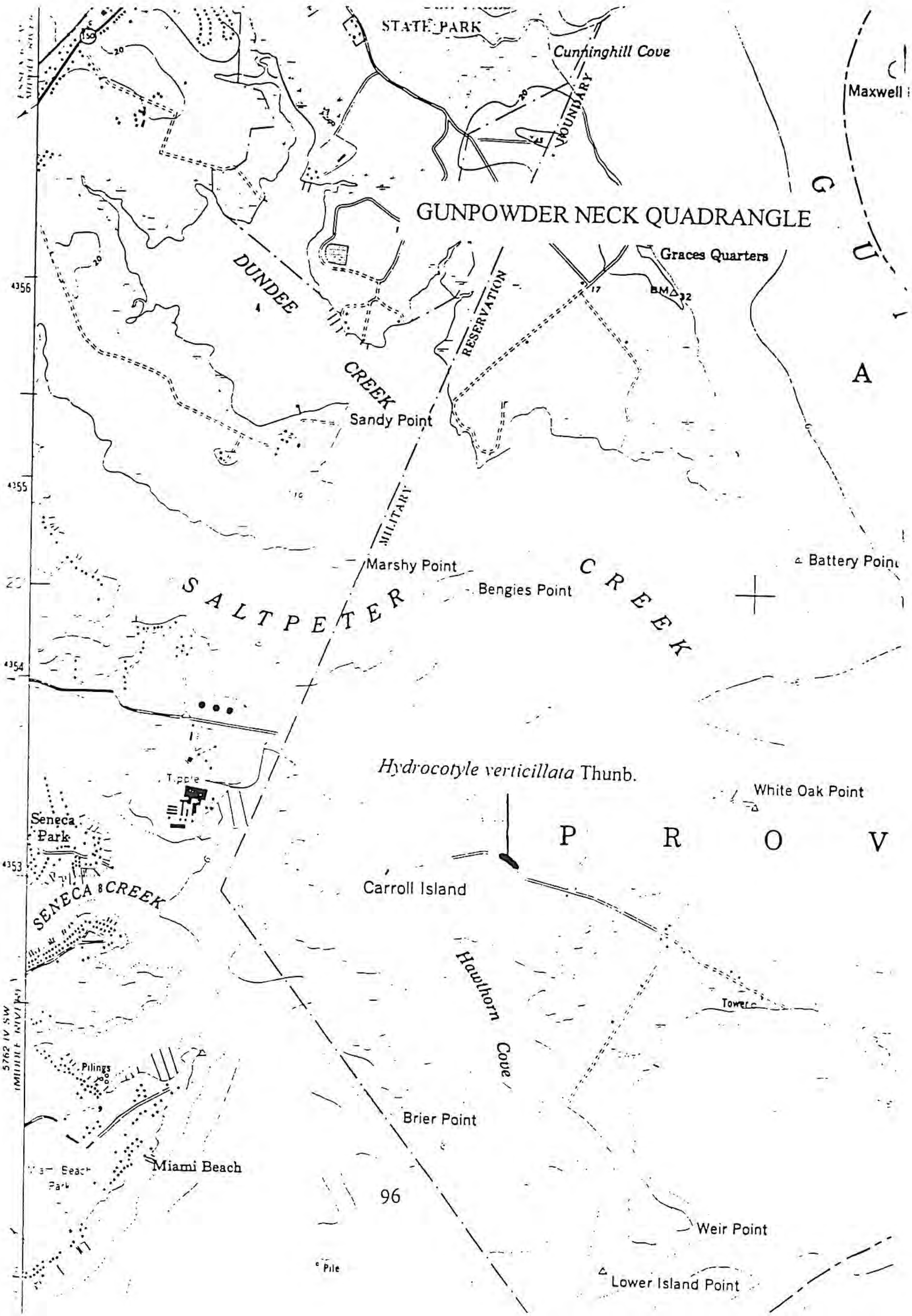

PERRYMAN QUADRANGLE
Helenium flexuosum Raf.
Helenium flexuosum Raf.
High Point
Cedar Point
Creek
Palisades Pt
Short Lane
715
AMTRAK
MILITARY
RESERVATION
HIGHWAY
Golf Course
Cem
Boothby Hill
FIELD
ROAD
PHILLIPS
Control tower
PHILLIPS FIELD
AVIATION
ARMS
ROAD
Pistol range
RANGE
ROAD
WARFARE
TRENCH
ROAD
MICHAELSVILLE
PROVING
GROUND
MILITARY
RESERVATION
Mosquito
Cre



EDGEWOOD QUADRANGLE
ARMY CHEMICAL CENTER
Covered reservoir
Underground aqueduct
Water
Reservoir
Branch
Foster
Magnolia
4 TRACKS
(ELECTRIFIED)
BM
SIBERT ROAD
MAGNOLIA
ROAD
Transformer station
Transformer stations
Canal Creek
Water tanks
Chemical tanks
Westwood Range
Hydrocotyle ranunculoides L. f.
Creek
Canal
East Branch
Reardon Inlet
AMTRAK
GUNPOWDER
Piney Point
Hog Point
APPROX BDY
HARFORD
BALTIMORE
CO
CO
HOADLEY
Edgewood Proving Ground
RIVER
ABERDEEN
Harewood
TRACKS
(GUNPOWDER NECK)
5762 IV SE
SCALE 1 24 000
l Survey
n aerial
Surveys
purposes
187 MILS

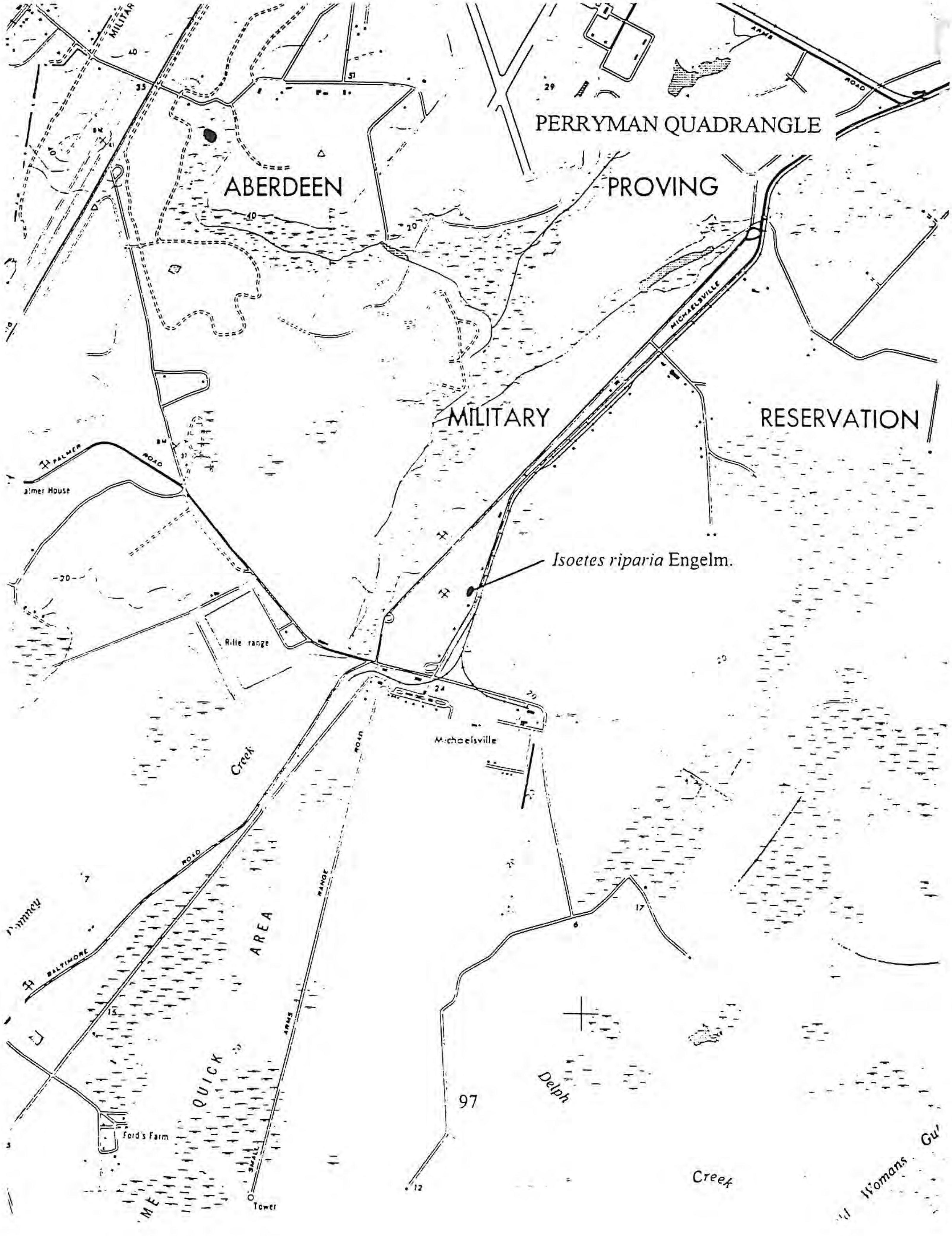


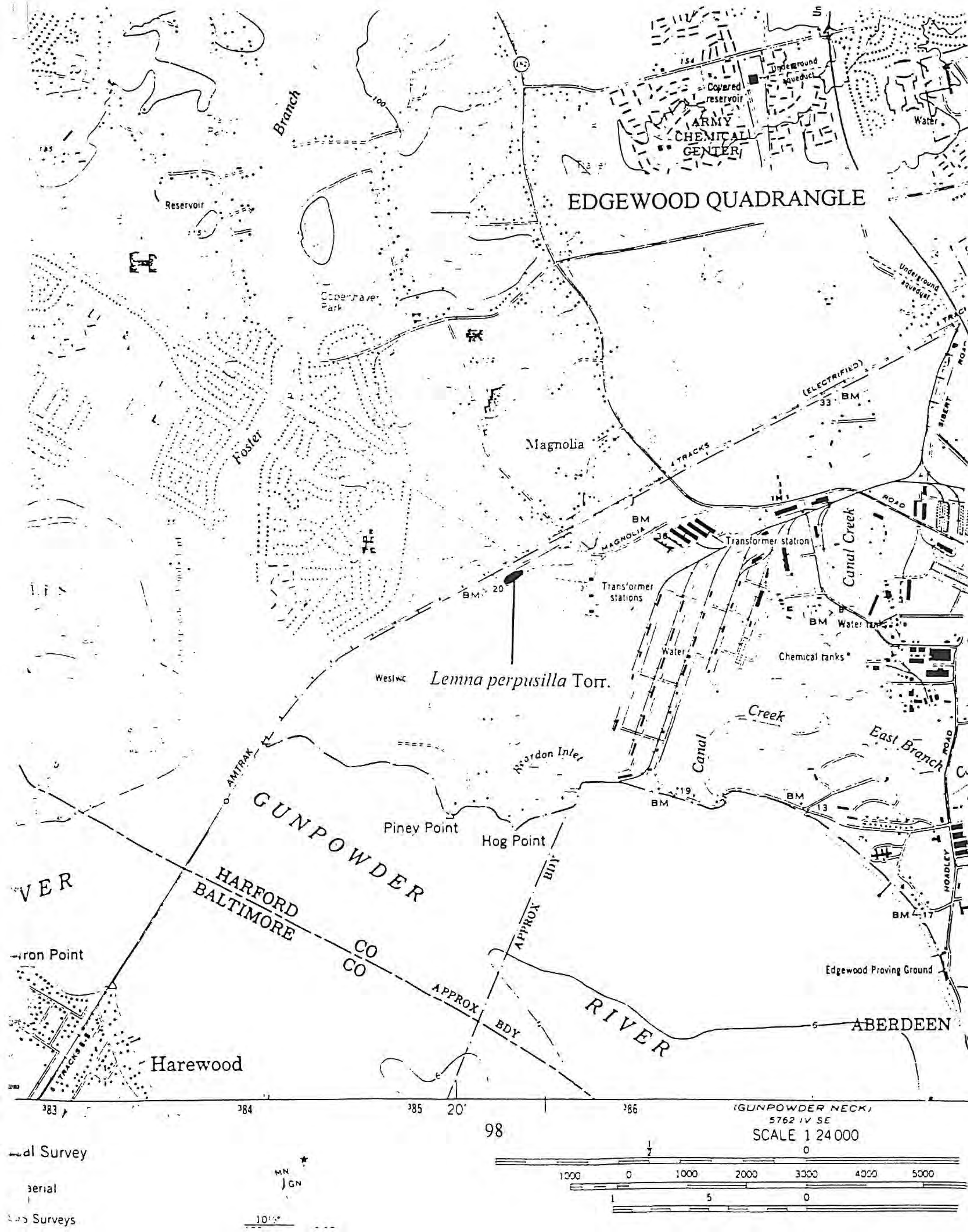
PROVING
GROUND
MILITARY
RESERVATION
PERRYMAN QUADRANGLE
ROAD
MICHAELSVILLE
TRENCH
WARFARE
27'30"
4368
4367
4366
4365
4364
25'
4363
4362
(SPESUTIE)
5762 I NE
Hydrocotyle ranunculoides L. f.
Mosquito Creek
Michaelsville
Delph Creek
Old Womans Gut
Sand
Stony Point
hard
soft
95
Little Romney Cre

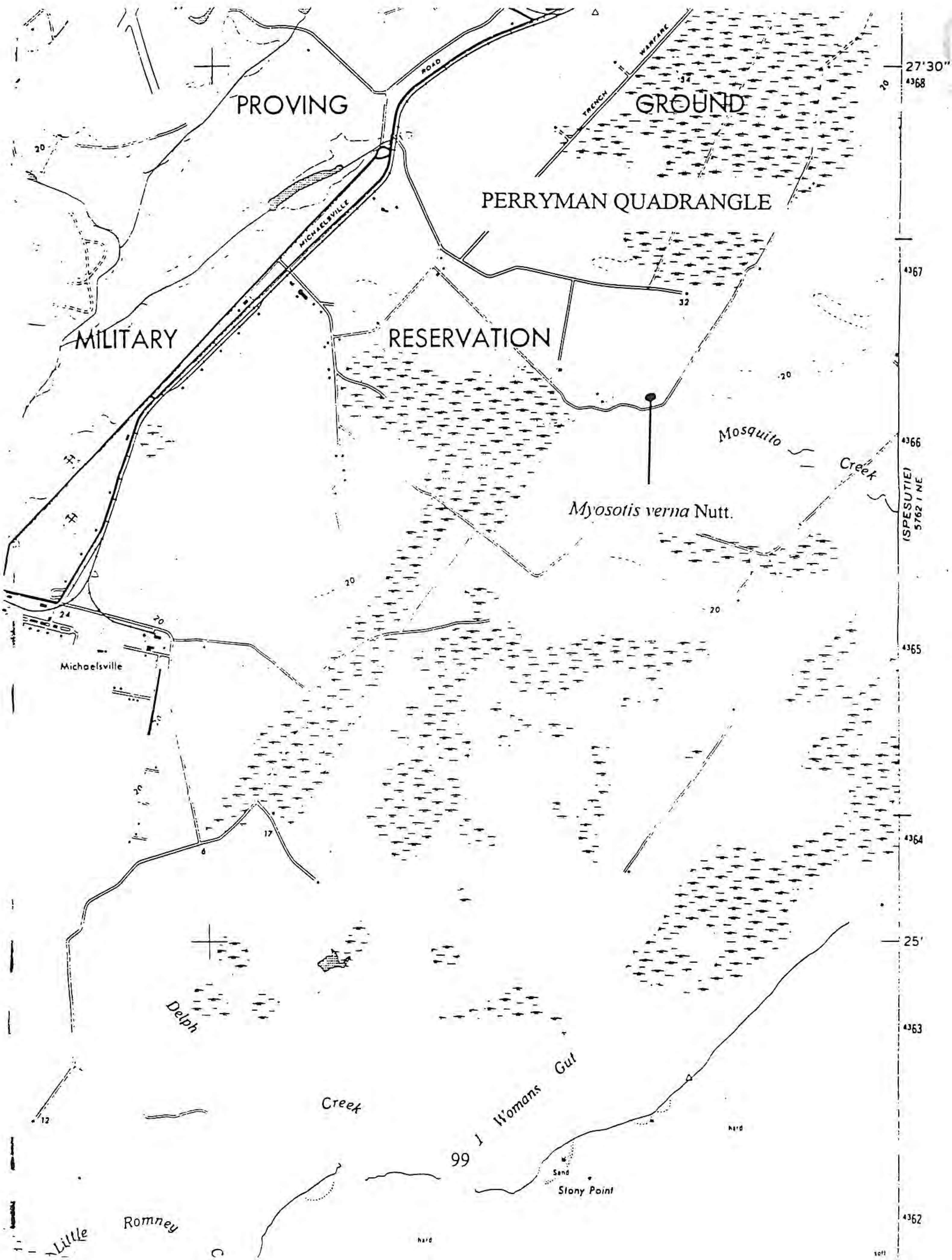


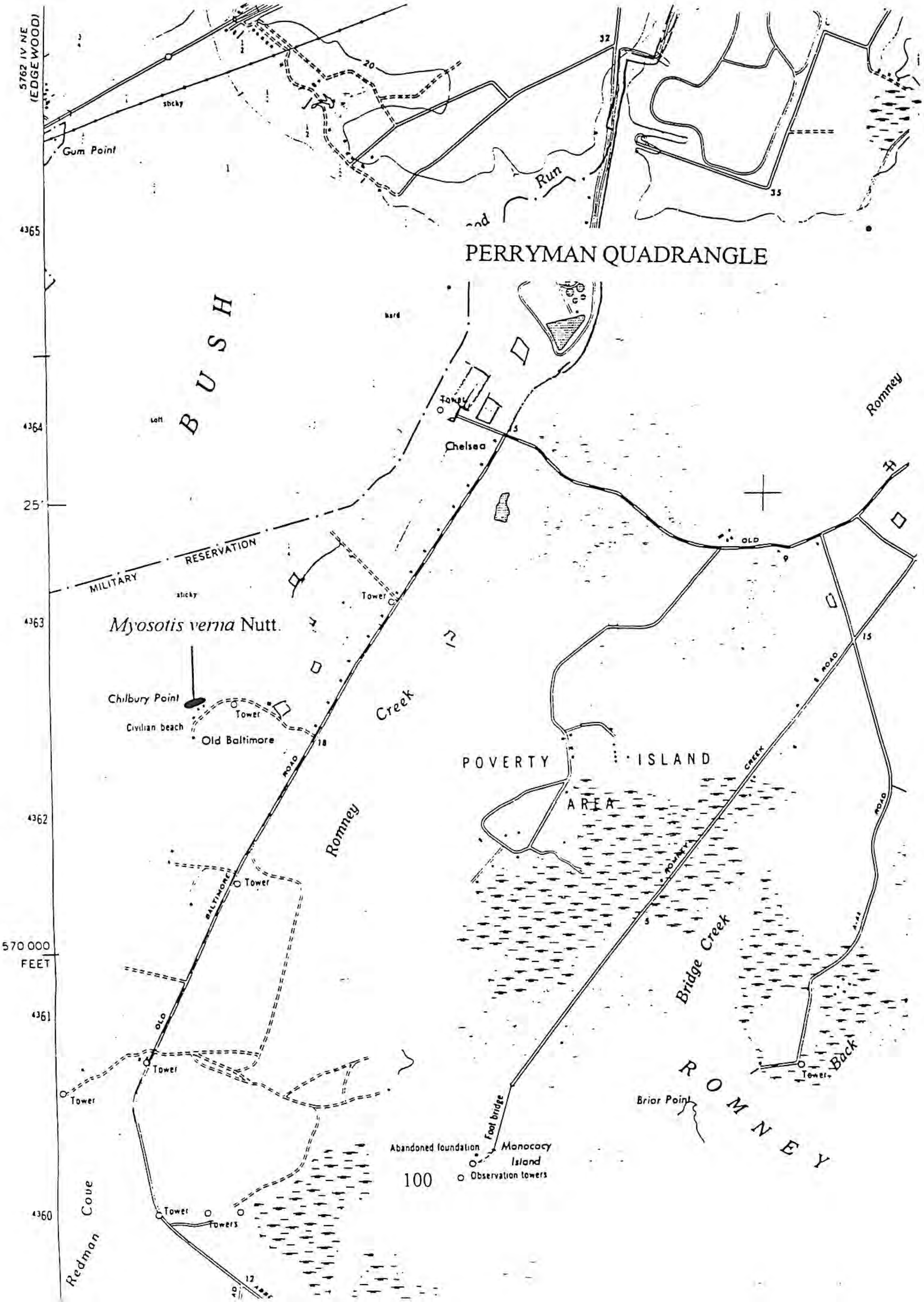
GUNPOWDER NECK QUADRANGLE

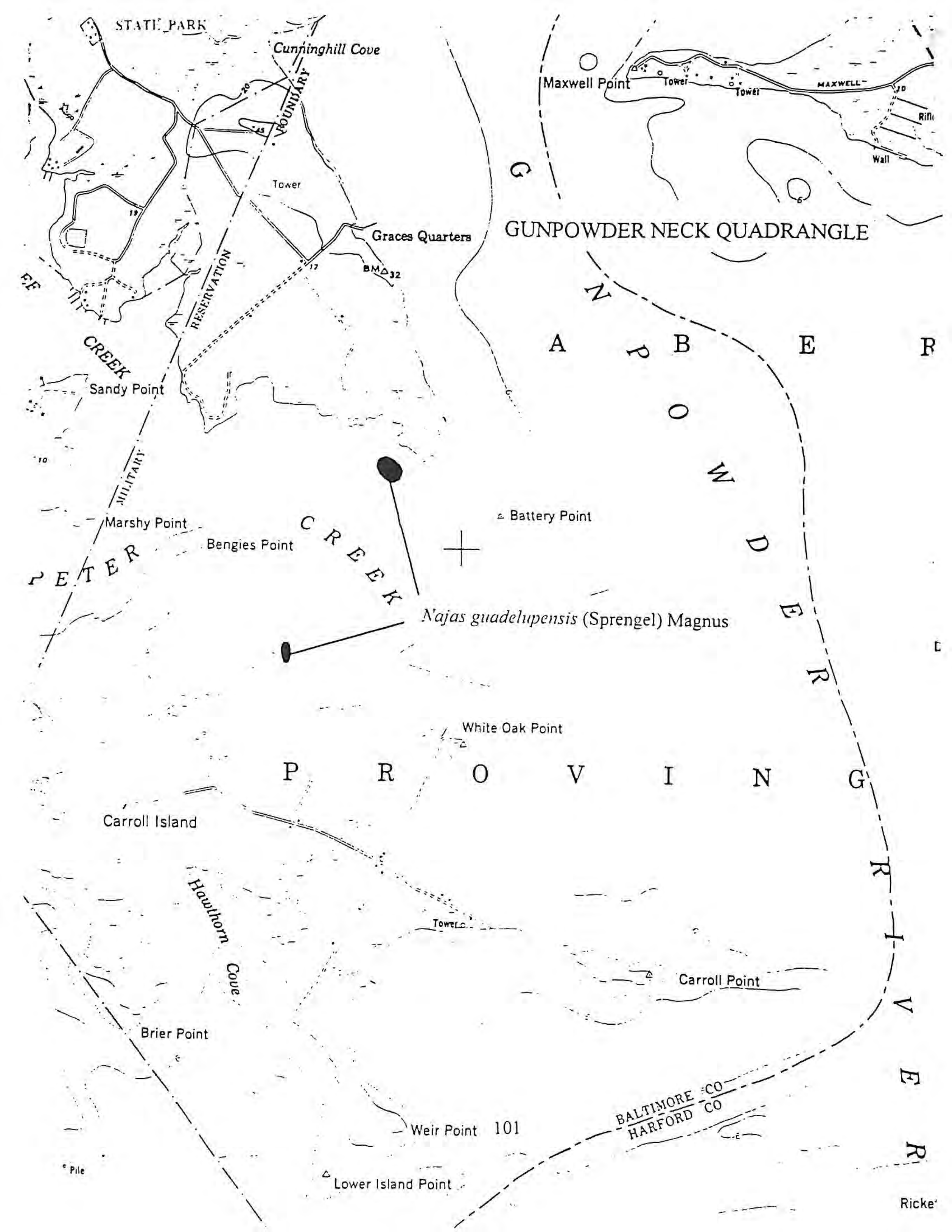
Hydrocotyle verticillata Thunb.


PERRYMAN QUADRANGLE
ABERDEEN
PROVING
MILITARY
RESERVATION
Isoetes riparia Engelm.
Palmer House
PALMER ROAD
MICHAELSVILLE
Rifle range
Michaelsville
Creek
BALTIMORE ROAD
QUICK AREA
SMALL ARMS RANGE ROAD
Ford's Farm
Tower
Delph
Creek
Womans

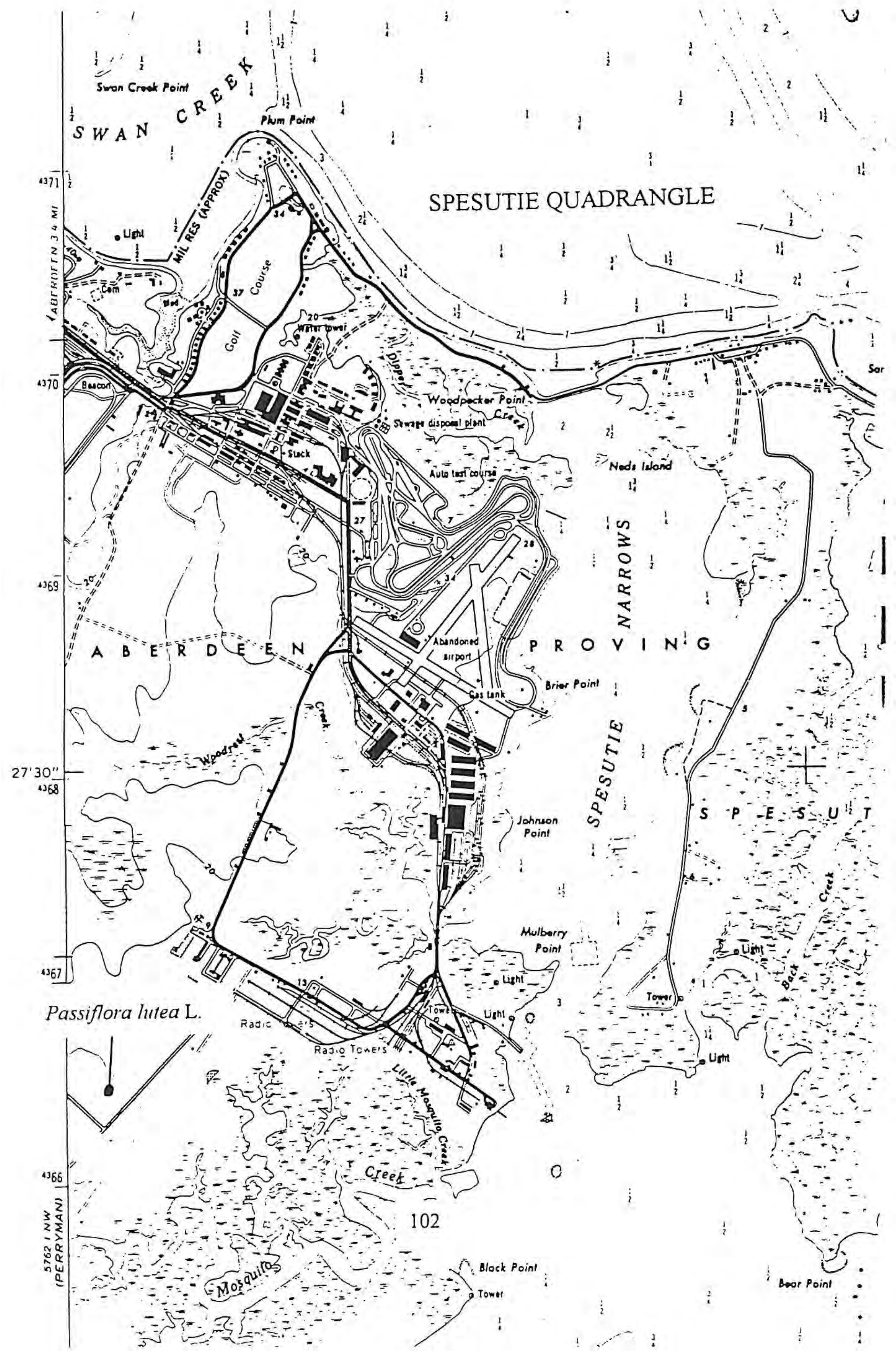

EDGEWOOD QUADRANGLE
ARMY CHEMICAL CENTER
Covered reservoir
Underground aqueduct
Water
Branch
Reservoir
Foster
Magnolia
Underground aqueduct
(ELECTRIFIED)
4 TRACKS
SIBERT ROAD
MAGNOLIA
Transformer station
Transformer stations
Canal Creek
Water tanks
Chemical tanks
Water
Lemna perpusilla Torr.
Creek
East Branch
Canal
Reardon Inlet
AMTRAK
Piney Point
Hog Point
GUNPOWDER
RIVER
HARFORD CO
BALTIMORE CO
APPROX BDY
HOADLEY
ROAD
Edgewood Proving Ground
ABERDEEN
Harewood
Iron Point
(GUNPOWDER NECK)
5762 IV SE
SCALE 1 24 000


PROVING GROUND
PERRYMAN QUADRANGLE
MILITARY RESERVATION
MICHAELSVILLE ROAD
TRENCH WARFARE
Myosotis verna Nutt.
Mosquito Creek
(SPESUTIE)
5762 I NE
27'30"
25'
4368
4367
4366
4365
4364
4363
4362
Michaelsville
Delph Creek
Womans Gut
Sand
Stony Point
Little Romney
hard
soft


5762 IV NE (EDGEWOOD)
Gum Point
sticky
Run
PERRYMAN QUADRANGLE
BUSH
hard
soft
Tower
Chelsea
Romney
25'
MILITARY RESERVATION
sticky
Tower
OLD
Myosotis verna Nutt.
Chilbury Point
Tower
Civilian beach
Old Baltimore
Creek
ROAD
POVERTY ISLAND AREA
ROAD
Romney
BALTIMORE
Tower
570 000 FEET
Bridge Creek
OLD
Tower
Tower
Back
ROMNEY
Briar Point
Foot bridge
Abandoned foundation
Monocacy Island
Observation towers
Tower
Towers
Redman Cove
4365
4364
4363
4362
4361
4360

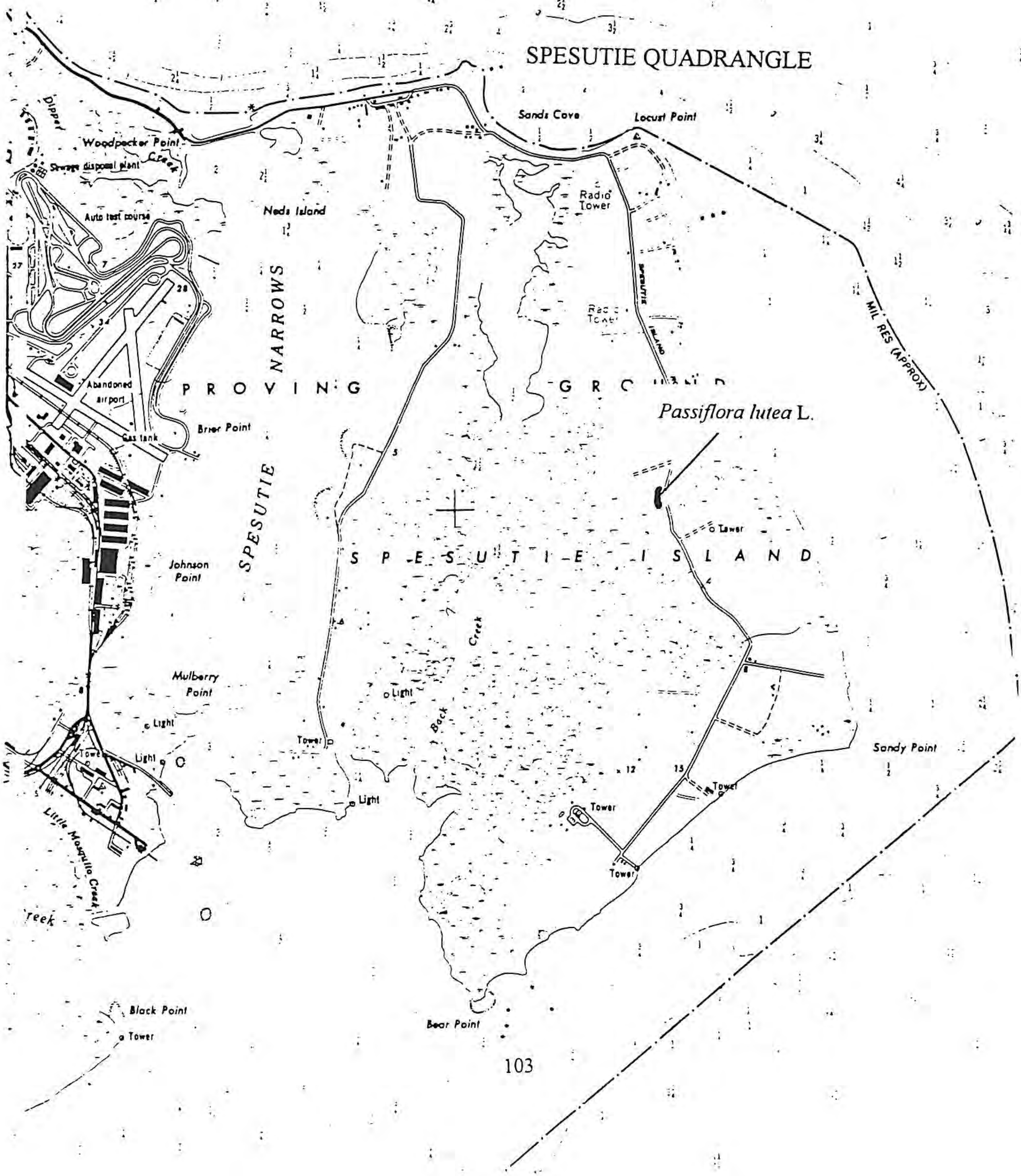

STATE PARK
Cunninghill Cove
BOUNDARY
Tower
RESERVATION
Graces Quarters
BM 32
CREEK
Sandy Point
MILITARY
Marshy Point
Bengies Point
PETER
CREEK
Battery Point
Najas guadelupensis (Sprengel) Magnus
White Oak Point
Carroll Island
Hawthorn Cove
Tower
Carroll Point
Brier Point
Weir Point
Pile
Lower Island Point
Maxwell Point
Tower
Tower
MAXWELL
Wall
GUNPOWDER NECK QUADRANGLE
A B E R
GUNPOWDER RIVER
P R O V I N G
BALTIMORE CO
HARFORD CO

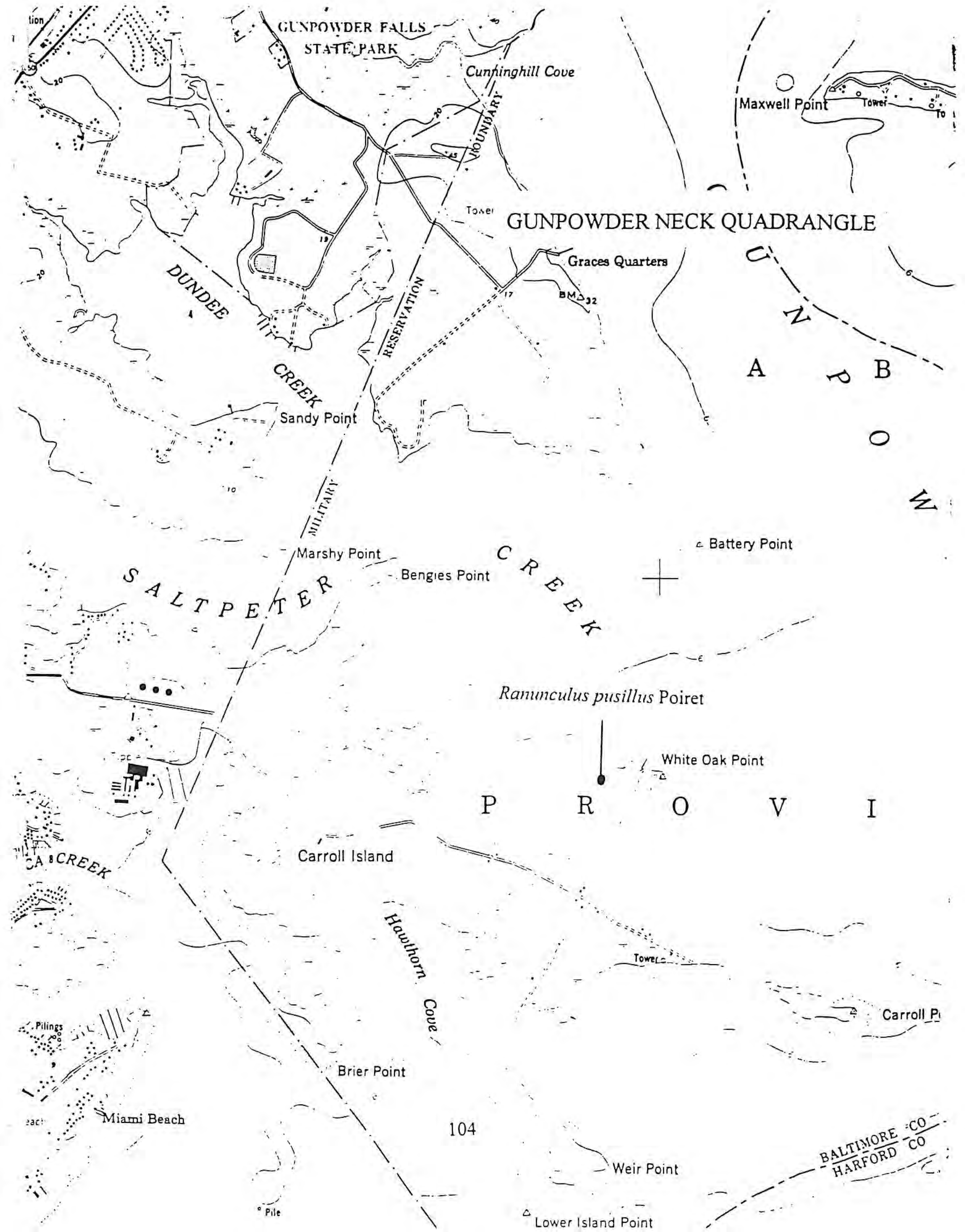
SPESUTIE QUADRANGLE

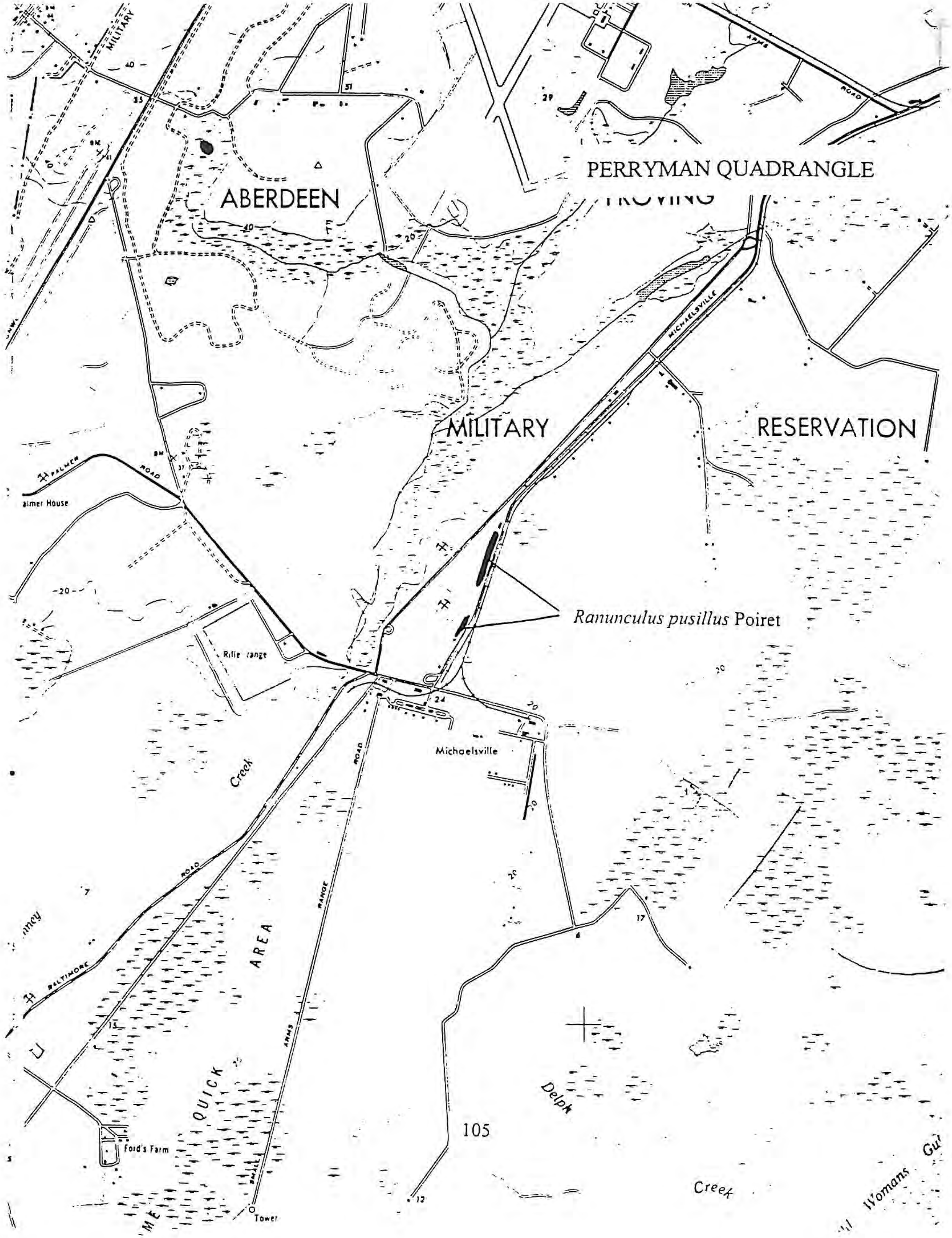


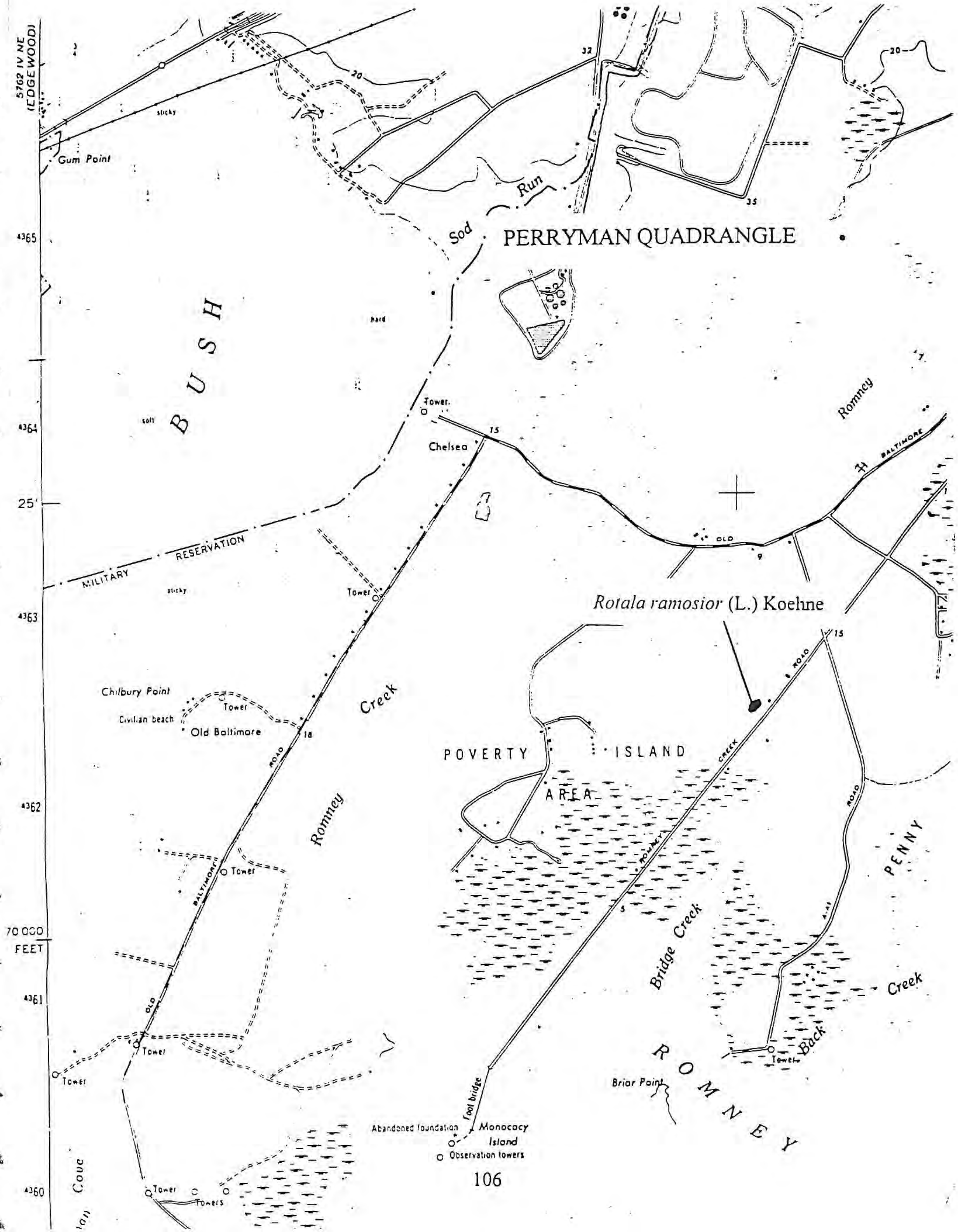
Passiflora lutea L.

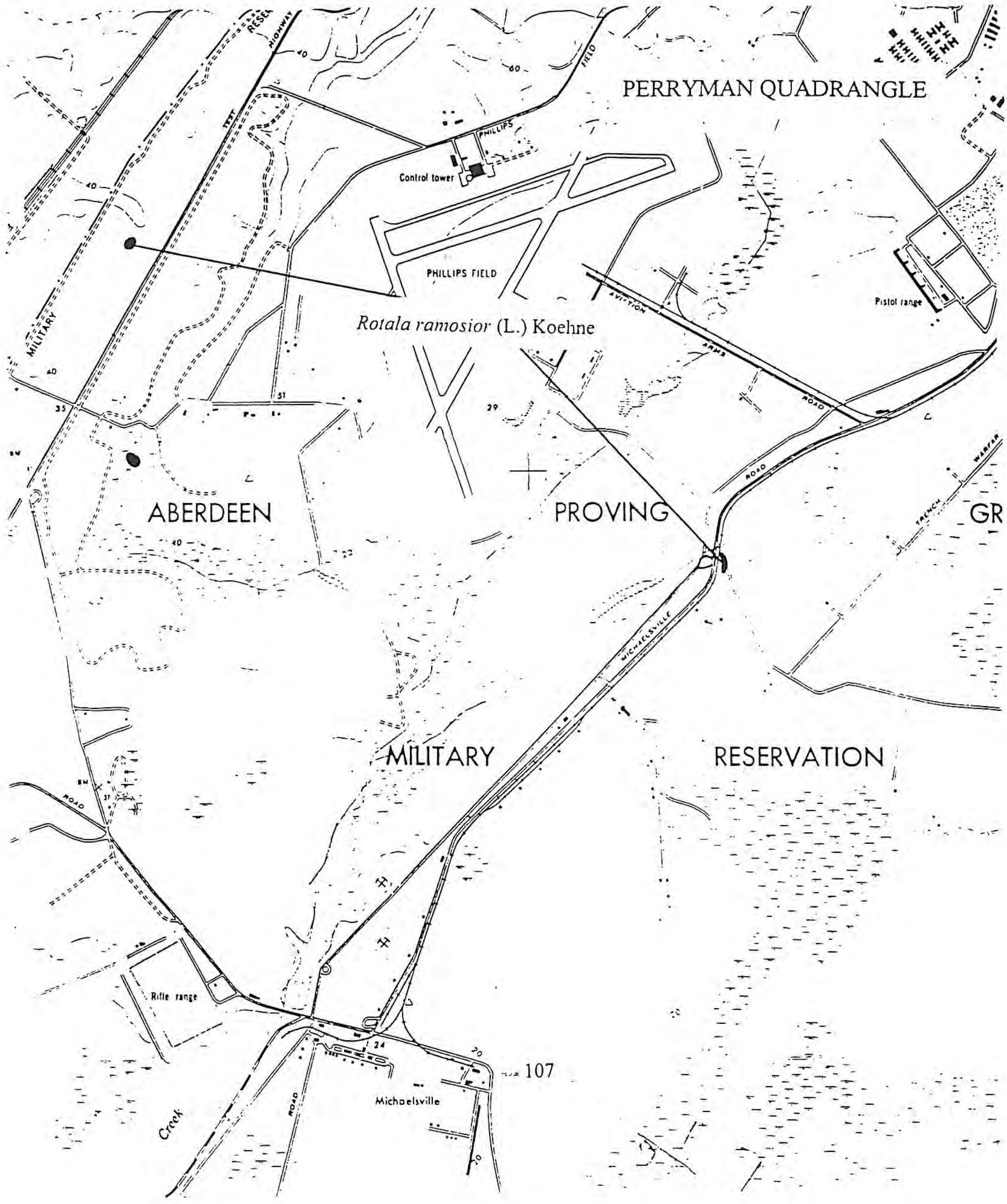
SPESUTIE QUADRANGLE

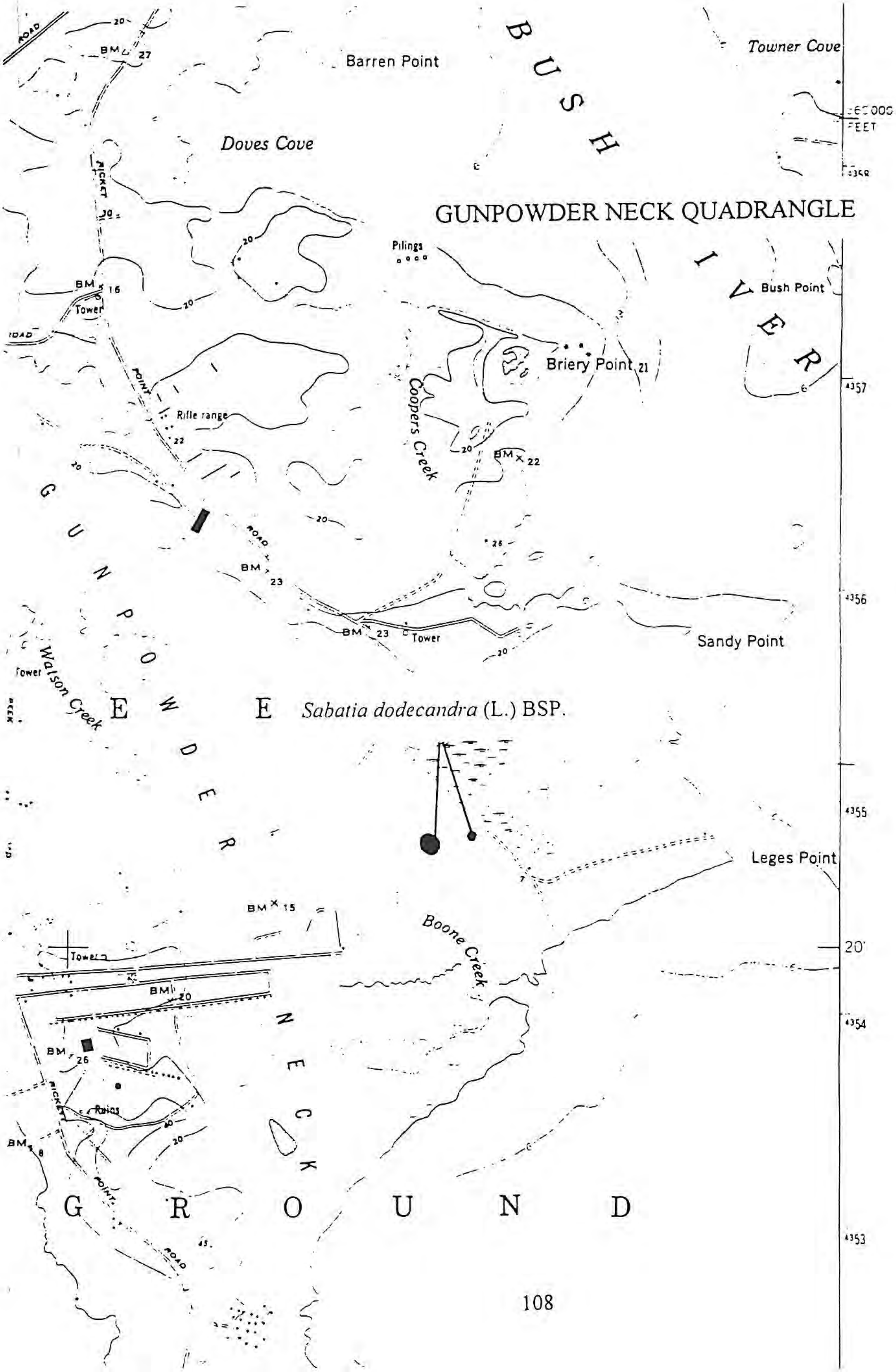



GUNPOWDER FALLS
STATE PARK
Cunninghill Cove
Maxwell Point
Tower
GUNPOWDER NECK QUADRANGLE
BOUNDARY
RESERVATION
MILITARY
Graces Quarters
BM 32
DUNDEE
CREEK
Sandy Point
Marshy Point
Bengies Point
SALTPETER
CREEK
Battery Point
Ranunculus pusillus Poiret
White Oak Point
Carroll Island
Hawthorn
Cove
Tower
Pilings
Brier Point
Miami Beach
Weir Point
Pile
Lower Island Point
BALTIMORE CO
HARFORD CO


PERRYMAN QUADRANGLE
ABERDEEN
PROVING
MILITARY
RESERVATION
MILITARY
MICHAELSVILLE
ARMS
ROAD
PALMER
ROAD
almer House
Ranunculus pusillus Poiret
Rifle range
Michaelsville
Creek
ROAD
RANGE
ARMS
SMALL
ROAD
BALTIMORE
AREA
QUICK
Delph
Creek
Womans
Ford's Farm
Tower

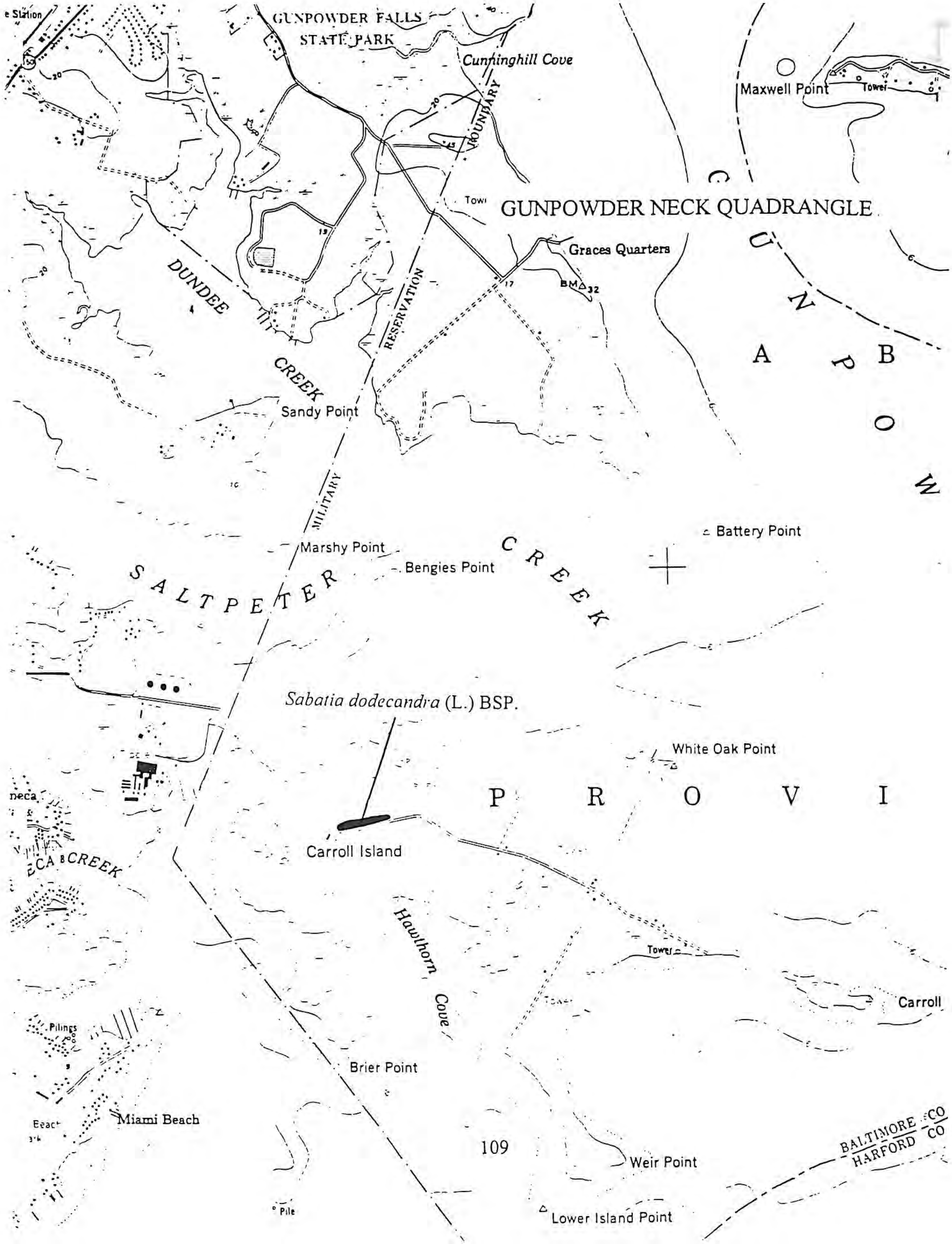

PERRYMAN QUADRANGLE
Rotala ramosior (L.) Koehne
5762 IV NE
(EDGEWOOD)
Gum Point
Sod Run
BUSH
MILITARY RESERVATION
Tower
Chelsea
Romney
BALTIMORE
OLD
Romney Creek
Chilbury Point
Civilian beach
Old Baltimore
ROAD
POVERTY ISLAND AREA
ROMNEY CREEK ROAD
Bridge Creek
PENNY
Back Creek
ROMNEY
Briar Point
Foot bridge
Abandoned foundation
Monocacy Island
Observation towers
Towers
70 000 FEET
25'
4365
4364
4363
4362
4361
4360


PERRYMAN QUADRANGLE
Control tower
PHILLIPS
PHILLIPS FIELD
Rotala ramosior (L.) Koehne
Pistol range
AVIATION
ARMS
ROAD
MILITARY
HIGHWAY
TEST
ABERDEEN
PROVING
GR
MILITARY
RESERVATION
MICHAELSVILLE
Rifle range
Michaelsville
Creek
TRENCH
WARFARE



GUNPOWDER NECK QUADRANGLE

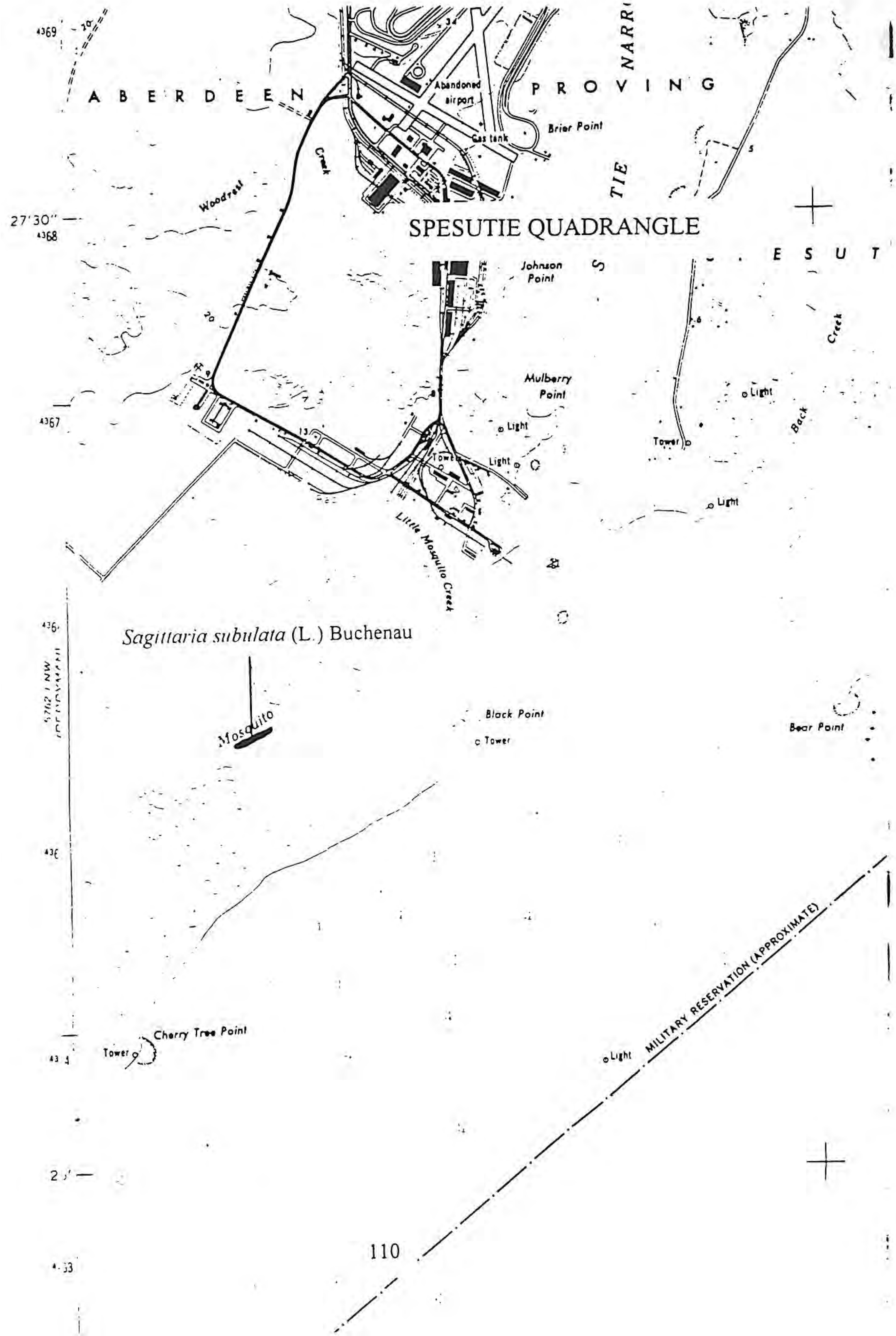
Sabatia dodecandra (L.) BSP.

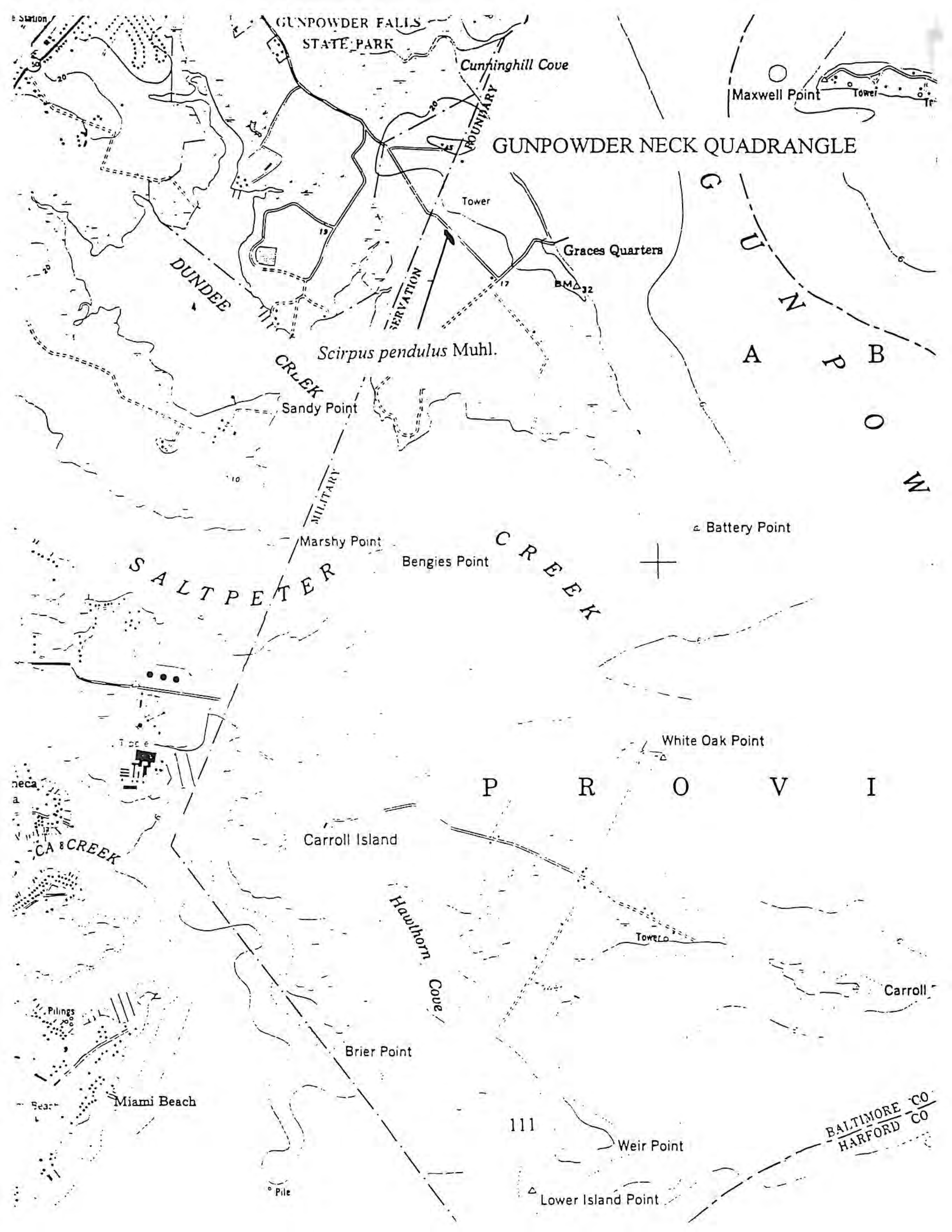


Sabatia dodecandra (L.) BSP.

SPESUTIE QUADRANGLE

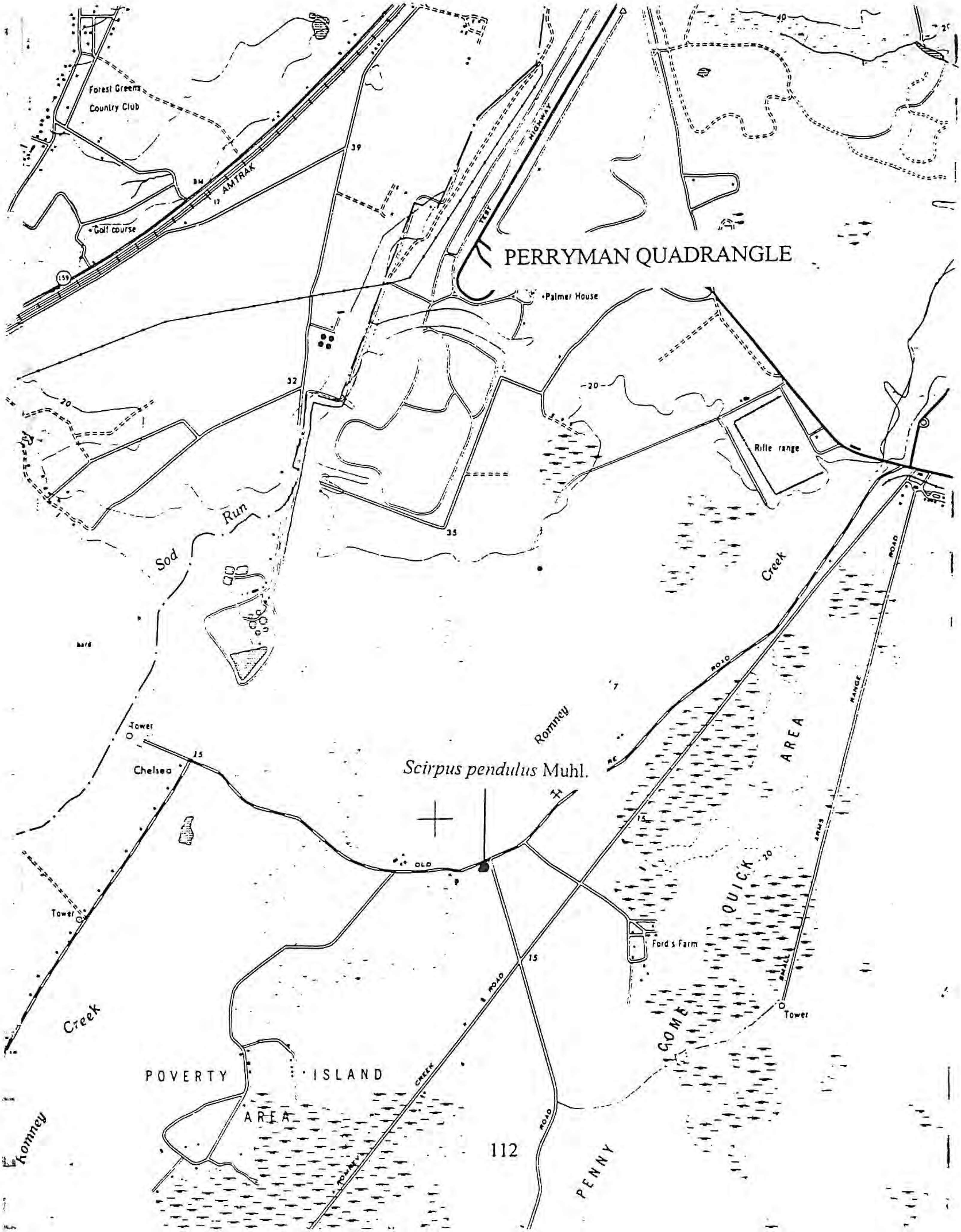
Sagittaria subulata (L.) Buchenau



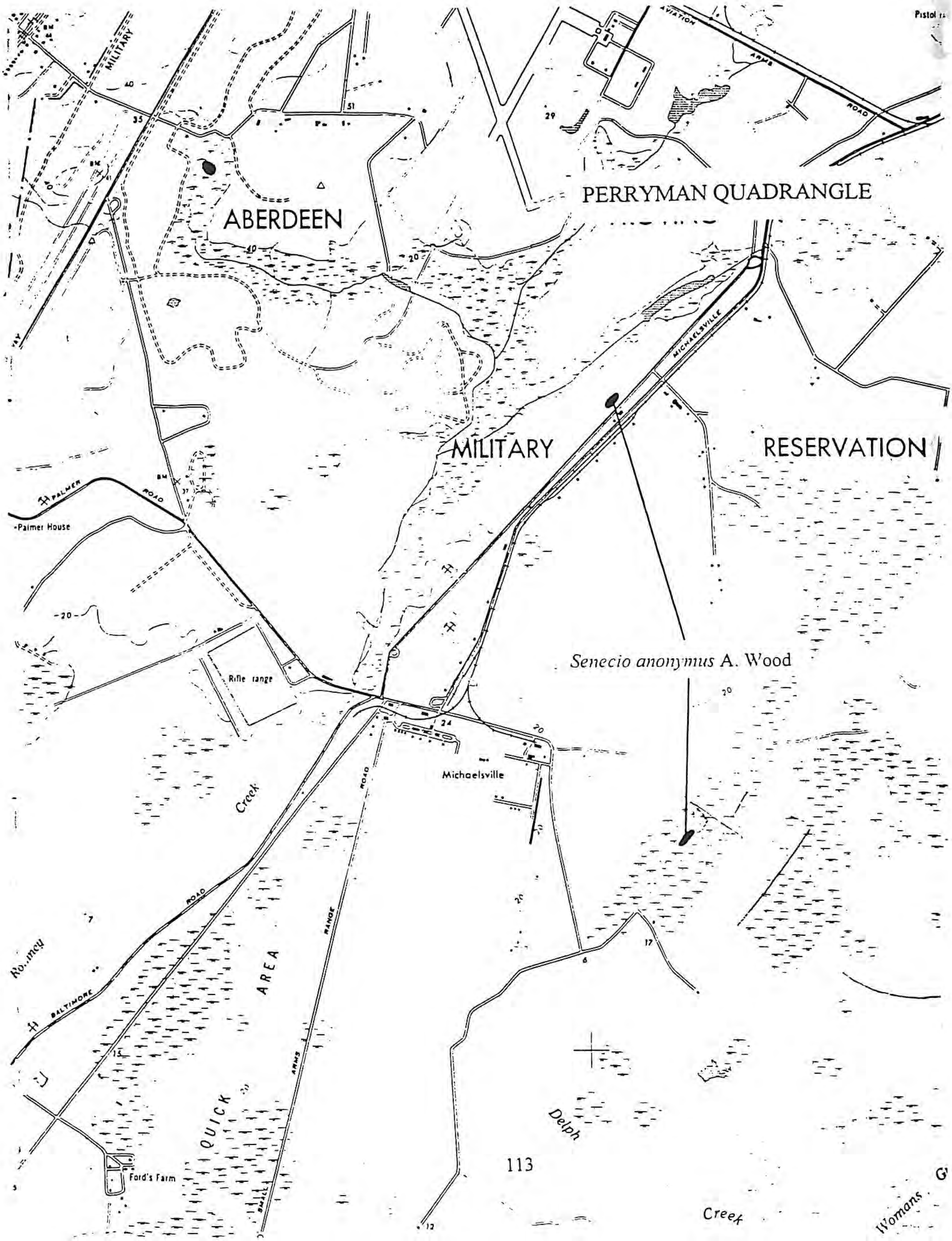


GUNPOWDER NECK QUADRANGLE

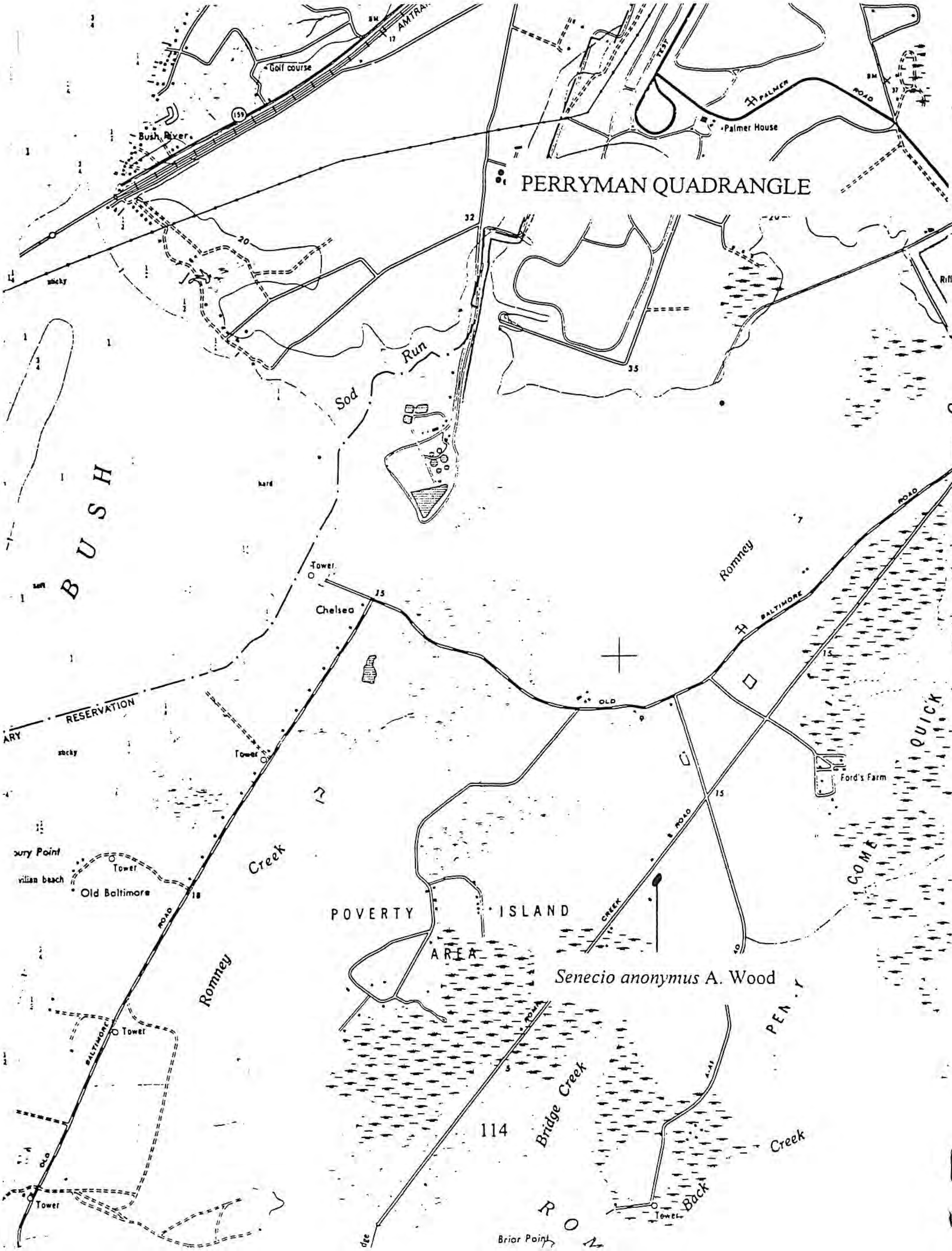
Scirpus pendulus Muhl.



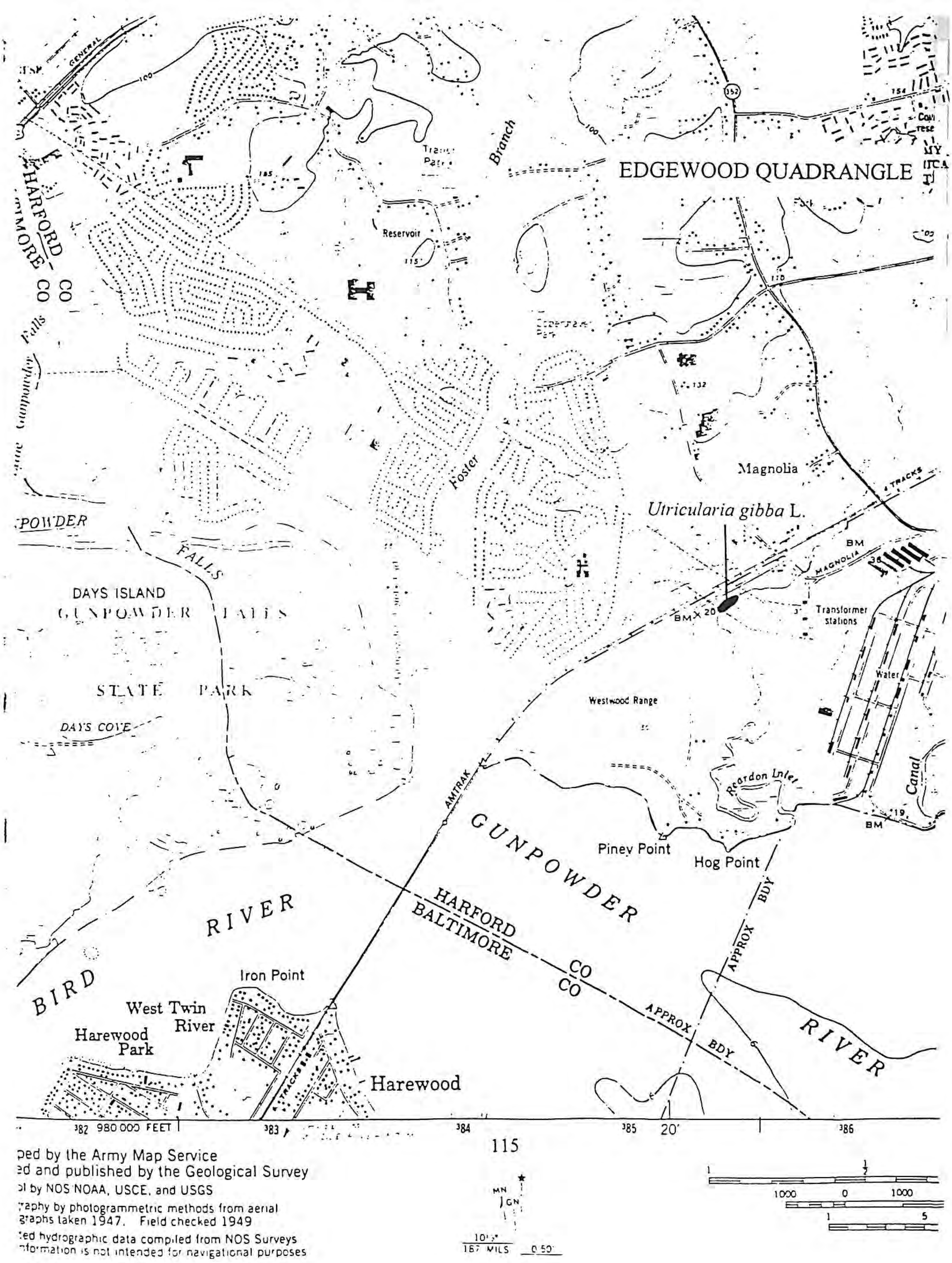
PERRYMAN QUADRANGLE
Scirpus pendulus Muhl.
Forest Greens Country Club
AMTRAK
Golf course
HIGHWAY
Palmer House
Rifle range
Sod Run
Creek
Romney
Tower
Chelsea
OLD
ROAD
Ford's Farm
QUICK
COME
AREA
SMALL ARMS RANGE ROAD
POVERTY ISLAND AREA
ROMNEY CREEK ROAD
PENNY
Romney Creek


PERRYMAN QUADRANGLE
ABERDEEN
MILITARY
RESERVATION
Senecio anonymus A. Wood
Palmer House
PALMER ROAD
Rifle range
Michaelsville
MICHAELSVILLE
Creek
ROAD
BALTIMORE
QUICK
AREA
RANGE
ARMS
SMALL
Ford's Farm
Delph
Creek
Womans
AVIATION
ARMS
ROAD
MILITARY
Pistol

PERRYMAN QUADRANGLE



Senecio anonymus A. Wood


EDGEWOOD QUADRANGLE
Utricularia gibba L.
Magnolia
Reservoir
Branch
Foster
HARFORD CO
BALTIMORE CO
Falls
Gunpowder
POWDER
FALLS
DAYS ISLAND
GUNPOWDER FALLS
STATE PARK
DAYS COVE
Westwood Range
Transformer stations
Water
Canal
Reardon Inlet
Piney Point
Hog Point
AMTRAK
GUNPOWDER
RIVER
HARFORD
BALTIMORE
CO
CO
APPROX BDY
APPROX
BDY
BIRD
RIVER
Iron Point
West Twin River
Harewood Park
Harewood
MAGNOLIA
4 TRACKS
BM
382 980 000 FEET
383
384
385
20'
386
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ed and published by the Geological Survey
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raphy by photogrammetric methods from aerial
graphs taken 1947. Field checked 1949
ted hydrographic data compiled from NOS Surveys
nformation is not intended for navigational purposes
MN
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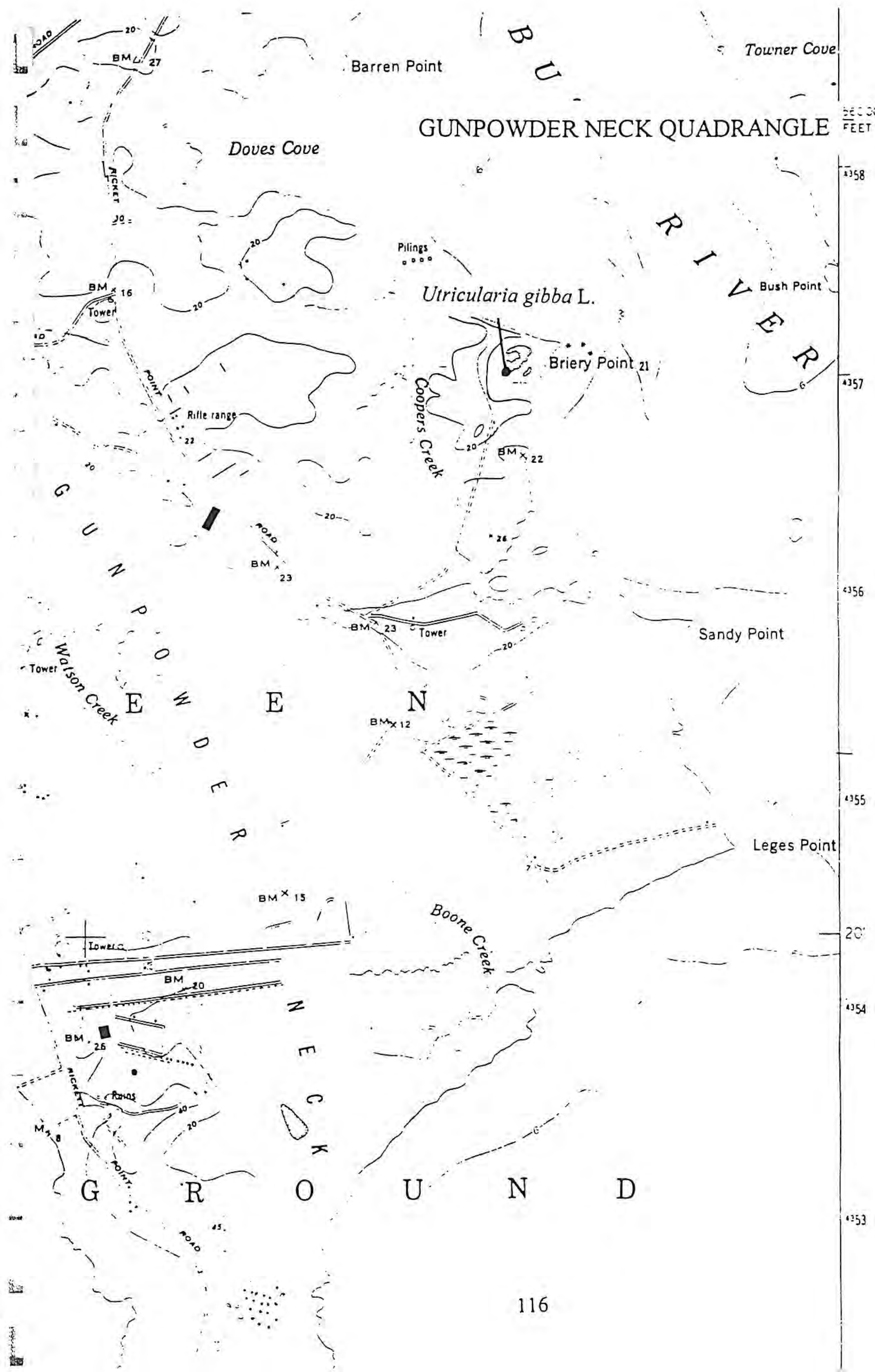
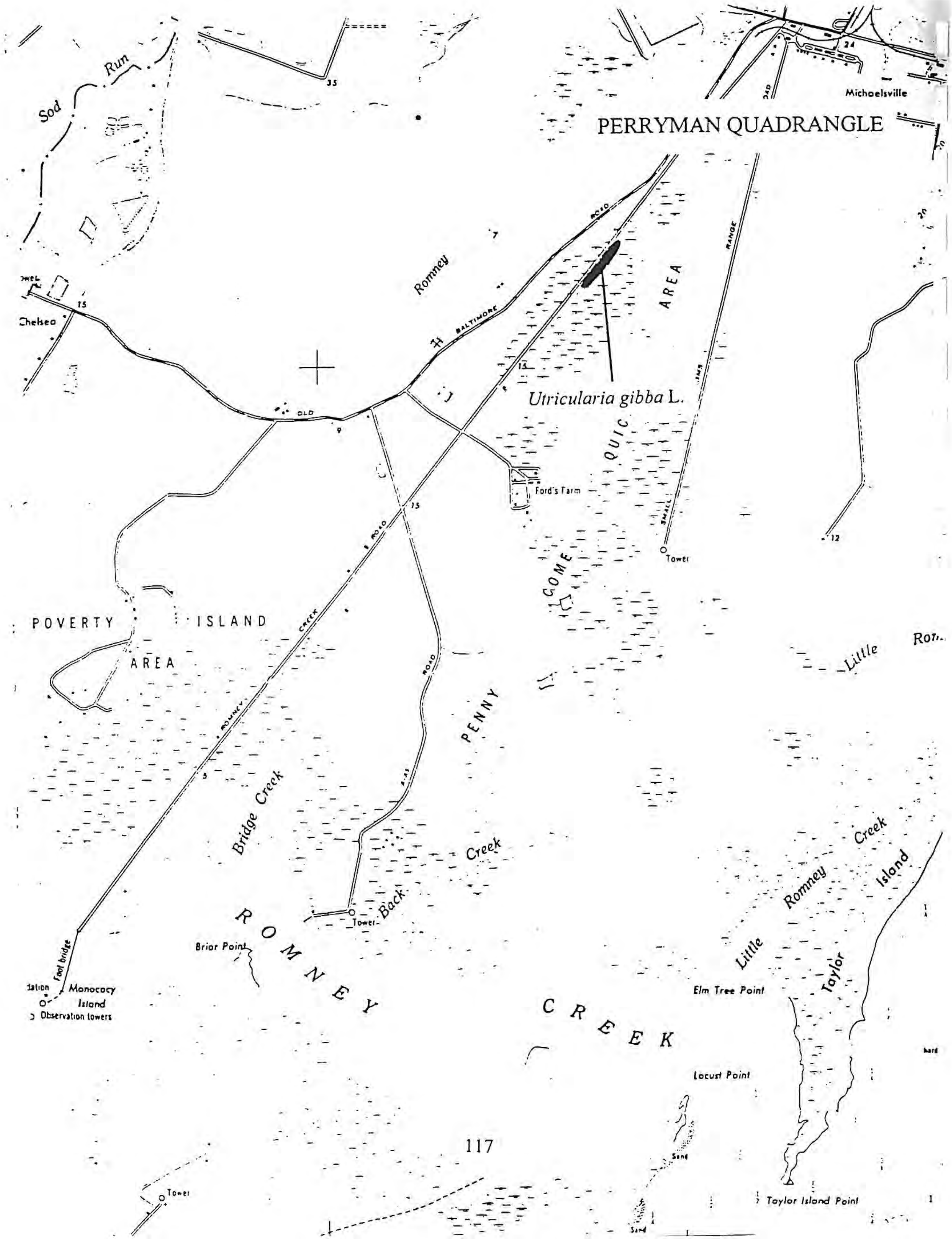
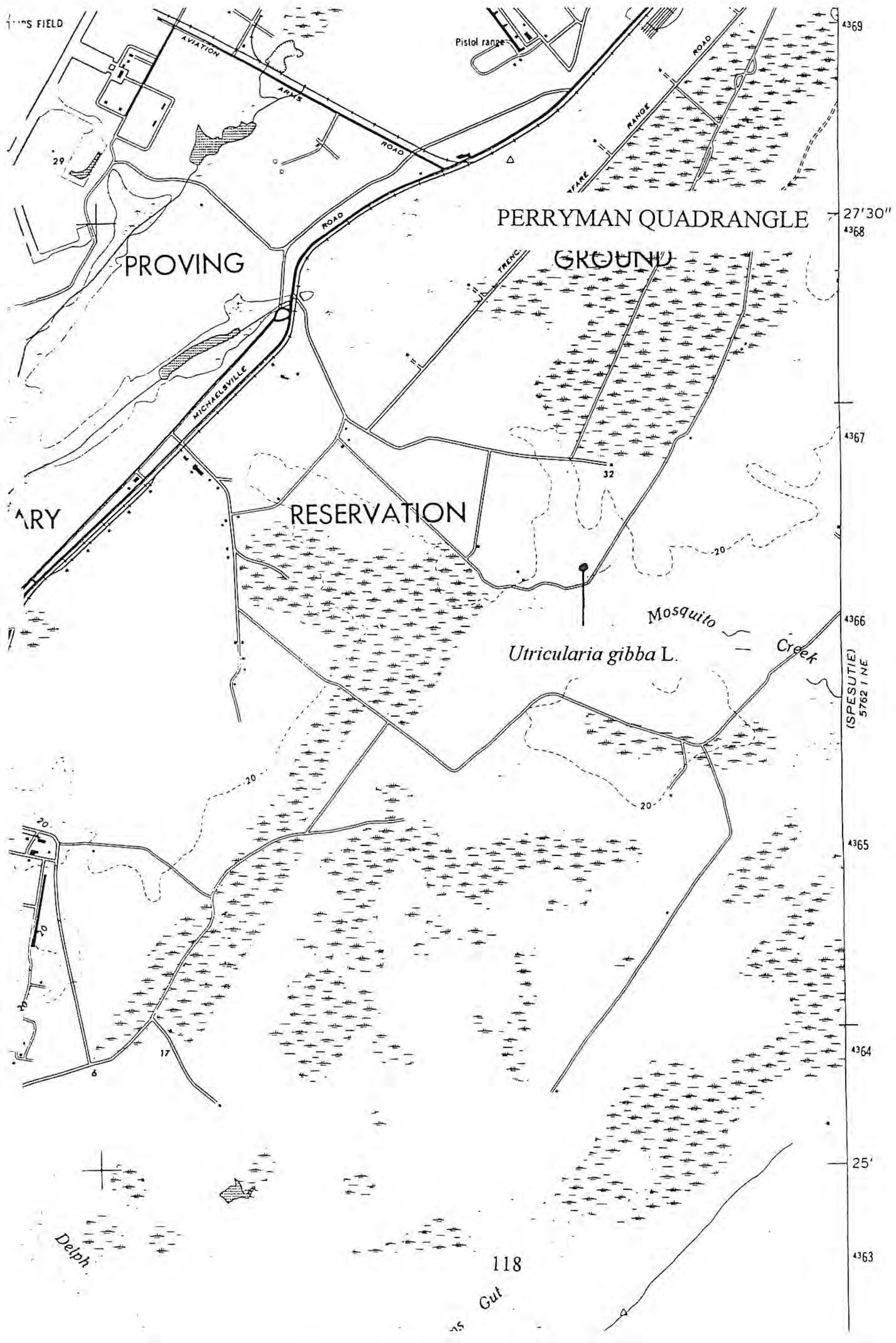


GUNPOWDER NECK QUADRANGLE


PERRYMAN QUADRANGLE
Utricularia gibba L.
Sod Run
Michaelsville
Romney
BALTIMORE
ROAD
OLD
Chelsea
QUIC
COME
AREA
RANGE
SMALL
Ford's Farm
Tower
POVERTY ISLAND
AREA
ROMNEY CREEK ROAD
PENNY
Bridge Creek
Back Creek
Tower
Brior Point
ROMNEY CREEK
Foot bridge
Monocacy Island
Observation towers
Little Romney Creek
Little Romney
Taylor Island
Elm Tree Point
Locust Point
Sand
Taylor Island Point


PERRYMAN QUADRANGLE
Utricularia gibba L.
PROVING
GROUND
RESERVATION
ARY
Pistol range
AVIATION
ARMS
ROAD
RANGE
ROAD
MICHAELSVILLE
Mosquito
Creek
Delph
Gut
27'30"
25'
4369
4368
4367
4366
4365
4364
4363
(SPESUTIE)
5762 I NE

RARE PLANTS ASSOCIATED WITH WETLAND HABITATS

Scientific Name and Author	State Rank
1. Spirodela punctata (G. Meyer) C. Thompson	State Record
2. Carex radiata (Wahlenb.) Small	S1
3. Ceratophyllum echinatum A. Gray	S1
4. Eleocharis rostellata (Torr.) Torr.	S1
5. Hottonia inflata Elliott	S1
6. Iris prismatica Pursh	S1
7. Juncus torreyi Cov.	S1
8. Lathyrus palustris L.	S1
9. Lysimachia hybrida Michx.	S1
10. Pedicularis lanceolata Michx.	S1
11. Potamogeton foliosus Raf.	S1
12. Potamogeton pusillus L.	S1
13. Scutellaria galericulata L.	S1
14. Hedyotis uniflora (L.) Lam.	S2
15. Potamogeton perfoliatus L.	S2
16. Sagittaria spatulata (J. G. Smith) Buchenau	S2
17. Wolffia papulifera C. Thompson	S2
18. Xyris difformis Chapman	S2
19. Bidens coronata (L.) Britton	S2S3
20. Bidens discoidea (T. & G.) Britton	S2S3
21. Bidens bidentoides (Nutt.) Britton	S3.1
22. Carex atlantica L. Bailey	S3
23. Carex canescens L.	S3
24. Carex grayi Carey	S3
25. Carex seorsa Howe.	S3
26. Carex straminea Willd.	S3
27. Cirsium muticum Michx.	S3
28. Cladium mariscoides (Muhl) Torr.	S3
29. Commelina virginica L.	S3
30. Eleocharis engelmannii Steud.	S3
31. Eleocharis flavescens (Poiret) Urban var. olivacea (Torr.) Gleason	S3
32. Glyceria septentrionalis A. Hitchc.	S3
33. Hydrocotyle ranunculoides L. f.	S3
34. Hydrocotyle verticillata Thunb.	S3
35. Isoetes riparia Engelm.	S3
36. Lemna perpusilla Torr.	S3
37. Najas guadelupensis (Sprengel) Magnus	S3
38. Ranunculus pusillus Poiret	S3

39. Sabatia dodecandra (L.) BSP.	S3
40. Sagittaria subulata (L.) Buchenau	S3
41. Utricularia gibba L.	S3
42. Rotala ramosior (L.) Koehne	S3S4

RARE PLANTS ASSOCIATED WITH DRY - MESIC HABITATS

Scientific Name and Author	State Rank
1) Apocynum sibiricum Jacq.	SH
2) Lycopodium carolinianum L.	SH
3) Carex typhina Michx.	S1
4) Gymnocladus dioica (L.) K. Koch	S1
5) Myosotis macrosperma Engelm.	S1
6) Rhynchospora globularis (Chapman) Small	S1
7) Pycnanthemum virginianum (L.) Durand & B.D. Jackson	S2
8) Castanea dentata (Marshall) Borkh.	S2S3
9) Juglans cinerea L.	S2S3
10) Ampelamus albidus (Nutt.) Britton	S3
11) Asclepias purpurascens L.	S3
12) Carex complanata Torr. & Hook	S3
13) Cirsium horridulum Michx.	S3
14) Cuscuta pentagona Engelm.	S3
15) Cyperus lancastriensis Porter	S3
16) Helenium flexuosum Raf.	S3
17) Myosotis verna Nutt.	S3
18) Passiflora lutea L.	S3
19) Senecio anonymus A. Wood	S3
20) Scirpus pendulus Muhl.	S3

SOILS ASSOCIATED WITH RARE PLANT POPULATIONS

The soil series and pedon descriptor following Ranson and Levan (1998) are listed below for each rare plant taxon reported from the Aberdeen Proving Grounds. Taxa are listed alphabetically by genus.

Ampelamus albidus - Nassawango Series, Nassawango silt loam, very deep (more than 152 cm), moderately permeable and well drained. Parent material - silty eolian deposits and/or fluvio-marine sediments.

Asclepias purpurascens - Elkton Series, Elkton silt loam, very deep, slowly permeable and poorly drained. Parent material - silty eolian deposits and/or fluvio-marine sediments. Longmarsh Series, Longmarsh sandy loam, very deep, very poorly drained with moderate permeability. Parent material - loamy alluvial sediments.

Bidens bidentoides - Lenape Series, Lenape mucky peat, very deep, moderately permeable and very poorly drained. Parent material - organic deposits over loamy fluvio-marine sediments. The Skippers Point population was observed on tidal sand with some mud and the population on the northwest corner of Spesutie Island occurred on tidal gravelly sand and mud.

Bidens coronata - Puckum Series, Puckum muck, very deep, moderately permeable, and very poorly drained. Parent material - organic woody deposits. Lenape Series, Lenape mucky peat.

Bidens discoidea - Pone Series, Pone mucky loam, very deep, moderately permeable, and very poorly drained. Parent material - organic deposits over fluvio-marine sediments.

Carex atlantica - Longmarsh Series, Longmarsh sandy loam and Lenape Series, Lenape mucky peat.

Carex canescens - Romney Series, Romney silt loam, very deep, moderately slow permeability, and somewhat poorly drained. Parent material - silty eolian deposits and/or fluvio-marine sediments. Observed in wet roadside ditch.

Carex complanata - Romney Series, Romney silt loam and Elkton Series, Elkton silt loam. Observed on dry crest microtopography.

Carex grayi- Romney Series, Udorthents, sandy loam, very deep and Manahawkin Series, Mattapex silt loam, very deep, moderately slow permeability, moderately well drained. Parent material - silty eolian deposits and/or fluvio-marine sediments.

Carex radiata - Romney Series, Romney silt loam.

Carex seorsa - Romney Series, Romney silt loam; Elkton Series, Elkton silt loam; Pone Series, Pone mucky loam; and Lenape Series, Lenape mucky peat.

Carex straminea - Corsica Series, Corsica loam, very deep, very poorly drained. Parent material - loamy alluvial sediments. Also, Pone Series, Pone mucky loam.

Carex typhina - Romney Series, Romney silt loam and Manahawkin Series, Mattapex silt loam.

Castanea dentata - Beltsville Series, Beltsville silt loam, very deep, moderately well drained. Dominant parent material - loamy fluviomarine sediments.

Ceratophyllum echinatum - Submerged aquatic on silty mud and sand.

Cirsium horridulum - Romney Series, Romney silt loam.

Cirsium muticum - Longmarsh Series, Longmarsh sandy loam; Puckum Series, Puckum muck and Manahawkin Series, Mattapex silt loam.

Cladium mariscoides - Puckum Series, Puckum muck; Lenape Series, Lenape mucky peat and Elkton Series, Elkton silt loam.

Commelina virginica - Lenape Series, Lenape mucky peat; Romney Series, Romney silt loam; and Manahawkin Series, Mattapex silt loam.

Cuscuta pentagona - Udorthents, sandy loam. Parasitic, observed on dry sandy soil and along a stone road.

Cyperus lancastriensis - Hambrook Series, Hambrook sandy loam, very deep, well drained, moderately permeable. Parent material - loamy fluviomarine sediments. Also, Manahawkin Series, Mattapex silt loam.

Eleocharis engelmannii - Udorthents, sandy loam. Observed on wet sandy soil.

Eleocharis flavescens var. *olivacea* - Puckum Series, Puckum muck and Longmarsh Series, Longmarsh sandy loam.

Eleocharis rostellata - Puckum Series, Puckum muck.

Glyceria septentrionalis - Romney Series, Romney silt loam. Observed in a wet roadside ditch.

Gymnocladus dioica - Hambrook Series, Hambrook sandy loam.

Hedyotis uniflora - Woodstown Series, Woodstown sandy loam, very deep, moderately permeable and moderately well drained. Parent material - loamy fluviomarine sediments. Throughout the bottom of a draught drawn down pool.

Helenium flexuosum - Romney Series, Romney silt loam; and Indiantown Series, Indiantown mucky silt loam, very deep, very poorly drained with moderate permeability. Parent material - loamy alluvial sediments. Edging on Manahawkin Series, Mattapex silt loam.

Hottonia inflata - Aquatic, rooted in Pone Series, Pone mucky loam.

Hydrocotyle ranunculoides - Hambrook Series, Hambrook sandy loam according to (Ranson and Levan 1998), but observed on peaty mud at this site. Also, Longmarsh Series, Longmarsh sandy loam.

Hydrocotyle verticillata - Puckum Series, Puckum muck.

Iris prismatica - Fallsington Series, Fallsington sandy loam, very deep, poorly drained, moderately permeable. Parent material - loamy fluviomarine sediments. Also Manahawkin Series, Mattapex silt loam; Elkton Series, Elkton silt loam; Romney Series, Romney silt loam. Observed to be restricted to moist/wet shallow depressions.

Isoetes riparia - Romney Series, Romney silt loam. Observed in an inundated roadside ditch on mud.

Juglans cinerea - Woodstown Series, Woodstown sandy loam. Bordering on Romney Series, Romney silt loam.

Juncus torreyi - Puckum Series, Puckum muck.

Lathyrus palustris - Lenape Series, Lenape mucky peat. Soils at this site were also observed to have some sand.

Lemna perpusilla - Wholly aquatic.

Lycopodium carolinianum - Romney Series, Romney silt loam / Elkton Series, Elkton silt loam.

Lysimachia hybrida - Udorthents, sandy loam. Observed to be restricted to moist/wet shallow depressions on these soils.

Myosotis macrosperma - Manahawkin Series, Mattapex silt loam.

Myosotis verna - Longmarsh Series, Longmarsh sandy loam and Hambrook Series, Hambrook sandy loam.

Najas guadelupensis - Submerged aquatic, rooted in silty mud under brackish water as deep as 3 m, plants not reaching the water's surface.

Passiflora lutea - Romney Series, Romney silt loam and Manahawkin Series, Mattapex silt loam.

Pedicularis lanceolata - Nassawango Series, Nassawango silt loam. This site appeared to be regularly flooded.

Potamogeton foliosus - Submerged aquatic, rooted in silty mud under fresh water not over 45 cm deep.

Potamogeton perfoliatus - Submerged aquatic, rooted in muddy sand under brackish water approximately 1 m deep, plants often reaching the water's surface.

Potamogeton pusillus - Submerged aquatic, rooted in silty mud under brackish water as deep as 3 m, plants not reaching the water's surface.

Pycnanthemum virginianum - Manahawkin Series, Mattapex silt loam. In some areas these soils appeared to contain more sand.

Ranunculus pusillus - Romney Series, Romney silt loam, in wet roadside ditch; and Zekiah Series, Zekiah loam, very deep, poorly drained, moderately permeable. Parent material - loamy alluvial sediments. Observed in a wet vernal depression.

Rhynchospora globularis - Lenape Series, Lenape mucky peat and Elkton Series, Elkton silt loam. Soils appeared sandy at these sites.

Rotala ramosior - Romney Series, Romney silt loam and Udorthents, sandy loam and Woodstown Series, Woodstown sandy loam. Observed along edges of wet depressions and pools within these areas.

Sabatia dodecandra - Puckum Series, Puckum muck. Soils appeared to contain some peat at this site. Also, Woodstown Series, Woodstown sandy loam

Sagittaria spatulata - Lenape Series, Lenape mucky peat and Puckum Series, Puckum muck.

Sagittaria subulata - Puckum Series, Puckum muck. Soils appeared to contain some peat at this site.

Scirpus pendulus - Woodstown Series, Woodstown sandy loam bordering Romney Series, Romney silt loam. Soils may be seasonally wet due to roadside runoff at this site. Also, Indiantown Series, Indiantown mucky silt loam.

Scutellaria galericulata - Puckum Series, Puckum muck.

Senecio anonymus - Woodstown Series, Woodstown sandy loam and Romney Series, Romney silt loam.

Spirodela punctata - Entirely aquatic.

Utricularia gibba - Floating aquatic, generally over Pone Series, Pone mucky loam and Longmarsh Series, Longmarsh sandy loam.

Wolffia papulifera - Entirely aquatic.

Xyris difformis - Woodstown Series, Woodstown sandy loam and Romney Series, Romney silt loam / Elkton Series, Elkton silt loam.

POPULATION SIZES OF RARE, THREATENED AND ENDANGERED PLANTS OBSERVED AT ABERDEEN PROVING GROUNDS

TABLE III

STATE RANK	GENUS	SPECIES	POPULATION SIZE ESTIMATES
S3	Ampelamus	albidus	Five vines climbing to 4 m occurred at one site.
SH	Apocynum	sibiricum	One site with three plants was seen.
S3	Asclepias	purpurascens	Approximately 30 plants collectively occurred at three sites.
S3.1	Bidens	bidentoides	Thirteen plants collectively occurred at two sites approximately 25 m apart on Spesutie Island and at least 125 plants occurred at Skippers Point on the Edgewood Facility.
S2S3	Bidens	coronata	At least 65 plants collectively occurred at two sites on Carroll Island and 95 plants collectively occurred at three sites in Harford County.
S2S3	Bidens	discoidea	An.estimated 50 plants occurred at one site over a distance of approximately 1 km.
S3	Carex	atlantica	Hundreds of tufts collectively occurred at three sites. The species was most common along Mosquito Creek.
S3	Carex	canescens	One tuft was observed along Michaelsville Road and 18 tufts were found along East Branch near Canal Creek.
S3	Carex	complanata	Fourty tufts collectively occurred at three sites.
S3	Carex	grayi	Two patches, neither larger than 1 x 1 m, collectively occurred at two sites.
S1	Carex	radiata	Fourteen tufts collectively occurred at three sites. Observed at both the Edgewood and Aberdeen Facilities.
S3	Carex	seorsa	Two small populations of not more than 10 tufts each were observed at the Edgewood Facility and two additional populations occurred at the Aberdeen Facility, the largest population at Skippers Point measured 15 x .5 m.
S3	Carex	straminea	Approximately 100 tufts collectively occurred at two sites.
S1	Carex	typhina	A single tuft was observed at each of the two sites where it was found. Each tuft contained about 20 fruiting culms.
S2S3	Castanea	dentata	Three trees occurred at one site, the largest tree was approximately 9 m tall.
S1	Ceratophyllum	echinatum	Two populations collectively occurred in freshwater ponds on the Edgewood and Aberdeen Facilities. Both populations covered areas of at least 10 x 10 m.
S3	Cirsium	horridulum	An estimated 35 plants occurred at one site over an area of approximately 80 x 80 m.
S3	Cirsium	muticum	At least 5 populations on Spesutie Island, the largest population contained not more than 21 plants.
S3	Cladium	mariscoides	An estimated 25 tufts occurred at one site in Baltimore County and at least 100,000 plants occurred near Sandy Point in Harford County.
S3	Commelina	virginica	Two populations collectively occurred at two sites. The largest population occurred on Spesutie Island and contained at least 150 plants.
S3	Cuscuta	pentagona	Two populations were observed, the largest measured 3.3 x .8 m.
S3	Cyperus	lancastriensis	Fifteen plants collectively occurred at two sites.
S3	Eleocharis	engelmannii	One population with a single tuft containing approximately 40 fruiting stems was observed.
S3	Eleocharis	flavescens	One population containing 18 tufts was observed on Carroll Island and at least 1500 tufts occurred at Briery Point.
S1	Eleocharis	rostellata	At least 100 tufts occurred over an area of approximately 65 x 65 m.
S3	Glyceria	septentrionalis	One patch measuring 3 x 2 meters was observed.
S1	Gymnocladus	dioica	At least 25 trees, some in fruit, occurred at one site.
S2	Hedyotis	uniflora	An estimated 1000 plants were observed over the bottom of a drought drawn down pool over an area of approximately 40 x 20 m.
S3	Helenium	flexuosum	At least 40 plants collectively occurred at two sites near Phillips Field and at least 1000 plants occurred on Gunpowder Neck.
S1	Hottonia	inflata	An estimated 800 plants occurred at one site.

STATE RANK	GENUS	SPECIES	POPULATION SIZE ESTIMATES
S3	Hydrocotyle	ranunculoides	Three populations occurred at the Edgewood facility, the largest covering an area of at least 25 x 50 m. It also occurred along Mosquito Creek at Aberdeen.
S3	Hydrocotyle	verticillata	One population occurred over an area of 2 x .5 m.
S1	Iris	prismatica	At least 1000 plants collectively occurred at six sites, restricted to moist depressions, the largest population occurred over an area of approximately 20 x 15 m on Gunpowder Neck and contained at least 500 plants.
S3	Isoetes	riparia	Only one plant was observed.
S2S3	Juglans	cinerea	Seven trees in fruit were observed at one site.
S1	Juncus	torreyi	Approximately 50 plants occurred at one site along .5 km of moist roadside.
S1	Lathyrus	palustris	An estimated 85 plants occurred at one site along approximately .7 km of roadside.
S3	Lemna	perpusilla	At least one site with thousands of plants was observed.
SH	Lycopodium	carolinianum	At least 1000 fruiting stems were observed at one site.
S1	Lysimachia	hybrida	Approximately 50 plants restricted to moist depressions at one site over an area of .7 x .7 km.
S1	Myosotis	macrosperma	One population with eight plants was observed.
S2	Myosotis	verna	Two populations were found, the largest population contained at least 30 plants.
S3	Najas	guadelupensis	At least 2 populations occurred, the largest population sporadically occurred over an area of at least 15 x 20 m.
S3	Passiflora	lutea	Two populations were found, the largest on Spesutie Island cover an area of 10 x 20 m.
S1	Pedicularis	lanceolata	One populations with at least 25 plants was observed.
S1	Potamogeton	foliosus	One population that covered an area of many meters was observed in a beaver pond at Edgewood.
S2	Potamogeton	perfoliatus	Two populations, neither larger than 2 x 2 m, were observed.
S1	Potamogeton	pusillus	Observed at three sites, the largest population occurred sporadically over an area of 20 x 20 m.
S2	Pycnanthemum	virginianum	Very common on Spesutie Island, absent elsewhere. Total number of plants estimated to be at least 1000.
S3	Ranunculus	pusillus	Observed at two sites. The largest population along Michaelsville Road contained an estimated 1000 plants.
S1	Rhynchospora	globularis	At least 250 plants occurred at three sites on Sandy Point at Gunpowder Neck.
S3S4	Rotala	ramosior	Observed at three sites. The largest population along Michaelsville Road contained an estimated 40 plants.
S3	Sabatia	dodecandra	The Carroll Island population contained at least 35 plants while at least 200 plants were found on Gunpowder Neck.
S2	Sagittaria	spatulata	34 plants occurred at two sites on Monks Creek and approximately 50 plants occurred at one site on Mosquito Creek.
S3	Sagittaria	subulata	An estimated 5000 plants occurred at one site along Mosquito Creek.
S3	Scirpus	pendulus	Six plants occurred at Graces Quarters and 16 plants were seen along Old Baltimore Road.
S1	Scutellaria	galericulata	Two populations collectively occured at two sites. The largest population occurred on Carroll Island and measured 6 x .5 m. On Spesutie Island, only 5 plants were observed.
S3	Senecio	anonymus	Observed at three sites, each population contained approximately 20 plants.
S?	Spirodela	punctata	Observed to be abundant at the only site where it was found.
S3	Utricularia	gibba	Observed at two Edgewood sites and two at Aberdeen. The Aberdeen population at Penny Come Quick was the largest containing at least 200 flowering stems.
S2	Wolffia	papulifera	Very common at the four sites where it was observed, least common at Briery Point.
S2	Xyris	difformis	Approximately 50 plants occurred off Romney Creek Road and 6 plants were observed off Cod Creek Road.

PHENOLOGY OF NOTEWORTHY ENDANGERED AND THREATENED VASCULAR PLANTS OF THE ABERDEEN PROVING GROUNDS, HARFORD AND BALTIMORE COUNTIES, MARYLAND (TABLE III)

STATE RANK	STATE STATUS	SPECIES	SYNONYMS	SOURCE	MONTHS J	F	M	A	M	J	J	A	S	O	N	D
SH	extirpated	*Apocynum sibiricum* Jacq.		G&C					X	X	X	X	X			
				BBH						X	X	X				
				GMB						X	X	X				
S1	extirpated	*Lathyrus palustris* L.		G&C						X	X					
				BBH						X	X	X	X			
				GMB						X	X	X	X			
				RAB					X	X	X	X	X			
SH	extirpated	*Lycopodium carolinianum* L.		RAB							X	X	X			
S1	endangered	*Ceratophyllum echinatum* A. Gray		BBH							X	X	X			
				RAB			X	X	X	X	X	X	X			
S1	endangered	*Hottonia inflata* Elliott		G&C					X	X	X	X				
				BBH				X	X	X						
				GMB				X	X	X						
				RAB				X	X	X						
S1	endangered	*Iris prismatica* Pursh.		G&C						X	X					
				BBH					X	X						
				GMB					X	X	X					
				RAB					X	X	X					
S1	endangered	*Juncus torreyi* Cov.		GMB							X	X	X	X		
S1	endangered	*Lysimachia hybrida* Michx.		G&C						X	X	X				
				BBH						X	X	X				
				GMB							X	X				
			Lysimachia lanceolata Walter var. *hybrida* (Michaux) Gray	RAB						X	X	X	X	X		
S1	endangered	*Pedicularis lanceolata* Michx.		G&C								X	X			
				BBH								X	X	X		
				GMB								X	X	X		
				RAB								X	X	X		
S1	endangered	*Rhynchospora globularis* (Chapman) Small		BBH						X	X					
				GMB							X	X	X			
				RAB						X	X	X	X			
S1	threatened	*Eleocharis rostellata* (Torr.) Torr.		BBH							X	X	X	X		
				GMB							X	X	X	X		
				RAB							X	X	X			

STATE RANK	STATE STATUS	SPECIES	SYNONYMS	SOURCE	J	F	M	A	M	J	J	A	S	O	N	D
S1	threatened	*Myosotis macrosperma* Engelm.		BBH				X	X							
				RAB				X	X							
				GMB				X	X							
S1	none	*Carex typhina* Michx.		BBH						X	X	X	X			
				GMB						X	X	X	X			
				RAB						X	X					
S1	none	*Scutellaria galericulata* L.		G&C						X	X	X				
				BBH						X	X	X				
			Scutellaria epilobiifolia A. Hamilton	GMB						X	X	X	X			
S1	none	*Pycnanthemum virginianum* (L.) Durand & B.D. Jackson		BBH							X	X	X			
				GMB							X	X	X			
				RAB							X	X	X	X		
S2	none	*Bidens coronata* (L.) Britton		G&C								X	X	X		
				BBH								X	X	X		
				GMB								X	X	X		
				RAB								X	X	X		
S2	none	*Hedyotis uniflora* (L.) Lam.	*Oldenlandia uniflora* L.	BBH							X	X	X	X		
			Oldenlandia uniflora L.	RAB								X	X	X		
S2	none	*Xyris difformis* Chapman		BBH							X	X	X	X		
				RAB								X	X	X		
				GMB							X	X	X	X		
S2S3	none	*Bidens bidentoides* (Nutt.) Britton		G&C							X	X	X	X		
				BBH								X	X	X		
			Bidens mariana Blake	GMB									X	X		

KEY TO SOURCE CODES

BBH = Brown and Brown 1984
G&C = Gleason and Cronquist 1991
GMB = Fernald 1950
RAB = Radford et al. 1968

OTHER MARYLAND SITES FOR EXTANT POPULATIONS OF THE ENDANGERED AND THREATENED PLANTS WHICH OCCURRED AT THE ABERDEEN PROVING GROUNDS

This information, unless noted otherwise, is a tally of the number of records that have been processed into the Maryland Wildlife and Heritage Division's Biological and Conservation Data System (BCD) as of January, 1999. Extant populations are defined by reports occurring within the last 25 years.

Apocynum sibiricum - This is the first known record from Harford County. Other extant populations are known from single sites in Calvert, Kent, Montgomery and Washington Counties.

Bidens bidentoides - This taxon is known in Maryland from extant populations in two counties, Cecil (30 sites) and two other sites in Harford County.

Bidens coronata - Extant populations from Maryland of this taxon are known from two sites in Somerset County, from single sites in Charles, Dorchester, Talbot, and Wicomico Counties and from one other site in Baltimore County.

Bidens discoidea - This is the only extant population of this taxon known from Harford County. Seventeen extant populations collectively occur in the State from single sites in Queen Annes and Talbot Counties, two sites each in Anne Arundel, Carroll, Dorchester, Kent, and Prince Georges Counties, and from three sites in Worcester County. In addition, Steury (1997, 1998) reported the species from two sites in Calvert County.

Carex radiata - Historically regarded as endangered in Maryland (Maryland Natural Heritage Program 1994) extant populations of this sedge are now known statewide (C. Frye, Maryland Natural Heritage Program, pers. comm. 1997).

Carex typhina - This is the first known record for Harford County. Other Maryland Counties with extant populations of this taxon are Carroll (2 sites), Charles (1 site) and Prince Georges (1 site).

Ceratophyllum echinatum - In Maryland, this taxon is known from a total of four extant populations in four counties: Kent County (Steury et al 1996), Dorchester and Queen Annes Counties and from one other site in Harford County.

Eleocharis rostellata - This is the only known population of this spike rush in Baltimore County and the northern most population in the State of Maryland. Other extant populations are known from single sites in Anne Arundel and Wicomico Counties and from eleven sites in Worcester County.

Gymnocladus dioica - This is the only population of this tree known from Harford County. Only two other extant populations are known from the State in Baltimore and Washington Counties.

Hedyotis uniflora - This is the first known record for Harford County. In Maryland, seventeen other extant populations of this taxon collectively occur in 8 Counties: Anne Arundel (1 site), Carroll (3 sites), Dorchester (1 site), Kent (1 site), Somerset (1 site), Queen Annes (1 site), Wicomico (2 sites), and Worcester (5 sites).

Hottonia inflata - This is the only population of this taxon known from Harford County. Other extant populations in Maryland occur in Carroll (3 sites), Kent (3 sites), Queen Annes (1 site) and Talbot (1 site) Counties.

Iris prismatica - No other populations are known from Harford County but two other sites have been reported in Baltimore County. Six other extant populations collectively occur statewide in Kent (1 site), Wicomico (2 sites), and Worcester (3 sites) Counties.

Juglans cinerea - This is the only population of this taxon known in Harford County. In Maryland, butternut is known from a total of ten extant populations in six counties: Allegany (2 sites), Dorchester (2 sites), Frederick (1 site), Garrett (2 sites) and Washington (2 sites). The author has also observed two specimens of this tree growing in Fort Washington National Park in Prince Georges County.

Juncus torreyi - Only two other known extant populations collectively occur in the State of Maryland in Prince Georges County (Davis 1995), and from one other site in Baltimore County.

Lathrus palustris - This is the only population known from Harford County. One other population was reported from Maryland in Montgomery County in 1983.

Lycopodium carolinianum - This is the first known record for Harford County. No other extant populations are known from the State of Maryland. The taxon was last collected in Worcester County in 1932.

Lysimachia hybrida - This is the only population known in Harford County. Nine other extant populations collectively occur in Dorchester (1 site), Montgomery (3 sites), Queen Annes (1 site), Washington (2 sites) and Worcester (2 sites).

Myosotis macrosperma - This is the first known record from Harford County. Sixteen other extant populations are known to collectively occur in 4 Maryland Counties: Calvert (6 sites), Charles (7 sites), Prince Georges (2 sites), and St. Marys (1 site).

Pedicularis lanceolata - This is the only extant population known from Harford County. In Maryland, this species is extant at a total of five sites in four counties: Prince Georges (Davis 1995), and Baltimore (1 site), Cecil (1 site) and Garrett (2 sites).

Potamogeton foliosus - Three other extant populations are known from the State in Howard and Calvert Counties and from one other site in Harford County.

Potamogeton perfoliatus - Apparently a declining species in Maryland, no other extant populations are reported from the State in the BCD. At least 28 populations were known in seven Maryland Counties prior to 1968 when the taxon was last entered in the BCD. However, Orth et al. (1997), does report this taxon from at least four Maryland counties.

Potamogeton pusillus - This is the only population known from Baltimore County. Extant populations are reported from two other Maryland Counties, Charles (1 site) and Queen Annes (1 site). At least 12 populations were known in five other Maryland Counties prior to 1969 according to BCD entries. The taxon is also recorded from at least two other Maryland counties by Orth et al. 1997.

Pycnanthemum virginianum - This is the only population known from Harford County. Seven extant populations collectively occur in three other Maryland Counties, Allegany (3 sites), Baltimore (2 sites) and Washington (2 sites).

Rhynchospora globularis - This taxon is known from three other extant populations collectively occurring in Anne Arundel, Dorchester and Worcester Counties.

Sagittaria spatulata - In Maryland, eighteen extant populations are reported from eight counties. It is most common in Cecil County (8 sites), but is also reported from Anne Arundel (1 site), Charles (1 site), Dorchester (2 sites), Kent (2 sites), Prince Georges (1 sites), and Wicomico (2 site) Counties and from one other site in Harford County.

Scutellaria galericulata - Extant populations in Maryland of this mint are known from a total of four sites in Howard, Montgomery, Calvert (Steury 1997) and Kent (Steury 1996) Counties.

Wolffia papulifera - No other extant populations are known from Maryland. The only other record of this species is from Worcester County in 1971.

Xyris difformis - This is the first known record for Harford County. Ten other extant Maryland populations are known from Dorchester (1 site), Somerset (1 site), Wicomico (1 site) and Worcester (7 sites) Counties.

THREATS TO THE RARE PLANTS OF ABERDEEN PROVING GROUNDS

Many of the populations of rare plants observed at the Aberdeen Proving Grounds were threatened by anthropogenic activity such as mowing or by their juxtaposition with a population of the Common Reed (*Phragmites australis*). The Common Reed, possibly a native species, displaces other native vegetation and forms dense monocultures, thus acting as an invasive species.

The following list includes each species population threatened by mowing or displacement by the Common Reed. Some populations were threatened by both types of disturbances. For rare taxa with more than one population, the location of the threatened populations are noted. A few populations were threatened by other types of anthropogenic activities. These are also noted below. Rare taxa listed in this report and not included below, had no apparent threats.

ENDANGERED PLANTS (S1 SPECIES)

Carex radiata	The northernmost population along Michaelsville Road is regularly mowed over.
Eleocharis rostellata	This population was observed to be surrounded by *Phragmites australis*.
Juncus torreyi	Occurred along a regularly mowed roadside within 2 m of a *Phragmites australis* marsh.
Lathyrus palustris	Occurred along an edge of shrub/scrub meadow and a mowed roadside.
Lysimachia hybrida	These populations occurred along a dirt road in an area used to test tanks.
Pedicularis lanceolata	Occurred at the edge of a shrub/scrub meadow and a regularly mowed roadside. Plants just inside the shrub/ scrub habitat flowered, while those in the abutting mowed area remained small and did not flower.
Rhynchospora globularis	The western most population is in an area that is occasionally mowed.
Scutellaria galericulata	Both populations occurred along a mowed roadside/ *Phragmites australis* marsh ecotone.

THREATENED PLANTS (S2 and S2S3 SPECIES)

Hedyotis uniflora	This population was restricted to the bottom of a drought drawn down pond near a roadside. Bulldozer activity was evident near this site.
Pycnanthemum virginianum	Less than 10 percent of the plants in this large population occurred along an edge of mowed roadside.
Xyris difformis	The population along Romney Creek Road was restricted to the bottom of a drought drawn down pond near a roadside. Bulldozer activity was evident along this roadside.
Bidens coronata	The largest population was observed to be surrounded by *Phragmites australis*.

WATCHLISTED PLANTS (S3 and S3S4 SPECIES)

Asclepias purpurascens	The area of this population was mowed before the fruits of these plants reached maturity.
Bidens bidentoides	The northern most population on Spesutie Island occurred along a riprapped shoreline. At Skippers Point, the southern tip of the population occurred between a boat dock and a boat ramp.
Carex canescens	This plant occurred along a frequently mowed roadside ditch.
Carex complanata	The population near Michaelsville Road occurred along a frequently mowed roadside.
Carex grayi	The population on Spesutie Island occurred at the edge of a mowed area and a stone parking lot. This area is often used by fishermen.
Cirsium muticum	A few of the plants in these populations occurred within 1 m of a mowed roadside.

Cladium mariscoides	This population was surrounded by *Phragmites australis*.
Commelina virginica	The population on Spesutie Island occurred at the ecotone of a mowed roadside and a shrub/scrub meadow.
Cuscuta pentagona	This population occurred within 10 m of a dirt road used to test tanks.
Eleocharis engelmannii	This population occurred along the edge of a wet dirt road used to test tanks.
Eleocharis flavescens var. *olivacea*	This population occurred within 15 m of a stand of *Phragmites australis*.
Glyceria septentrionalis	This population occurred along a frequently mowed roadside.
Helenium flexuosum	The northernmost population of this taxa was mowed over before its fruits were mature.
Hydrocotyle verticillata	Occurred in a mowed roadside ditch 2 m distant from a *Phragmites australis* marsh.
Isoetes riparia	This population occurred in a wet roadside ditch that was mowed over.
Myosotis verna	The population on Chilbury Point is in an area that is regularly mowed.
Ranunculus pusillus	The population along Michaelsville Road occurred in a moist roadside ditch that is often mowed.
Rotalla ramosior	The northernmost population occurred within a tank testing area.
Sabatia dodecandra	This population occurred in a frequently mowed, wet roadside depression, approximately 3 m from a large stand of *Phragmites australis*.
Scirpus pendulus	Both populations occurred within 5 m of a paved road.
Senecio anonymus	The northernmost population of this taxa occurred in an area that is regularly mowed.

UNRANKED PLANTS VOUCHERED FROM THE ABERDEEN PROVING GROUNDS

During the course of this study a few vascular plants were collected that are not ranked as state rare but were previously unvouchered from the Aberdeen Proving Grounds. These taxa are listed below along with their collection numbers and repositories.

Allium tricoccum Aiton var. *burdickii* Hanes (ramps), 990508.4 (US)
Andropogon gerardii Vitman (big bluestem or turkeyfoot bluejoint), 990807.7 (US)
Aster umbellatus Miller (tall flat-topped white aster), 991009.1 (US)
Campanula aparinoides Pursh (marsh bellflower), 990626.6 (US)
Cardamine rhomboidea (Pers.) DC. (spring-cress), 990508.1 (US)
Carex frankii Kunth (frank's sedge), 980821.3 (US)
Carex lupulina Muhl. (hop sedge), 980918.1 (MICH)
Carex umbellata Schk. (umbel bearing sedge), 980529.99 (US)
Carya illinoinensis (Wangenh.) K. Koch (pecan), 980720.5 (US)
Diodia virginiana L. (virginia buttonweed), 980807.3 (US)
Eleocharis acicularis (L.) Roemer & Schultes (least spikerush), 990724.1 (US)
Eleocharis tenuis (Willd.) Schultes var. *pseudoptera* (Weath.) Svenson (a spikerush), 990626.5 (US)
Eryngium aquaticum L. (marsh eryngo or marsh rattlesnake master) 990911.6 (US)
Gentiana saponaria L. (soapwort gentian) 990925.3 (US)
Hedyotis crassifolia Raf. (small bluets), 980417.3 (US)
Helianthemum canadense (L.) Michx. (frostweed), 990612.5 (US)
Juncus debilis A. Gray (weak rush), 991009.4 (US)
Lespedeza capitata Michx. (round-headed bush-clover), 980904.7 (US)
Lespedeza intermedia (S. Watts) Britton (intermediate bush-clover), 980904.9 (US)
Lespedeza virginica (L.) Britton (slender bush-clover), 980904 (US)
Lilaeopsis chinensis (L.) Kuntze (creeping finger carrot), 990710.6 (US)
Lobelia puberula Michx. (downy lobelia), 990911.4 (US)
Ludwigia peploides (HBK) Raven (creeping primrose willow), 980724.17 (US)
Lycopodiella appressa (Chapman) Small (southern clubmoss) 990911.8 (US)
Lysimachia vulgaris L. (garden loosestrife), 990710.5 (US)
Myriophyllum pinnatum (Walter) BSP. (pinnate water milfoil), 990807.5 (US)
Phalaris arundinacea L. (reed canary grass), 990710.4 (US)
Polygala sanguinea L. (purple milkwort), 980904.6 (US)
Polygala verticillata L. (whorled milkwort), 980724.11 (US)
Poncyrus trifolia (L.) Raf. (flying dragon), 980821 (US)
Potamogeton epihydrus Raf. (floating pondweed), 990724.2 (US)
Pycnanthemum muticum (Michx.) Pers (gray mountain-mint), 980821.1 (US)
Quercus x *dubia* Ashe = *Q. phellos* x *Q. velutina* (hybrid willow/black oak), 990925.4 (US)
Quercus x *ludoviciana* Sarg. = *Q. falcata* x *Q. phellos* (hybrid southern red/willow oak), 991009.3 (US)
Quercus michauxii Nutt. (basket or swamp chestnut oak), 990925.2 (US)

Senna herbecarpa (Fern.) Irwin & Barneby (wild senna), 980724.7 (US)
Spiranthes cernua (L.) Rich (nodding ladies' tresses), 991009.2 (NYS)
Stachys byzantina C. Koch (wooly hedge-nettle), 980515.9 (US)
Stachys tenuifolia Willd. (smooth hedge-nettle), 980807.6 (US)
Stellaria graminea L. (common stitchwort), 990522.3 (US)
Tilia americana L. (american basswood), 980904.4 (US)

SPECIES OF RARE PLANTS PREVIOUSLY REPORTED IN ERROR FROM THE ABERDEEN PROVING GROUNDS

Prior to this survey, the only inventory of the vascular flora of the Aberdeen Proving Grounds was conducted by Johnson et al. 1995. This report documented 407 species (410 taxa). Of the species reported, 21 were ranked as rare, threatened or endangered in the state of Maryland (Maryland Natural Heritage Program 1994). The voucher specimens for this study are deposited at the Bebb Herbarium at the University of Oklahoma in Norman, Oklahoma. Duplicates of most of this collection were laminated and delivered to the U. S. Army Construction and Engineering Research Laboratories.

In the spring of 1998, Dr. Forrest Johnson of the Bebb Herbarium examined the voucher specimens of the 21 rare Maryland taxa. Of the 21 rare plants reported, Dr. Johnson determined that 12 were misidentified. The eight taxa correctly identified were relocated during the course of this study and are cited in table I of this report. The 12 taxa reported in error and their amended identifications are given below.

Silene nivea (Nutt.) Otth.	amended to	*Lychnis alba* Mill.
Carex lupiliformis Sartw.	amended to	*Carex lupulina* Muhl.
Senna marilandica (L.) Link	amended to	*Senna hebecarpa* (Fern.) Irwin & Barneby
Lycopus rubellus Moench	amended to	*Lycopus americanus* Muhl.
Spiranthes laciniata (Small) Ames	amended to	*Spiranthes vernalis* Engelm. & Gray
Polygala curtissii Gray	amended to	*Polygala mariana* Mill.
Lysimachia tonsa (A. Wood)	amended to	*Lysimachia ciliata* L.
Ranunculus fascicularis Muhl.	amended to	*Ranunculus hispidus* Michx.
Malus angustifolia (Ait.) Michx.	amended to	*Pyrus communis* L.
Agalinis fasciculata (Elliott) Raf.	amended to	*Agalinis purpurea* (L.) Raf.
Limosella subulata E. Ives	amended to	*Lilaeopsis chinensis* (L.) Kuntze
Hybanthus concolor (T.F. Forest.) Spreng.	amended to	*Viola canadensis* L.

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APPENDIX C

List of Fauna Species Known to Occur on APG

List of Fauna Species Known to Occur on APG

Scientific Name	Common Name
Mammals	
Blarina brevicauda	Short-tailed shrew
Canis latrans	Coyote
Castor canadensis	American beaver
Condylura cristata	Star-nosed mole
Didelphis virginiana	Virginia opossum
Eptesicus fuscus	Big brown bat*
Glaucomys volans	Southern flying squirrel
Lasionycteris noctivagans	Silver-haired bat*
Lasiurus borealis	Eastern red bat*
Lasiurus cinereus	Hoary bat*
Lontra canadensis	Northern river otter
Marmota monax	Groundhog
Mephitis mephitis	Striped skunk
Microtus pennsylvanicus	Meadow vole
Microtus pinetorum	Woodland vole
Mus musculus	House mouse
Myotis lucifugus	Little brown bat*
Neovison vison	American mink*
Odocoileus virginianus	White-tailed deer
Ondatra zibethicus	Muskrat
Oryzomys palustris	Marsh rice rat
Perimyotis subflavus	Tricolored bat*
Peromyscus leucopus	White-footed mouse
Procyon lotor	Raccoon
Rattus norvegicus	Brown rat
Scalopus aquaticus	Eastern mole
Sciurus carolinensis	Eastern gray squirrel
Sciurus niger	Eastern fox squirrel
Sylvilagus floridanus	Eastern cottontail
Tamias striatus	Eastern chipmunk
Vulpes vulpes	Red fox
Zapus hudsonius	Meadow jumping mouse
Birds	
Passerines	
Agelaius phoeniceus	Red-winged blackbird
Ammodramus savannarum	Grasshopper sparrow*
Baeolophus bicolor	Tufted titmouse
Bombycilla cedrorum	Cedar waxwing
Cardinalis cardinalis	Northern cardinal
Cardellina pusilla	Wilson’s warbler

List of Fauna Species Known to Occur on APG (continued)

Scientific Name	Common Name
Carduelis tristis	American goldfinch
Certhia americana	Brown creeper*
Contopus virens	Eastern wood-pewee
Corvus brachyrhynchos	American crow
Corvus ossifragus	Fish crow
Cyanocitta cristata	Blue jay
Dumetella carolinensis	Gray catbird
Empidonax virescens	Acadian flycatcher*
Geothlypis formosa	Kentucky warbler*
Geothlypis trichas	Common yellowthroat
Haemorhous mexicanus	House finch
Helmitheros vermivorus	Worm-eating warbler*
Hirundo rustica	Barn swallow
Hylocichla mustelina	Wood thrush*
Icteria virens	Yellow-breasted chat*
Icterus galbula	Baltimore oriole
Icterus spurius	Orchard oriole
Junco hyemalis	Dark-eyed junco*
Melospiza georgiana	Swamp sparrow
Melospiza georgiana nigrescens	Coastal plain swamp sparrow*
Melospiza melodia	Song sparrow
Mimus polyglottos	Northern mockingbird
Molothrus ater	Brown-headed cowbird
Myiarchus crinitus	Great crested flycatcher
Passer domesticus	House sparrow
Passerina caerulea	Blue grosbeak
Passerina cyanea	Indigo bunting
Pipilo erythrophthalmus	Eastern towhee
Piranga olivacea	Scarlet tanager*
Piranga rubra	Summer tanager
Plegadis falcinellus	Glossy ibis
Poecile carolinensis	Carolina chickadee
Polioptila caerulea	Blue-gray gnatcatcher
Protonotaria citrea	Prothonotary warbler*
Quiscalus quiscula	Common grackle
Regulus satrapa	Golden-crowned kinglet
Sayornis phoebe	Eastern phoebe
Seiurus aurocapillus	Ovenbird*
Setophaga americana	Northern parula*
Setophaga coronata	Yellow-rumped warbler
Setophaga discolor	Prairie warbler*
Setophaga petechia	Yellow warbler
Setophaga ruticilla	American redstart*

List of Fauna Species Known to Occur on APG (continued)

Scientific Name	Common Name
Setophaga striata	Blackpoll warbler
Sialis sialis	Eastern bluebird
Sitta carolinensis	White-breasted nuthatch
Spizella arborea	American tree sparrow
Spizella passerina	Chipping sparrow
Spizella pusilla	Field sparrow
Sturnella magna	Eastern meadowlark*
Sturnus vulgaris	European starling
Tachycineta bicolor	Tree swallow
Thryothorus ludovicianus	Carolina wren
Toxostoma rufum	Brown thrasher
Troglodytes aedon	House wren
Turdus migratorius	American robin
Tyrannus tyrannus	Eastern kingbird
Vireo griseus	White-eyed vireo
Vireo olivaceus	Red-eyed vireo
Vireo flavifrons	Yellow-throated vireo*
Wilsonia citrina	Hooded warbler
Zonotrichia albicollis	White-throated sparrow
Non-Passerines	
Antrostomus vociferus	Eastern whip-poor-will*
Archilochus colubris	Ruby-throated hummingbird
Chaetura pelagica	Chimney swift*
Charadrius vociferus	Killdeer
Chordeiles minor	Common nighthawk*
Coccyzus americanus	Yellow-billed cuckoo
Coccyzus erythropthalmus	Black-billed cuckoo
Colaptes auratus	Northern flicker
Colinus virginianus	Northern bobwhite*
Columba livia	Rock pigeon
Dryocopus pileatus	Pileated woodpecker
Melanerpes carolinus	Red-bellied woodpecker
Meleagris gallopavo	Wild turkey
Picoides pubescens	Downy woodpecker
Picoides villosus	Hairy woodpecker
Scolopax minor	American woodcock*
Zenaida macroura	Mourning dove
Accipiter cooperii	Cooper’s hawk
Accipiter striatus	Sharp-shinned hawk*
Aquila chrysaetos	Golden eagle (winter transient)*
Asio flammeus	Short-eared owl**

Scientific Name	Common Name
Bubo virginianus	Great horned owl
Buteo jamaicensis	Red-tailed hawk
Buteo lineatus	Red-shouldered hawk
Cathartes aura	Turkey vulture
Circus cyaneus	Northern harrier*
Coragyps atratus	Black vulture
Falco sparverius	American kestrel*
Haliaeetus leucocephalus	Bald eagle*
Megascops asio	Eastern screech owl
Pandion haliaetus	Osprey
Strix varia	Barred owl
Tyto alba	Barn owl*
Aix sponsa	Wood duck
Anas acutu	Northern pintail
Anas americana	American wigeon
Anas clypeata	Northern shoveler
Anas crecca	Green-winged teal
Anas discors	Blue-winged teal*
Anas penelope	Eurasian wigeon
Anas platyrhynchos	Mallard
Anas rubripes	Black duck*
Anas strepera	Gadwall
Ardea alba	Great egret*
Ardea herodias	Great blue heron*
Aythya affinis	Lesser scaup
Aythya americana	Red head duck
Aythya collaris	Ring-necked duck
Aythya valioneria	Canvasback*
Branta canadensis	Canada goose
Bucepha albeola	Bufflehead
Bucephala clangule	Common goldeneye
Butorides virescens	Green heron
Cygnus columbianus	Tundra swan
Cygnus olor	Mute swan
Egretta thula	Snowy egret*
Fulica americana	American coot
Larus argentatus	Herring gull
Larus delawarensis	Ring-billed gull
Lophodytes cucullatus	Hooded merganser
Megaceryle alcyon	Belted kingfisher
Nycticorax nycticorax	Black-crowned night heron*
Oxyura jamaicensis	Ruddy duck*

Scientific Name	Common Name
Phalacrocorax auritus	Double-crested cormorant
Rallus elegans	King rail*
Rallus limicola	Virginia rail
Amphibians	
Acris crepitans	Eastern cricket frog
Ambystoma maculatum	Spotted salamander
Ambystoma opacum	Marbled salamander
Anaxyrus a. americanus	Eastern American toad
Anaxyrus fowleri	Fowler's toad
Hemidactylium scutatum	Four-toed salamander
Hyla cinerea	Green tree frog
Hyla chrysosalis/versicolor	Cope's/Eastern gray treefrog complex
Notophthalmus v. viridescens	Red-spotted newt
Plethodon cinereus	Eastern red-backed salamander
Plethodon glutinosus	Northern slimy salamander
Pseudacris crucifer	Northern spring peeper
Pseudacris feriarum	Upland chorus frog
Lithobates catesbeianus	American bullfrog
Lithobates clamitans	Northern green frog
Lithobates palustris	Pickerel frog
Lithobates sphenocephalus	Southern leopard frog
Lithobates sylvaticus	Wood frog
Scaphiopus holbrookii	Eastern spadefoot
Reptiles	
Agkistrodon contortrix mokasen	Northern copperhead
Carphophis amoenus amoenus	Eastern worm snake
Chelydra serpentina	Eastern snapping turtle
Chrysemys p. picta	Eastern painted turtle
Clemmys guttata	Spotted turtle*
Coluber c. constrictor	Northern black racer
Diadophis punctatus edwardsii	Northern ring-necked snake
Kinosternon subrubrum	Eastern mud turtle
Lampropeltis triangulum	Eastern milksnake
Nerodia s. sipedon	Northern water snake
Pantherophis alleghaniensis	Eastern ratsnake
Plestiodon fasciatus	Five-lined skink
Pseudemys rubriventris	Northern red-bellied cooter
Terrapene carolina	Eastern box turtle*
Thamnophis s. sauritis	Common ribbonsnake*
Thamnophis s. sirtalis	Eastern garter snake
Trachemys scripta elegans	Red-eared slider

List of Fauna Species Known to Occur on APG (continued)

Scientific Name	Common Name
Finfish	
Acipenser oxyrhynchus	Atlantic sturgeon**
Acipenser brevirostrum	Shortnose sturgeon**
Alosa aestivalis	Blueback herring
Alosa mediocris	Hickory shad*
Alosa pseudoharengus	Alewife
Alosa sapidissima	American shad*
Ameiurus catus	White catfish*
Ameiurus nebulosus	Brown bullhead
Anchoa mitchilli	Bay anchovy
Anguilla rostrata	American eel
Catostomus commersoni	White sucker
Channa argus	Northern snakehead
Cyprinus carpio	Common carp
Dorosoma cepedianum	Gizzard shad
Fundulus diaphanous	Banded killifish
Fundulus heteroclitus	Mummichog
Gobiosoma bosci	Naked goby
Ictalurus punctatus	Channel catfish
Lepomis gibbosus	Pumpkinseed
Lepomis macrochirus	Bluegill
Menidia beryllina	Inland silverside
Micropterus salmoides	Largemouth bass
Morone americana	White perch
Morone saxatilis	Striped bass
Notemigonus crysoleucas	Golden shiner
Notropis hudsonius	Spottail shiner
Perca flavescens	Yellow perch
Pomoxis nigromaculatus	Black crappie
Shellfish	
Callinectes sapidus	Blue crab
Dreissena polymorpha	Zebra mussel (likely; not yet documented)

*Species of Greatest Conservation Need in Maryland
**Maryland endangered

APPENDIX D

List of Priority Bird Species for Conservation Management
that Have Potential to Occur on APG

List of Priority Bird Species for Conservation Management that Have Potential to Occur on APG

Species	BoCC	GBBDC	NMBSC	NAWBCP	NAWMP	PIF	SCP	ESA	SWAP	DoD
Acadian flycatcher						High Overall Priority (B)			Moderate (G5,S5B)	
American bittern									Highest (Threatened, G4,S1B, S1N)	
American black duck		X			Highest	High Overall Priority (B,W)			Moderate (G5,S4B,S5N)	
American kestrel									Moderate (G5,S4B,S3N)	
American oystercatcher	X					High Overall Priority (B,W)	High Concern		Moderate (G5,S3B,S2N)	
American redstart									Moderate (G5,S4B)	
American wigeon		X								
American woodcock		X				High Overall Priority (W), Additional Watch List (B)	High Concern		Moderate (G5,S4B,S4N)	
Audobon's shearwater	X								Uncertain (G4G5,SNR)	
Bald eagle						High Overall Priority (W)			Moderate (G5,S4)	
Baltimore oriole						High Overall Priority (B)				
Bank swallow									Moderate (G5,S3B)	
Barn owl									High (In Need of Conservation, G5,S2)	
Bicknell's thrush	X							Listing not warranted	Uncertain (G4,SNA)	
Black-and-white warbler						High Regional Priority (B)			Moderate (G5,S4B)	
Black-bellied plover							Moderate Concern		Moderate (G5,S3N)	
Black-billed cuckoo	X					High Regional Priority (B)				Tier 2
Blackburnian warbler						High Regional Priority (B)			Moderate (G5,S3B)	
Black-crowned night-heron				Moderate Concern					Moderate (G5,S3B,S2N)	
Black rail						High Overall Priority (B,W)		Threatened (Eastern subspecies)	Highest (Endangered, G3G4,S1)	
Black scoter					High				Moderate (G5,S3N)	
Black skimmer	X			High Concern		High Overall Priority (B)			Highest (Endangered, G5,S1B)	
Black-throated blue warbler						High Overall Priority (B)			Moderate (G5,S3S4B)	
Black-throated green warbler									Moderate (G5,S4B)	
Blue-winged teal					Identified in Previous Yrs				High (G5,S2B,S3N)	
Blue-winged warbler	X					High Overall Priority (B)			Moderate (G5,S4B)	
Boat-tailed grackle									Moderate (G5,S4B,S3N)	
Bobolink	X					Additional Watch List (B)			Moderate (G5,S3S4B)	
Bonaparte's gull				Moderate Concern						
Brant	X	X			High				Moderate (G5,S4S3N)	
Broad-winged hawk						High Regional Priority (B)			Moderate (G5,S3S4B)	
Brown creeper									Moderate (G5,S3B,S4N)	

Species	BoCC	GBBDC	NMBSC	NAWBCP	NAWMP	PIF	SCP	ESA	SWAP	DoD
Brown pelican	X			Moderate Concern					Highest (G4,S1B)	
Brown thrasher						High Regional Priority (B)				
Bufflehead					High	High Regional Priority (W)				
Canada warbler	X					High Overall Priority (B)			Moderate (G5,S3B)	Tier 2
Canvasback		X			High	High Overall Priority (W)			Moderate (G5,S3S4N)	
Carolina chickadee						High Regional Priority (B,W)				
Cerulean warbler	X					High Overall Priority (B)			Moderate (G4,S3B)	MSS
Chimney swift	X					High Regional Priority (B)			Moderate (G5,S5B)	
Chuck-will's-widow	X								Moderate (G5,S4B)	
Clapper rail						High Overall Priority (B,W)				
Coastal plain swamp swallow									Highest (In Need of Conservation, G5T3,S2S3B,SUN)	
Common gallinule									High (In Need of Conservation, G5,S2S3B)	
Common goldeneye					Moderately High					
Common loon						High Regional Priority (W)			Moderate (G5,S4N)	
Common merganser									High (G5,S2B,S3S4N)	
Common nighthawk	X								High (G5,S2S3B)	
Common snipe							Moderate Concern			
Common tern	X					High Regional Priority (B)			Highest (Endangered, G5,S1B)	
Dark-eyed junco									Moderate (G5,S3B,S5N)	
Dunlin						High Overall Priority (W)	Moderate Concern		Moderate (G5,S3N)	
Eastern kingbird						High Regional Priority (B)				
Eastern meadowlark	X								Moderate (G5,S5B,S3N)	
Eastern towhee						High Regional Priority (B,W)				
Eastern whip-poor-will	X					High Overall Priority (B)			Moderate (G5,S3S4B)	Tier 2
Eastern wood-pewee						High Regional Priority (B)				
Field sparrow	X					High Regional Priority (B,W)				
Fish crow						Additional Watch List (B)				
Forster's tern	X			Moderate Concern					High (In Need of Conservation, G5,S2B,S2N)	
Gadwall					Identified in Previous Yrs				High (G5,S2B,S4N)	
Glossy ibis				Low Concern		Additional Watch List (B)			Moderate (G5,S3B)	
Golden eagle									High (G5,S2N)	Tier 2
Golden-crowned kinglet									Moderate (G5,S3B,S4N)	
Golden-winged warbler	X					High Overall Priority (B)		Under Review	High (In Need of Conservation, G4,S2B)	MSS

List of Priority Bird Species for Conservation Management that Have Potential to Occur on APG (continued)

Species	BoCC	GBBDC	NMBSC	NAWBCP	NAWMP	PIF	SCP	ESA	SWAP	DoD
Grasshopper sparrow	X					High Regional Priority (B)			Moderate (G5,S5B)	Tier 2
Gray catbird						High Regional Priority (W), Additional Watch List (B)				
Green-winged teal					Identified in Previous Yrs					
Great blue heron									Moderate (G5,S5B,S3S4N)	
Great crested flycatcher						High Regional Priority (B)				
Great egret									Moderate (G5,S3S4B)	
Greater scaup		X			High	High Overall Priority (W)				
Greater yellowlegs							Moderate Concern		High (G5,S2S3N)	Tier 2
Gull-billed tern	X			High Concern					Highest (Endangered, G5,S1B)	
Henslow's sparrow	X					High Overall Priority (B)			High (In Need of Conservation, G4,S2B)	MSS
Hooded merganser					Identified in Previous Yrs					
Hooded warbler									Moderate (G5,S4B)	
Horned grebe						High Regional Priority (W)			Moderate (G5,S4N)	
Kentucky warbler	X					High Overall Priority (B)			Moderate (G5,S4B)	Tier 2
King rail	X	X							High (G4,S2B,S2N)	Tier 2
Laughing gull				Not Currently at Risk		Additional Watch List (B)			Highest (G5,S1B,S2N)	
Least bittern									High (In Need of Conservation, G5,S2S3B)	
Least flycatcher									Moderate (G5,S3S4B)	
Least tern	X			High Concern				Endangered (interior population only)	High (Threatened G4,S2B)	MSS
Lesser black-backed gull				Moderate Concern						
Lesser scaup		X			High					
Lesser yellowlegs	X						Moderate Concern		Highest (G5,S1N)	
Little blue heron	X			High Concern					Moderate (G5,S3B)	
Little gull				High Concern						
Loggerhead shrike	X					High Regional Priority (B,W)			Highest (Endangered, G4,S1B)	Tier 2
Long-eared owl	X					High Regional Priority (W)			Highest (G5,S1B,S1N)	
Long-tailed duck (Oldsquaw)					High				Moderate (G5,S4N)	
Louisiana waterthrush						High Overall Priority (B)			Moderate (G5,S5B)	
Magnolia warbler									Moderate (G5,S3S4B)	
Mallard		X			High					
Marbled godwit	X						High Concern			
Marsh wren						High Overall Priority (B)			Moderate (G5,S4B,S2N)	
Mourning dove		X								
Mourning warbler									Highest (Endangered, G5,S1B)	

Species	BoCC	GBBDC	NMBSC	NAWBCP	NAWMP	PIF	SCP	ESA	SWAP	DoD
Nashville warbler									Highest (Threatened, G5,S1B)	
Nelson's sparrow									Highest (G5,S1N)	
Northern bobwhite			X						Moderate (G5,S4)	MSS
Northern flicker						High Regional Priority (B)				
Northern goshawk									Highest (Endangered, G5,S1B,SNA)	
Northern harrier	X					High Regional Priority (W)			High (In Need of Conservation, G5,S2B,S4N)	
Northern parula									Moderate (G5,S5B)	
Northern pintail		X			Identified in Previous Yrs					
Northern saw-whet owl	X								Highest (G5,S1B,S1N)	
Northern waterthrush									High (In Need of Conservation, G5,S2B)	
Olive-sided flycatcher	X								Endangered Extirpated, G4,SHB	Tier 2
Ovenbird									Moderate (G5,S5B)	
Painted bunting	X									
Pied-billed grebe									High (G5,S2S3B,S3N)	
Pine siskin									High (G5,S2B,S1S3N)	
Piping plover						High Overall Priority (B,W)	Highly Imperiled	Threatened	Highest (Endangered, G3,S1B)	
Prairie warbler	X					High Overall Priority (B)			Moderate (G5,S4B)	Tier 2
Prothonotary warbler	X					Additional Watch List (B)			Moderate (G5,S4B)	Tier 2
Red-breasted nuthatch									Moderate (G5,S3B,S3S4N)	
Redhead		X			Identified in Previous Yrs	High Regional Priority (W)			Moderate (G5,S3S4N)	
Red-headed woodpecker	X					High Overall Priority (B,W)			Moderate (G5,S4)	Tier 2
Red knot	X					Additional Watch List (W)	High Concern	Threatened	Uncertain (Threatened, G4T2,SNA)	
Red-necked phalarope									Uncertain (G4G5,SNA)	
Red phalarope									Uncertain (G5,SNA)	
Red-throated loon									Moderate (G5,S3S4N)	
Ring-necked duck		X			Identified in Previous Yrs					
Roseate tern				High Concern				Endangered	Endangered Extirpated, G4,SXB,S1N	
Rose-breasted grosbeak	X					High Regional Priority (B)				
Royal tern				Moderate Concern					Highest (Endangered, G5,S1B)	
Ruddy duck									Moderate (G5,S3N)	
Ruddy turnstone							High Concern		High (G5,S2N)	
Ruffed grouse									Moderate (G5,S4)	
Rusty blackbird	X								High (G4,S2S3N)	MSS

Species	BoCC	GBBDC	NMBSC	NAWBCP	NAWMP	PIF	SCP	ESA	SWAP	DoD
Saltmarsh sharp-tailed sparrow	X					High Overall Priority (B,W)			High (In Need of Conservation, G4,S2B,S1N)	
Sanderling							High Concern		Moderate (G5,S3N)	
Sandwich tern	X								Highest (G5,S1B)	
Savannah sparrow									Moderate (G5,S4B,S4N)	
Scarlet tanager	X					High Overall Priority (B)			Moderate (G5,S5B)	
Seaside sparrow	X					High Overall Priority (B,W)			Moderate (G4,S4B,S2N)	
Sedge wren						High Overall Priority (B), High Regional Priority (W)			Highest (Endangered, G5,S1B)	
Semipalmated sandpiper	X								Uncertain (G5,SNA)	
Sharp-shinned hawk									High (G5,S2S3B,S4N)	
Short-billed dowitcher	X						High Concern		Uncertain (G5,SNA)	
Short-eared owl	X					High Overall Priority (W), High Regional Priority (B)			Highest (Endangered, G5,S1B,S2N)	
Snow goose		X			High					
Snowy egret				High Concern					Moderate (G5,S3B)	
Sora									Highest (G5,S1B,S1N)	
Spotted sandpiper									Moderate (G5,S3S4B)	
Surf scoter					High				Moderate (G5,S4N)	
Swainson’s thrush									Endangered Extirpated, G5,SHB	
Swainson’s warbler									Highest (Endangered, G4,S1B)	
Tricolored heron				High Concern					Moderate (G5,S3B)	
Tundra swan					High					
Upland sandpiper	X					High Overall Priority (B)			Highest (Endangered, G5,S1B)	
Veery	X								Moderate (G5,S4B)	
Vesper sparrow									Moderate (G5,S4B,S2N)	
Virginia rail						High Regional Priority (B)				
Wayne’s black-throated green warbler									Uncertain (G5T3,SUB)	
Western sandpiper							High Concern			
Whimbrel	X						High Concern		Uncertain (G5,SNA)	
White-winged scoter					High				High (G5,S2S3N)	
Willet	X						Moderate Concern		Moderate (G5,S4B,S2N)	
Willow flycatcher									Moderate (G5,S4B)	
Wilson's plover	X					High Overall Priority (B)	High Concern		Highest (Endangered, G5,S1B)	
Winter wren									High (G5,S2B,S3N)	

List of Priority Bird Species for Conservation Management that Have Potential to Occur on APG (continued)

Species	BoCC	GBBDC	NMBSC	NAWBCP	NAWMP	PIF	SCP	ESA	SWAP	DoD
Wood duck		X			Identified in Previous Yrs	High Regional Priority (W)				
Wood thrush	X					High Overall Priority (B)			Moderate (G5,S5B)	Tier 2
Worm-eating warbler						High Overall Priority (B)			Moderate (G5,S4B)	
Yellow-bellied sapsucker									Highest (G5,S1B,S3S4N)	
Yellow-breasted chat	X								Moderate (G5,S5B)	
Yellow-crowned night-heron				Moderate Concern					Moderate (G5,S3S4B)	
Yellow-throated vireo						High Overall Priority (B)			Moderate (G5,S4B)	

BoCC = USFWS Birds of Conservation Concern
GBBDC = Game Birds Below Desired Condition
NMBSC = Non-Migratory Bird Species of Concern
NAWBCP = North American Waterbird Conservation Plan
NAWMP = North American Waterfowl Management Plan
PIF = Partners in Flight
SCP = U.S. Shorebird Conservation Plan
ESA = Federal Endangered Species Act
SWAP = Maryland State Wildlife Action Plan, Draft 2015-2025
DoD = DoD Mission-Sensitive Species (MSS), May 2021 Fact Sheet

PIF:
B = Breeding
W = Wintering

SWAP:
G1 or S1 = Critically Imperiled/Highly State Rare at Global (G) or State (S) level; at very high risk of extinction or extirpation due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors; typically occurring in fewer than five populations
G2 or S2 = Imperiled/State Rare at Global (G) or State (S) level; at high risk of extinction or extirpation due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors; typically occurring in 6-20 populations
G3 or S3 = Vulnerable/Watchlist at Global (G) or State (S) level; at moderate risk of extinction or extirpation due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors; typically occurring in 21-80 populations
G4 or S4 = Apparently Secure at Global (G) or State (S) level; at fairly low risk of extinction or extirpation due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors
G5 or S5 = Demonstrably Secure at Global (G) or State (S) level; at very low risk of extinction or extirpation due to a very extensive range, abundant populations or occurrences, or little to no concern from declines or threats
GU or SU = Status Uncertain at Global (G) or State (S) level; a numerical rank cannot be established with confidence for reasons including lack of historical records, low survey effort, cryptic nature of the species, or concerns that the species may not be native to the state; uncertainty spans a range of 4- 5 ranks as defined above
GNR or SNR = Not ranked at Global (G) or State (S) level; conservation status has not yet been fully assessed
SNA = Not a conservation target; species is not a suitable target for most conservation actions because of its transient occurrence or other factors
B = Breeding
N = Nonbreeding
M = Migrant

Data compiled from DoD PIF website (https://www.denix.osd.mil/dodpif/groups/mission-sensitive-species/msswg/index.html) and MDDNR SWAP.

APPENDIX E

Memorandum of Understanding for
Federal Consistency and Maryland Enforceable Policies

Memorandum of Understanding Between The State of Maryland And The United States Department of Defense

This Memorandum of Understanding is entered into this 8th day of May, 2013, to evidence and affirm the mutual understanding of the State of Maryland and the United States Department of Defense, the Parties to the Agreement herein, concerning the Federal consistency requirements of the Coastal Zone Management Act (16 U.S.C. § 1451 et seq) and the application and implementation of certain enforceable policies of Maryland's Coastal Zone Management Program.

WHEREAS, the Department of Defense and the State of Maryland are committed to using the Federal consistency process to protect coastal uses and resources within Maryland's Coastal Zone;

WHEREAS, the Coastal Zone Management Act was enacted by Congress on October 27, 1972 to encourage coastal States, Great Lakes States and U.S. territories and commonwealths to be proactive in managing natural resources for their benefit and for the benefit of the Nation with the main objectives of preserving, protecting, developing, and where possible, restoring or enhancing the resources of the Nation's Coastal Zone;

WHEREAS, the Department of Defense is required under the Coastal Zone Management Act to demonstrate consistency to the maximum extent practicable with the approved, enforceable policies of Maryland's Coastal Zone Management Program, as approved by the National Oceanographic and Atmospheric Administration, for all projects and activities having reasonably foreseeable effects on land or water use or natural resources of Maryland's Coastal Zone. The review of activities on Federal lands for consistency with Maryland's Enforceable Coastal Policies only applies to the extent that those activities have reasonably foreseeable effects on coastal uses or resources of the State. Federal lands subject solely to the discretion of the Federal Government, its officers or agents, are excluded from the Coastal Zone under the Coastal Zone Management Act (16 U.S.C. § 1453 (1));

WHEREAS, the State of Maryland first prepared its Coastal Zone Management Program in 1978 and, on November 19, 2010, submitted a Routine Program Change updating its Coastal Zone Management Program to the National Oceanic and Atmospheric Administration for approval. This Routine Program Change, approved by National Oceanic and Atmospheric Administration on March 18, 2011, updates, clarifies, and improves access to Maryland's Enforceable Coastal Policies;

WHEREAS, the Department of Defense participated in the public review of Maryland's November 2010 Routine Program Change, and this participation led to a series of discussions between the Parties and the National Oceanic and Atmospheric Administration Office of Ocean and Coastal Resource Management in which several agreements and understandings were reached on the application of Maryland's Coastal Zone Management Program to Department of Defense activities;

AND, WHEREAS, the parties agreed to reduce those agreements and understandings to writing;

NOW THEREFORE, the Parties agree as follows:

Article I: General

Section 1.01 Terminology: As used throughout this document, "Department of Defense" means components, subordinate services, commands, and installations and not necessarily Cabinet-level activities. Also as used throughout this document, "Policies" refers to Maryland's Enforceable Coastal Policies, effective April 8, 2011 and implemented pursuant to Maryland's Coastal Zone Management Program. "Policy" refers to a specific Maryland Enforceable Coastal Policy.

Section 1.02 State Permits: In general, the obligation of the Department of Defense under the Coastal Zone Management Act is to demonstrate consistency to the maximum extent practicable with the substantive requirements identified in Maryland's Enforceable Coastal Policies. Unless otherwise required under Federal law, the Department of Defense is not required to obtain State permits or comply with any specific State procedural requirements to demonstrate consistency with Maryland's Enforceable Coastal Policies. The Department of Defense may, at its discretion, take advantage of an existing State permitting process or existing State procedural requirement if it determines these processes or requirements are the most convenient and efficient way of demonstrating consistency. The act of the Department of Defense submitting a permit application in such cases does not expand the jurisdiction of any State agency over Department of Defense activities.

Section 1.03 Early Coordination: Prior to providing a consistency determination, the Department of Defense should confer with relevant Maryland agencies early in the planning process on the nature and expected complexity of planned Department of Defense projects and activities. Attachment 1 is appended hereto and lists the Maryland Federal Coastal Consistency

Review Points of Contact. The Department of Defense welcomes Maryland's assistance in determining which Policies are applicable to a given project or activity and developing strategies for achieving and demonstrating consistency with those Policies. At the earliest possible time, Maryland shall notify the Department of Defense of an action that the Department of Defense has not provided a consistency determination for, but which may have a reasonably foreseeable effect on Maryland's Coastal Zone.

Section 1.04 List of *de minimis* and Environmentally Beneficial Activities and General Consistency Determinations: The Department of Defense and Maryland agree to work together to develop a list of *de minimis* activities and a list of environmentally beneficial activities, as these terms are defined in 15 C.F.R. § 930.33. The List of *de minimis* and Environmentally Beneficial Activities will be appended hereto as Attachment 2 following completion of the procedures outlined in 15 C.F.R. § 930.33. Absent unusual circumstances, the projects and activities on these lists will require no individual consistency determination. Either Party may recommend revisions to this list at any time. Projects and activities can be added to this list with the agreement of both Parties through the process under 15 C.F.R. §930.33. Either Party can modify or remove an item from this list in accordance with Section 3.03 of this Memorandum of Understanding.

Section 1.05 Federal Consistency Determination Process: In accordance with 15 C.F.R. § 930.33(a), the Department of Defense shall determine which of its activities affect coastal uses or resources. For Federal agency projects and activities that have reasonably foreseeable effects on any coastal use or coastal resource on Maryland's Coastal Zone, the Department of Defense will submit a consistency determination in accordance with 15 C.F.R. § 930 et seq, identifying the relevant Maryland Enforceable Coastal Policies and demonstrating the consistency of the project or activity with those Policies. Attachments 1, 3 and 4 contain the Federal consistency submission and approval process.

Section 1.06 Exceptions: Any time the circumstances of a particular project or activity that would otherwise fall under Attachment 2 indicate that there may be adverse coastal effects, the Department of Defense will prepare and submit a Federal Coastal Consistency Determination for that individual project or activity.

Section 1.07 Options for Demonstrating Consistency: The Department of Defense and Maryland agree that Integrated Natural Resources Management Plans ("INRMPs") or consultation with Maryland may be appropriate options for demonstrating consistency. Consulting with Maryland or implementing an INRMP does not however relieve the Department of Defense of its obligation to submit a written consistency determination when required by the Coastal Zone Management Act. Rather, the Department of Defense may, where appropriate, point to relevant provisions of an INRMP or consultation with Maryland in a written consistency determination to demonstrate consistency with certain Maryland Enforceable Coastal Policies. Additionally, the Department of Defense may, at its discretion, utilize Maryland's administrative processes, including but not limited to permits, to assist in demonstrating consistency with the substantive requirements of Maryland's Enforceable Coastal Policies. When resources are available and environmental benefits will accrue, the Department of Defense may, at its discretion and with Maryland concurrence, perform mitigation above and beyond that required to demonstrate consistency. These additional mitigation measures will be documented by the Department of Defense and Maryland, and may be used to meet mitigation requirements for future Department of Defense projects and activities.

Section 1.08 Mapping / Alternative Sites - Oyster Reefs, Trout Waters and Colonial Bird Nesting Sites: To address potential impacts to specific habitats that would have reasonably foreseeable effects to coastal uses or resources of Maryland and to provide greater specificity to the application of the policies, Maryland is creating a coastal atlas which will delineate the geographic areas of significance referred to in Maryland's Enforceable Coastal Policies B.1.1, B.2.1 and B.6.5. Maryland will make the coastal atlas available to the Department of Defense and the general public. The Department of Defense may share with Maryland any information previously collected and included in the INRMP that the State could use in creating the coastal atlas.

Article II. Specific Maryland Enforceable Coastal Policies for the Purpose of Federal Consistency Determinations:

Section 2.01 General Policies: Core Policies (Noise): The Department of Defense will demonstrate consistency with this Policy for new activities having a reasonably foreseeable effect on the Coastal Zone, other than aircraft operations. Compliance with internal Department of Defense and military service component noise abatement policies will be sufficient to demonstrate consistency with this Policy for such projects.

Section 2.02 General Policies: Water Quality (Pesticide Storage): The Department of Defense will demonstrate consistency with Maryland's Enforceable Coastal Policies regarding pesticide storage through compliance with Department of Defense Instruction 4150.07, "DoD Pest Management Program".

Section 2.03 General Policies: Water Quality (Toxic Discharges): The Department of Defense will continue to demonstrate consistency with this Policy by applying for and complying with permits required under the Clean Water Act and the relevant section of the Code of Maryland Regulations, currently 26.08.03.01.

Section 2.04 General Policies: Flood Hazards: The Department of Defense and Maryland agree that Policy A.3.2 does not establish absolute prohibitions against development on Department of Defense lands by Federal agencies.

Section 2.05 Coastal Resources: The Chesapeake and Atlantic Coastal Bays Critical Area: The Department of Defense and Maryland agree to continue discussing appropriate measures to demonstrate consistency with Maryland's Enforceable Coastal Policies related to the Chesapeake Bay and Atlantic Coastal Bays Critical Areas, including the development and maintenance of a List of *de minimis* and Environmentally Beneficial Activities, addressed in Section 1.04.

Section 2.06 Coastal Resources: Tidal and Non-Tidal Wetlands: The Department of Defense will consult with Maryland to ensure projects that may alter wetlands are consistent to the maximum extent practicable with the intent of this Policy. Maryland and the Department of Defense recognize that wetland impacts may be unavoidable due to mission requirements. In instances where adverse wetland impacts cannot be avoided, the Department of Defense and Maryland will work together to ensure any adverse effects to the Maryland Coastal Zone are minimized, any environmental benefits are maximized, and Department of Defense's operational flexibility is maximized. By submitting a Joint Permit Application under Clean Water Act Sections 404/401 to the appropriate regulatory agencies, the Department of Defense demonstrates consistency with the substantive requirements of Maryland's Enforceable Coastal Policies.

Section 2.07 Coastal Resources: Forests: The Department of Defense will demonstrate consistency with the underlying conservation goals of the Forest Conservation Act as embodied in Maryland's Enforceable Coastal Policies to the maximum extent practicable. An installation's INRMP may be sufficient for this purpose. For land-disturbing activities of 40,000 square feet or greater occurring on an installation, the Department of Defense will submit to Maryland either a negative determination with a finding of no effect to coastal uses or resources, or a consistency determination. If the Department of Defense proposes an action that will have reasonably foreseeable effects on uses or resources of Maryland's Coastal Zone, then the Department of Defense must be consistent to the maximum extent practicable with the substantive provisions of the Forest Conservation Act related to the reasonably foreseeable effects. The Department of Defense is not required to meet the procedural requirements of the Forest Conservation Act, such as creating and submitting forest conservation plans, forest stand delineation plans, or Long-Term Protective Agreements to Maryland. Likewise, the Department of Defense may not contribute to the State Forest Conservation Fund. However, the Department of Defense may, at its discretion and consistent with Federal fiscal legal requirements, follow Maryland's administrative process to assist in demonstrating consistency with the substantive requirements of Maryland's Enforceable Coastal Policies.

Section 2.08 Coastal Resources: Historical and Archaeological Sites: The Department of Defense will continue to use procedures in accordance with the requirements of the National Historic Preservation Act that are consistent with Maryland's Historical Preservation Program. Maryland agrees that meeting the consultation requirements under the National Historic

Preservation Act is sufficient to demonstrate consistency with Policies relating to historic preservation. In the event a tidal shore erosion project affects historical or archaeological resources, the Department of Defense will continue to use the consultation procedures under the National Historic Preservation Act that are consistent with Maryland's Historic Preservation Program.

Section 2.09 Coastal Resources: Living Aquatic Resources: Each INRMP maintains a relevant and updated baseline list of plant and animal species located at each installation for all pertinent taxonomic and regionally important groups, and may include State-listed endangered and threatened species. INRMPs are prepared, maintained, and implemented for all installations and ranges that contain significant natural resources for which the Department of Defense has authority for, or control of, natural resources management pursuant to the Sikes Act, 16 U.S.C. § 670 et seq. Maryland will continue to participate in the development and review of all INRMPs. Each Department of Defense component should ensure, to the extent practicable, that current and planned installation programs, plans, and projects that affect natural resources are integrated and compatible with INRMPs. Each INRMP requires that biologically or geographically significant or sensitive natural resources, such as ecosystems or species, are monitored and managed for their protection and long-term sustainability. The INRMP reflects the mutual agreement between Maryland Department of Natural Resources, the United States Fish and Wildlife Service and the Department of Defense concerning conservation, protection, and management of fish and wildlife resources, and it may be used to demonstrate consistency with Maryland's Enforceable Coastal Policies. If there are reasonably foreseeable effects on living aquatic resources as described in Maryland's Enforceable Coastal Policies, the Department of Defense and Maryland will work together to ensure any adverse effects are minimized, any environmental benefits are maximized, and the Department of Defense's operational flexibility is maximized.

Section 2.10 Coastal Uses: Tidal Shore Erosion Control (Living Shoreline): When, after consultation with Maryland, the Department of Defense determines that mission requirements or safety may be threatened by wildlife attracted to living shoreline habitats, less preferred alternatives for shoreline stabilization, such as hardened structures, should be considered consistent to the maximum extent practicable with this Policy. By submitting a Joint Permit Application under Clean Water Act Sections 404/401 to the appropriate regulatory agencies, the Department of Defense demonstrates consistency with the substantive requirements of Maryland's Enforceable Coastal Policies.

Article III. General Statements of Understanding

Section 3.01 Effective Date: This Memorandum of Understanding shall be effective as of the date of the last signature shown below and shall not expire.

Section 3.02 Pursuant to the Anti-Deficiency Act, 31 U.S.C. §§ 1341 and 1342, this Memorandum of Understanding makes no commitments of funds. Nothing in this Memorandum of Understanding will be construed by the Parties to require the obligation, appropriation, or expenditure of any money from the U.S. Treasury.

Section 3.03 Amendment and Termination: This Memorandum of Understanding and attachments may be modified or amended upon written request of any Party hereto and the subsequent written concurrence of the other Party. Moreover, this Memorandum of Understanding may be terminated sixty (60) days after providing written notice of such termination to the other Party.

Section 3.04 This Memorandum of Understanding does not create any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity by any person or Party against the United States, its agencies, its officers; or against the State of Maryland, its agencies, its officers; or against any other person. This Memorandum of Understanding is to be construed in a manner consistent with all existing laws and regulations.

Section 3.05 This Memorandum of Understanding neither expands nor is in derogation of those powers and authorities vested in the Parties by applicable law, statutes, regulations, or Executive Orders, nor is it intended to modify or supersede any other applicable interagency agreements existing as of the date of this Memorandum of Understanding. The Parties enter into this agreement in good faith and intend to fully carry out the terms of this Memorandum of Understanding.

Section 3.06 The Parties will meet at least every two years to discuss this Memorandum of Understanding and its Attachments.

Signed this 8th day of May, 2013.

For the State of Maryland:

John Griffin, Secretary
Maryland Department of Natural Resources

David Costello, Deputy Secretary
Maryland Department of the Environment

For the U.S. Department of Defense:

Donald R. Schregardus, Deputy Assistant Secretary of the Navy for Environment

Hershell E. Wolfe, Deputy Assistant Secretary of the Army for Environment, Safety and Occupational Health

Gerald F. (Fred) Pease Jr, Deputy Assistant Secretary of the Air Force for Environment, Safety and Occupational Health

Memorandum of Understanding between the State of Maryland and The United States Department of Defense

Attachment 1: List of De Minimis and Environmentally Beneficial Activities

This process is for federal consistency purposes pursuant to the Coastal Zone Management Act (16 U.S.C. § 1451 et seq.) only and in no way relieves the United States Department of Defense (hereinafter "DoD") from any other applicable federal, state, or local laws, regulations or other requirements.

Section I contains a list of federal agency activities (hereinafter "activities") that typically have minor or *de minimis* effects on coastal uses and resources in the Maryland Coastal Zone. *De minimis* activities are activities that are expected to have insignificant direct or indirect (cumulative and secondary) coastal effects and which the State agency concurs are *de minimis*.

Section II contains environmentally beneficial activities that have beneficial impacts on Maryland's Coastal Zone resources. "Environmentally beneficial activities" means an activity or activities that protect, preserve, or restore the natural resources of the coastal zone.

Upon approval by Maryland in accordance with 15 C.F.R. 930.33(a)(3) or 15 C.F.R. 930.36(c), DoD may generally carry out these activities without submitting a negative Federal Coastal Consistency Determination unless the circumstances of a particular Federal Development Project (hereinafter "Project") or activity indicate that the activity will have a greater than *de minimis* adverse effect on coastal uses or resources. In determining whether a particular activity qualifies as *de minimis* or as having an environmentally beneficial impact, each project or activity should be evaluated individually, taking into account the cumulative effects of all previous, current, and planned activities on and around the installation and the proximity of the project or activity to any coastal uses or resources. For an activity to be considered *de minimis*, wetland impacts shall be limited to 5,000 square feet or less. Land disturbing activities that include grubbing may require further assessment.

Best management practices (hereinafter "BMPs") will be implemented for each activity to protect water quality, coastal uses, and coastal resources. For the list of *de minimis* or environmentally beneficial activities BMPs are defined as resource management decisions that are based on the latest professional and technical standards for the protection, enhancement, and rehabilitation of natural resources. BMPs include schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce pollution. BMPs also include treatment requirements, operating procedures, and control practices. (*Department of Defense Instruction, Number 4715.03, "Natural Resources Conservation Program"*, March 18, 2011)

I. Examples of *De Minimis* Activities: Pursuant to 15 C.F.R. § 930.33(a)(3)(i), the list of *de minimis* activities identifies those activities not subject to further state agency review for federal consistency in accordance with the Coastal Zone Management Act.

   a. Existing buildings, facilities or structures: The following list of projects on existing buildings or structures are considered *de minimis* so long as the building or structure is not eligible for listing on the National Register of Historic Places. If the structure is determined eligible for listing, the project must have been determined by the appropriate cultural resources manager to have no adverse effect on the building or structure.

1. Exterior painting, staining or sealing of existing building/infrastructure
2. Brick repointing
3. Repair but not replacement of building foundations
4. Repair and replacement of roofs, windows, scuppers, gutters, or snow guards
5. HVAC modernization to include a new pad in the same footprint as the current pad so long as the new pad is not larger than the current pad
6. Water softener restoration
7. Repair and replacement of sump pump(s)
8. Repair and replacement of exterior door(s)
9. Installation, repair, and maintenance of solar panel(s) and wall(s) taking place within or upon existing structures or existing impervious surface area(s)
10. Exclusively external structural and cosmetic alterations to existing buildings or structures as long as any ground disturbance is within the same foot print (e.g., installation of a canopy that is harmonious and compatible with the appearance and character of the existing building and does not contribute to additional storm water pollution)

b. Road Maintenance and Parking Maintenance (within the same footprint or less):

1. Routine repairs including but not limited to milling, grooving, stripping, repairing (patching or slurry seal), striping, or resurfacing that does not result in a net increase in stormwater discharge
2. Barrier skirt and pop up barrier maintenance and repair

c. Grounds Maintenance:

1. Grading and sodding of existing athletic and parade fields
2. Routine grounds maintenance, including but not limited to mowing existing mowed areas; seeding/reseeding; planting and replacement of flowers, trees and shrubs; and hiking trail maintenance
3. Maintenance of vegetation within existing firebreaks, airfield/radar clear zones, airfield imaginary surfaces, firing lines, lines of sight, ranges, anti-terrorism/force protection fence lines, and building clearance requirements not involving grubbing or other excavation
4. Maintenance and in-kind replacement of existing fencing

d. Utilities:

1. Repair and in-kind replacement of underground utility lines (such as fiber optic, water, and electric lines)
2. Maintenance of vegetation within existing utility clearance zones, rights-of-way and easements that does not involve grubbing or other excavation
3. Utility line maintenance and repair including but not limited to maintenance and repair of sewer lines, steam lines, gas lines, fire mains, and water lines
4. Cleaning of storm drain inlets and swales
5. Repair and maintenance of existing piping under roads and culverts
6. Maintenance and repair of aboveground storage tanks, underground storage tanks, and fuel lines
7. Studies (such as archeological investigations, periodic sampling, and geotechnical studies) for utility projects that require excavation but do not exceed 5,000 square feet of land disturbance and does not include grubbing
8. Maintenance, repair, and replacement of streetlights
9. Cleaning, maintenance, repair, and replacement of the following facilities and devices, to include removal of vegetation, including trees and shrubs, without grubbing or excavation, when other state or federal permits are not required:
    a. Existing drainage facilities,
    b. Storm water management devices, and
    c. Water quality facilities and devices
10. Roadside ditch regrading
11. Retrofit and redesign of existing drainage facilities that use environmental site design to the maximum extent practicable
12. In-kind replacement, reconstruction, repair, and modification of existing lighting, guardrails, traffic and pedestrian signals, curbs and gutters, sidewalks and ramps, variable message signs, and Americans with Disabilities Act compliant retrofits
13. Maintenance, repair, and replacement of existing railroad structures

g. Military Operations and Training: Activities described in this section shall be under 5,000 square feet of new land disturbance.

1. Installation of temporary metal plates, target poles, and targets and maintenance and replacement of catch boxes on existing ranges
1. Temporary placement and use of simulated target fields (e.g., inert mines, simulated mines, or passive hydrophones) in fresh, estuarine, and marine waters for the purpose of non-explosive research, development, test, and evaluation

2. Short term increases in air operations up to 50 percent of the typical operation rate, or increases of 50 operations per day, whichever is greater
3. Routine testing and evaluation of military equipment on a military reservation or an established range, restricted area, or operating area; similar in type, intensity and setting, including physical location and time of year, to other actions for which it has been determined, through NEPA analysis where a Department of Defense agency was a lead or cooperating agency, that there are no significant impacts; and conducted in accordance with all applicable standard operating procedures protective of the environment
4. Routine military training associated with transits, maneuvering, safety and engineering drills, replenishments, flight operations, and weapons systems conducted at the unit or minor exercise level; similar in type, intensity and setting, including physical location and time of year, to other actions for which it has been determined, through NEPA analysis where a Department of Defense was a lead or cooperating agency, that there are no significant impacts; and conducted in accordance with all applicable standard operating procedures protective of the environment.

h. Miscellaneous:

1. Preliminary engineering and technical studies
2. Non-invasive inspections, educational programs, and environmental surveys
3. Normal agricultural operations performed as part of an agricultural out-lease contract as described in the installation's approved Integrated Natural Resources Management Plan (hereinafter "INRMP")
4. Recreational hunting and fishing programs and routine fish and wildlife habitat management projects as described in the installation's approved INRMP
5. Prescribed burning for purposes of natural resources management, maintaining military operations, and wildfire prevention as described in the installation's approved INRMP
6. Installation, maintenance, repair, and replacement of signage that does not significantly affect coastal resources
7. Renewal of existing lease agreements, licenses, and easements under the same or nearly the same conditions that existed prior to renewal
8. Hosting or participating in military ceremonies and public events such as air shows, open houses, Earth Day events, National Public Lands Day events, conferences, concerts, and athletic events where no permanent changes to installation infrastructure are required to accommodate all aspects of the event
9. Routine movement, handling, and distribution of materials, including hazardous materials and wastes, that are moved, handled, or

distributed in accordance with existing, applicable regulatory requirements and permits

10. Transfer of real property from DoD to another federal agency
11. Receipt of real property from another federal agency when there is no anticipated or proposed substantial change in land use
12. Disposal of excess easement interests to the underlying fee owner where the easement is not part of an existing DoD environmental impact mitigation measure
13. Relocation of personnel into existing federally-owned or commercially leased space that does not involve a substantial change affecting the supporting infrastructure (e.g. no increase in vehicular traffic beyond the capacity of the existing road network to support such an increase)
14. Installation of devices to protect human or animal life (e.g., raptor electrocution prevention devices, fencing to restrict wildlife movement onto airfields, and fencing and grating to prevent accidental entry into hazardous areas)

II. Environmentally Beneficial Activities: Pursuant to 15 C.F.R. § 930.33(a)(4), the list of environmentally beneficial activities are excluded from further state agency consistency review.

a. The following activities are considered beneficial, and are not primarily for the purpose and benefit of stormwater best management practices ("BMPs") or mitigation as a result of a permitted activity:

1. Stand alone low-impact development retrofit or enhancement activities including but not limited to:
    a. Replacement of impervious surface with permeable materials or any form of low impact development design
    b. Storm water retrofits
    c. Demolition, disposal, or improvement of National Register of Historic Places ineligible structures or infrastructure that includes Maryland-approved sediment/erosion control measures and results in reduced impervious surface or increased ecosystem service providing vegetation.
    d. Construction and installation of grass swales
    e. Installation, maintenance, repair, and replacement of rain barrels, dry wells, and cisterns to manage storm water runoff from existing structures
    f. Installation, maintenance, and repair of green roof
2. Vegetative invasive species removal pursuant to the installation's approved INRMP
3. Reintroduction of endemic or native species (other than endangered or threatened species) into their historic habitat where no substantial site preparation is involved

4. Existing living shoreline restoration, maintenance and repair so long as any coastal disturbance is returned to its pre-disturbance condition. During staging operations, BMPs will be applied
5. Wetland creation and enhancement that does not involve excavation or clearing of forested buffers
6. Forest enhancement (clearing and replanting) in accordance with the installation’s approved INRMP
7. Silviculture in accordance with the installation’s approved INRMP
8. Implementation of an Urban Forest Management Plan in accordance with the installation’s approved INRMP
9. Replacement of aboveground utilities with underground utilities using directional drilling and avoiding coastal uses and resources

Memorandum of Understanding between the State of Maryland and The United States Department of Defense

Attachment 2: Contents of Consistency Determinations

Consistency Determinations shall generally conform to the following format, when appropriate:

1. Enclosure 1: Proposed Project Description
    a. Project Location
    b. Project Description
    c. Public Participation Section
    d. Other Consultations (e.g., National Historic Preservation Act Section 106 Consultations)
2. Enclosure 2: Site Location
    a. Site Location Map
    b. Photographs
3. Enclosure 3: Basis of Determination: Each affected and unaffected Enforceable Coastal Policy should be addressed as relevant or not relevant in the Consistency Determination.
    a. General Policies
        i. Core Policies
        ii. Water Quality
        iii. Flood Hazards
    b. Coastal Resources
        i. Chesapeake and Atlantic Coastal Bays Critical Area
        ii. Tidal Wetlands
        iii. Nontidal Wetlands
        iv. Forests
        v. Historic and Archaeological Sites

vi. Living Aquatic Resources

c. Coastal Uses

i. Mineral Extraction

ii. Electrical Generation and Transmission

iii. Tidal Shore Erosion Control

iv. Oil and Natural Gas Facilities

v. Dredging and Disposal of Dredged Material

vi. Navigation

vii. Transportation

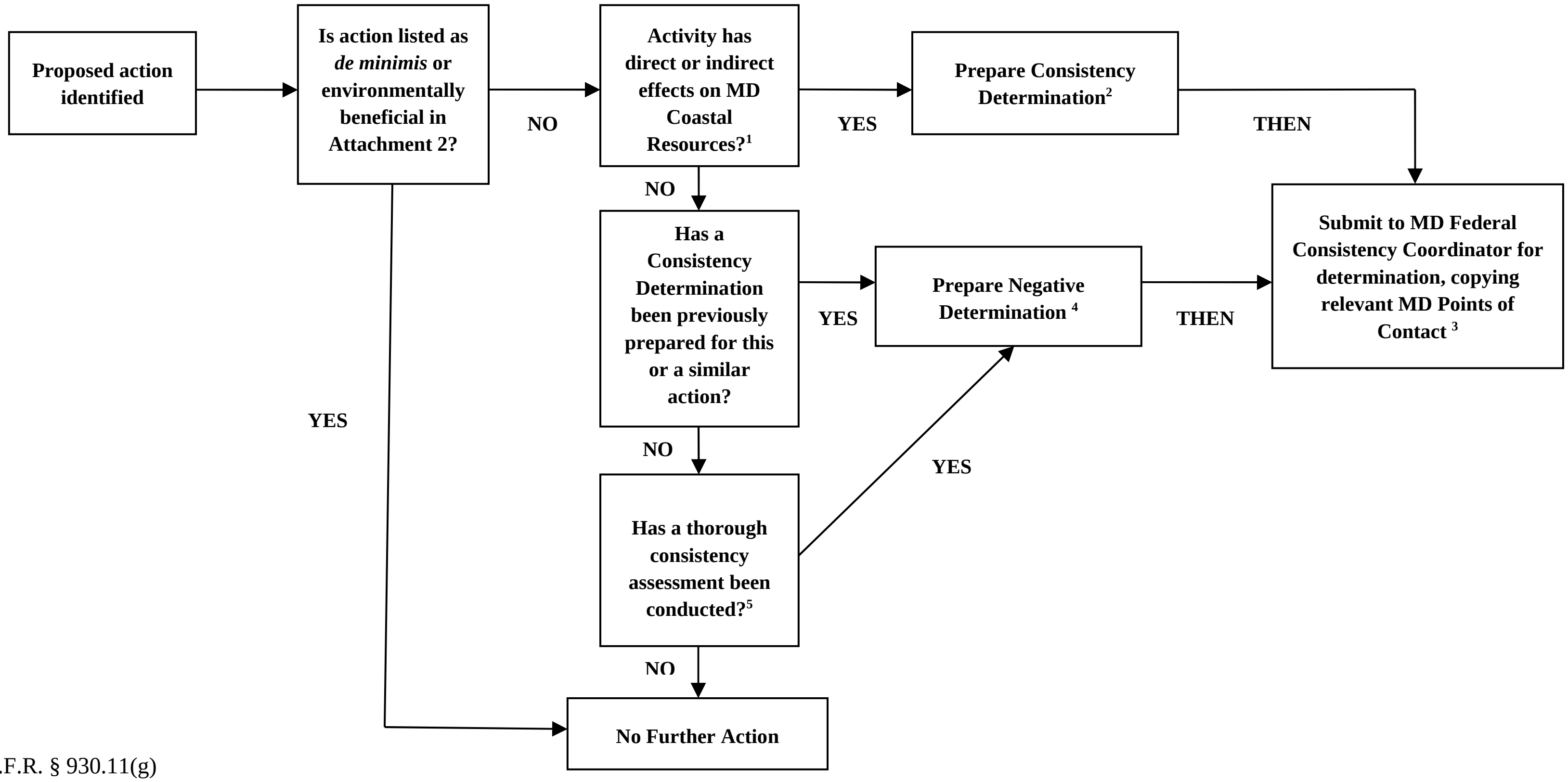
viii. Agriculture

ix. Development

x. Sewage Treatment

Memorandum of Understanding between the State of Maryland and The United States Department of Defense

Attachment 3: Federal Consistency Flow Chart



[1]15 C.F.R. § 930.11(g)

[2]See Contents of Consistency Determinations (Attachment 4) for a consistency determination template. Consistency determinations shall indicate whether such proposed activities will be undertaken in a manner consistent to the maximum extent practicable with Maryland's Enforceable Coastal Policies. See 15 C.F.R. § 930.32.

[3]See Maryland Federal Consistency Review Points of Contact (Attachment 1). The Maryland Federal Consistency Coordinator shall inform the DoD-identified point of contact of Maryland's concurrence with, or objection to, the DoD's consistency determination at the earliest practicable time, after providing for public participation in Maryland's review of the consistency determination. DoD may presume Maryland's concurrence if Maryland's response is not received within 60 days from the receipt of the DoD's consistency determination and supporting information. According to 15 C.F.R. § 930.41(a), the 60 day review period begins when the Maryland Federal Consistency Coordinator receives the consistency determination and supporting information required by 15 C.F.R. § 930.39(a).

[4]In accordance with 15 C.F.R. § 930.35,the DoD shall provide the negative determination to the Maryland Federal Consistency Coordinator and relevant points of contact, listed in Attachment 4, at least 90 days before final approval of the DoD activity. Maryland has 60 days to respond, and may request an extension of 15 days or less. The Maryland Federal Consistency Coordinator is not obligated to respond to a negative determination. If the Maryland Federal Consistency Coordinator does not respond to the Department of Defense's negative determination within 60 days, Maryland Federal Consistency Coordinator concurrence with the negative determination shall be presumed. See 15 C.F.R. § 930.35(c) and (e) for guidance on how to proceed should Maryland object to the negative determination.

[5]An EA or EIS prepared pursuant to NEPA which evaluates effects to coastal uses or resources is a thorough consistency assessment triggering the requirement to prepare a Negative Determination. However, in cases where the activity is on the list of *de minimis* and environmentally beneficial activities, a Negative Determination would not be required.

Memorandum of Understanding between the State of Maryland and The United States Department of Defense

Attachment 4: Maryland Federal Consistency Review Points of Contact Dated January 9, 2013

All federal consistency reviews for proposed Department of Defense activities shall be sent to:

Elder Ghigiarelli
Federal Consistency Coordinator
Deputy Program Administrator
Maryland Department of the Environment
Wetlands and Waterways Program
1800 Washington Boulevard, Suite 430
Baltimore, MD 21230-1708
(410) 537-3763
Email: eghigiarelli@mde.state.md.us

Joe Abe
Coastal Policy Coordination Section Chief
Chesapeake and Coastal Service
Maryland Department of Natural Resources
580 Taylor Avenue, E-2
Annapolis, Maryland 21401
(410) 260-8740
Email: jabe@dnr.state.md.us

When the Department of Defense evaluates Maryland's enforceable coastal policies in the following policy areas the consistency statement and supporting information must be transmitted to the relevant points of contact when the consistency statement is transmitted to the Maryland Federal Consistency Coordinator. The indicated point of contact should also be included in any early coordination.

<u>(B.1) The Chesapeake and Atlantic Coastal Bays Critical Area</u>

Lisa Hoerger
Regulations Coordinator
Department of Natural Resources
Critical Area Commission for the Chesapeake & Atlantic Coastal Bays
1804 West Street
Suite 100
Annapolis, MD 21401
(410) 260-3478
E-mail: lhoerger@dnr.state.md.us

<u>(B.2) Tidal Wetlands</u>

Rick Ayella
Division Chief
Maryland Department of the Environment
Tidal Wetlands Division – Baltimore Office
1800 Washington Boulevard
Baltimore, MD 21230-1718
(410) 537-3835
Email: rayella@mde.state.md.us

<u>(B.3) Non-Tidal Wetlands</u>

Amanda Sigillito
Division Chief
Maryland Department of the Environment
Nontidal Wetlands and Waterways Division
1800 Washington Boulevard
Baltimore, MD 21230-1718
(410) 537-3766
Email: asigillito@mde.state.md.us

<u>(B.4) Forests</u>

Marian Honeczy
Supervisor of Urban Programs & FCA Coordinator
Department of Natural Resources
Forest Service
Tawes State Office Building E1
580 Taylor Avenue
Annapolis, MD 21401-2397
(410) 260-8511
E-mail: mhoneczy@dnr.state.md.us

<u>(B.5) Historical and Archeological Sites</u>

Elizabeth J. Cole
Administrator, Review & Compliance
Department of Planning
Maryland Historical Trust - Crownsville Office
100 Community Place
Crownsville, MD 21032-2023
(410) 514-7631
bcole@mdp.state.md.us

(B.6) Living Aquatic Resources

Catherine McCall
Assistant Director
Coastal and Marine Assessment
Maryland Department of Natural Resources
580 Taylor Avenue, E-2
Annapolis, MD 21401
(410) 260-8737
Email: cmccall@dnr.state.md.us

APPENDIX F

Army Compatible Use Buffer (Chesapeake Bay)
Program Proposal

DEPARTMENT OF THE ARMY
ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
600 ARMY PENTAGON
WASHINGTON, DC 20310-0600

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DEC 19 2016

MEMORANDUM THRU U.S. Army Installation Management Command (IMCG), 2405 Gun Shed Road, Joint Base San Antonio Fort Sam Houston, Fort Sam Houston, Texas 78234-1223

FOR Commander U.S. Army Garrison Aberdeen Proving Ground (IMAP-PWE), 4510 Boothby Hill Avenue, Aberdeen Proving Ground, MD 21005-5001

SUBJECT: Revised Approval – U.S. Army Garrison Aberdeen Proving Ground (USAGAPG) Army Compatible Use Buffer (ACUB) Priority Area Changes

1. References:

a. Memorandum, HQ, DAIM-ISE, 22 Sep 16, subject: Approval – U.S. Army Garrison Aberdeen Proving Ground (USAGAPG) Army Compatible Use Buffer (ACUB) Priority Area Changes.

b. Memorandum, U.S. Army Installation Management Command, IMAP-PWE, 11 May 16, subject: U.S. Army Garrison Aberdeen Proving Ground (USAGAPG), MD, Army Compatible Use Buffer (ACUB) Priority Area Changes.

2. This memorandum supersedes the approval memorandum at reference a.

3. I approve the changes proposed to the USAGAPG ACUB priorities described at reference b.

4. USAGAPG is expected to coordinate with Headquarters IMCOM G4 for applicable execution guidance.

5. Within 120 days from the issuance of this memorandum, USAGAPG will update its original ACUB proposal including associated maps, tables, and cost estimates by incorporating the changes approved by this action and accomplishments to date. Please transmit copies of the updated proposal to the POC listed below, HQ U.S. Installation Management Command G-4, and the U.S. Army Environmental Command Cooperative Agreement Manager responsible for the USAGAPG ACUB.

6. The point of contact for this matter is Mr. John Housein (571) 256-9731 (DSN 260), email john.g.housein.civ@mail.mil.

GWEN BINGHAM
Lieutenant General, GS
Assistant Chief of Staff
for Installation Management

CF:
U.S. Army Environmental Command

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
600 ARMY PENTAGON
WASHINGTON, DC 20310-0600

DAIM-ISE

SEP 2 2 2016

MEMORANDUM THRU U.S. Army Installation Management Command (IMPW-SE), 2405 Gun Shed Road, Joint Base San Antonio Fort Sam Houston, Fort Sam Houston, Texas 78234-1223

MEMORANDUM FOR Commander U.S. Army Garrison Aberdeen Proving Ground (IMAP-PWE), 4510 Boothby Hill Avenue, Aberdeen Proving Ground, MD 21005-5001

SUBJECT: Approval – U.S. Army Garrison Aberdeen Proving Ground (USAGAPG) Army Compatible Use Buffer (ACUB) Priority Area Changes

1. References:

a. Memorandum, DAIM-ISE, 24 Feb 12, subject: Interim Army Implementation Guidance for Encroachment Authorities

b. Memorandum, IMAP-PWE, 11 May 16, U.S. Army Garrison Aberdeen Proving Ground (USAGAPG), MD, Army Compatible Use Buffer (ACUB) Priority Area Changes

c. Memorandum, IMPW-SE, 3 Jun 16, Description of proposed changes to the USAG-Aberdeen Proving Ground (APG) Army Compatible Use Buffer (ACUB) Priority Areas

2. In accordance with the procedures outlined in reference 1.a., and in response to reference 1.b., the changes proposed for the USAGAPG ACUB have been reviewed by Headquarters Department of the Army (HQDA) staff in coordination with stakeholder organizations. HQDA staff have found that USAGAPG proposed changes amount to a 23% reduction in Priority Areas targeted for ACUB action through encroachment partnership. The proposed changes do not substantially increase cost or geographic scope and therefore do not warrant higher level approval.

3. The Chief of Army Training Support Systems Division in the Office of the Deputy Chief of Staff G-3/5/7 and the Chief of the Army Environmental Division, in the Office of the Assistant Chief of Staff for Installation Management approve the proposed actions subject to the following conditions.

a. Funds appropriated to IMCOM for Base Operations Support and funds obtained through the Office of the Secretary of Defense Readiness and Environmental Protection Integration Program cannot be used to execute transactions in priority areas identified as PA 1 NE Kent (6,423 acres), PA 1 S Kent (20,981 acres) and PA 1 N Cecil (966 acres).

b. Within 120 days from the issuance of this memorandum, USAGAPG will update its original ACUB proposal including associated maps, tables, and cost estimates by incorporating the changes approved by this action and accomplishments to date. Please transmit copies of the updated proposal to the POC listed below, HQ U.S. Installation Management Command G-4, and the U.S. Army Environmental Command Cooperative Agreement Manager responsible for the USAGAPG ACUB.

5. The point of contact for this matter is Mr. John Housein (571) 256-9731 (DSN 260), email john.g.housein.civ@mail.mil.

MARY WILLIAMS-LYNCH
Colonel, GS
Chief, Army Environmental Division

THOMAS E. MACIA
Chief, Training Support Systems Division

DEPARTMENT OF THE ARMY
U.S. ARMY INSTALLATION MANAGEMENT COMMAND
U.S. ARMY GARRISON ABERDEEN PROVING GROUND
4510 BOOTHBY HILL AVENUE
ABERDEEN PROVING GROUND MARYLAND 21005-5001

REPLY TO
ATTENTION OF

IMAP-PWE

MAY 11 2016

MEMORANDUM THRU U.S. Army Installation Management Command (IMPW-E), 2405 Gun Shed Road, JBSA Fort Sam Houston, TX 78234-1223

FOR Office of the Assistant Chief of Staff for Installation Management (DAIM-ISE), 600 Army Pentagon, Washington, DC 20310-0600

SUBJECT: U.S. Army Garrison Aberdeen Proving Ground (USAGAPG), MD, Army Compatible Use Buffer (ACUB) Priority Area Changes

1. References:

a. Memorandum, DAIM-ISE, 24 Feb 12, subject: Interim Army Implementation Guidance for Encroachment Authorities.

b. U.S. Army Garrison Aberdeen Proving Ground, MD, Army Compatible Use Buffer (ACUB), 18 Mar 11.

c. Memorandum, DAIM-ZA, 1 May 12, subject: Approval – U.S. Army Garrison Aberdeen Proving Ground, MD, Army Compatible Use Buffer (ACUB).

2. In accordance with procedures outlined in reference 1a, USAGAPG requests Installation Management Command and Headquarters, Department of the Army approval for changes to APG's approved ACUB Priority Areas (PA's) as referenced in 1b and 1c.

3. The proposed changes to APG's approved PA's will strategically reduce the acreage of the PA's and realign them with targeted areas of other land conservation programs. This revision will also allow the partner to secure more matching funds to further the support of APG's mission.

4. A memorandum for record detailing the proposed changes and copies of maps of the originally approved and the proposed adjusted PA's are enclosed.

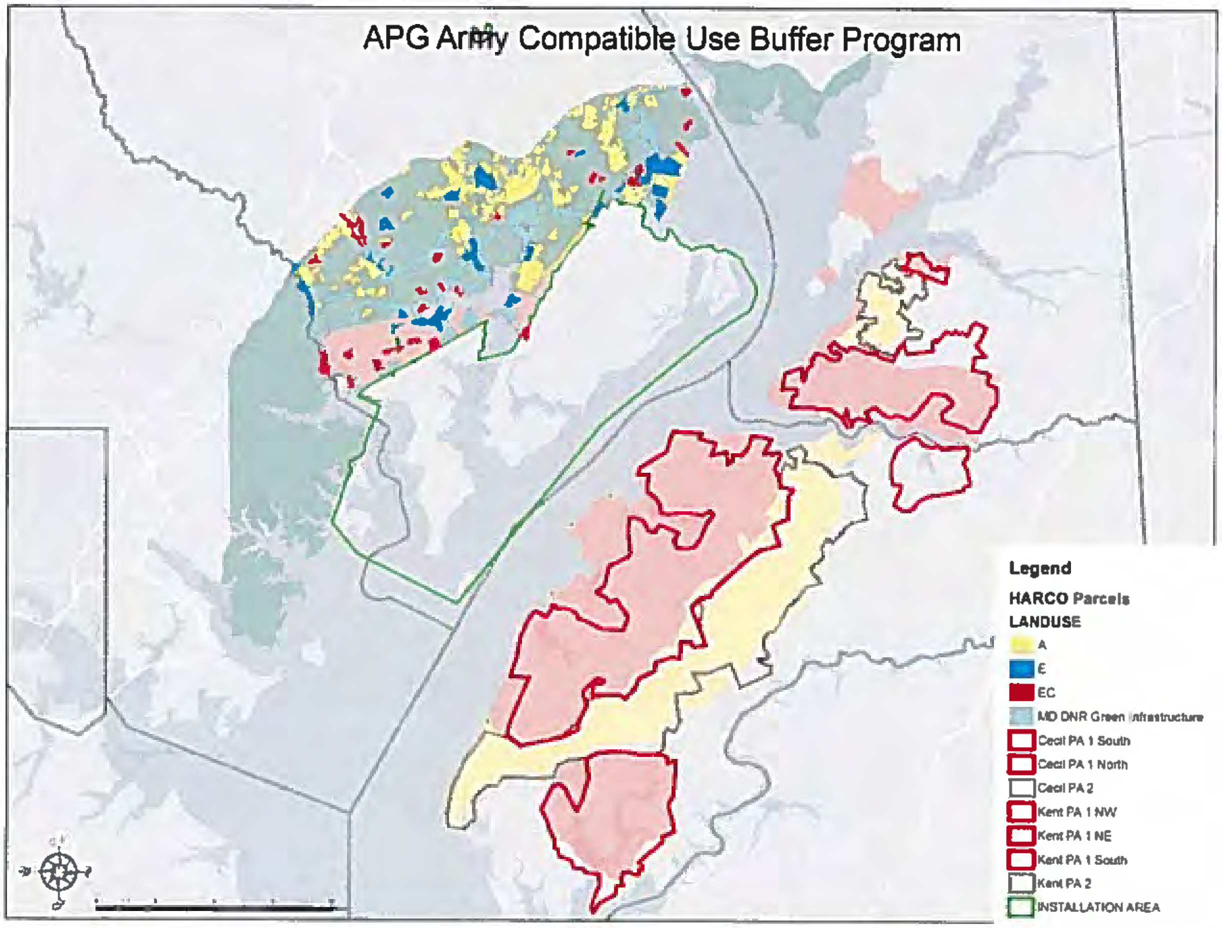
5. Once approved, reference 1b will be updated to reflect the updated PA's and end state.

6. The point of contact for this action is Mr. Todd Beser, at (410) 436-0721, or by email: todd.m.beser.civ@mail.mil.

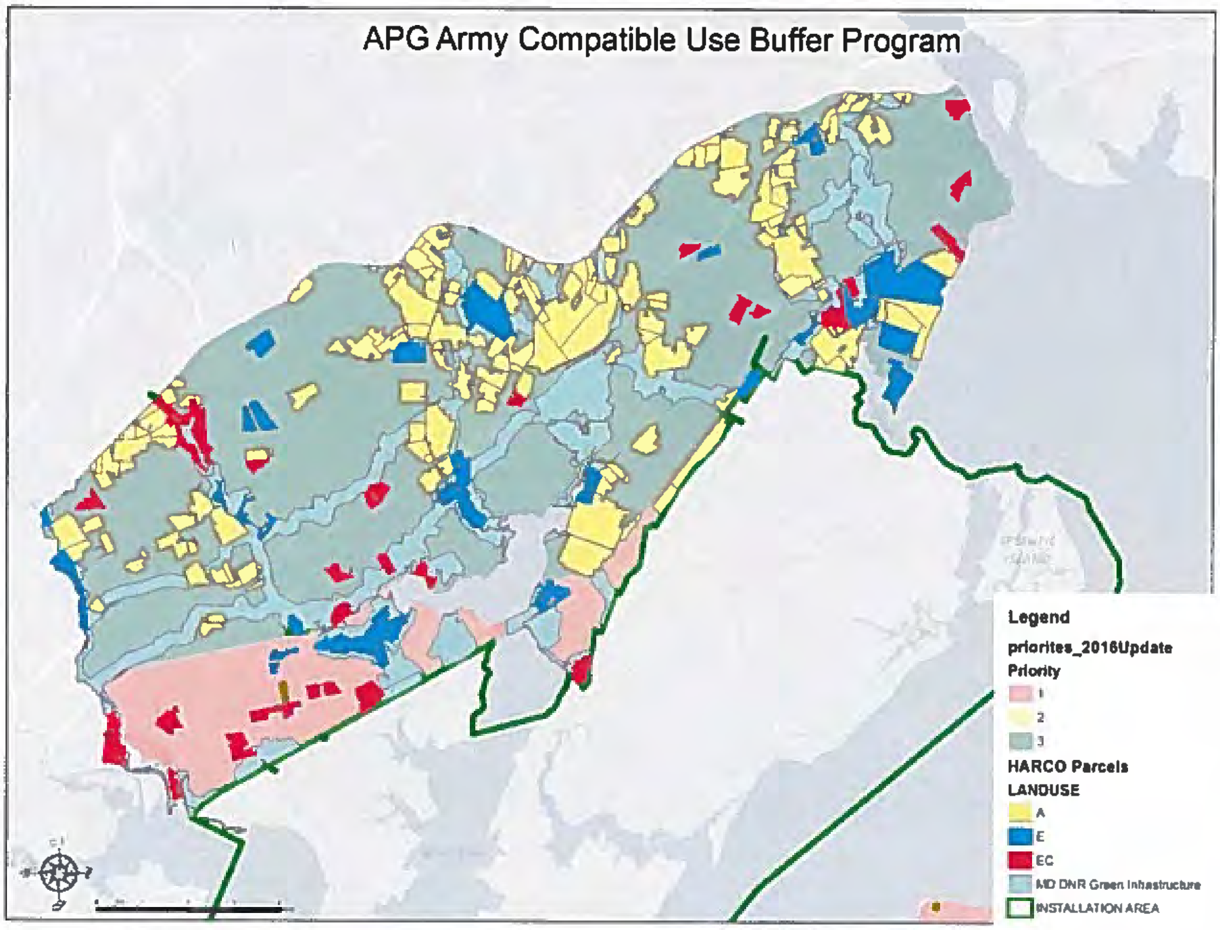
James E Davis

5 Encls

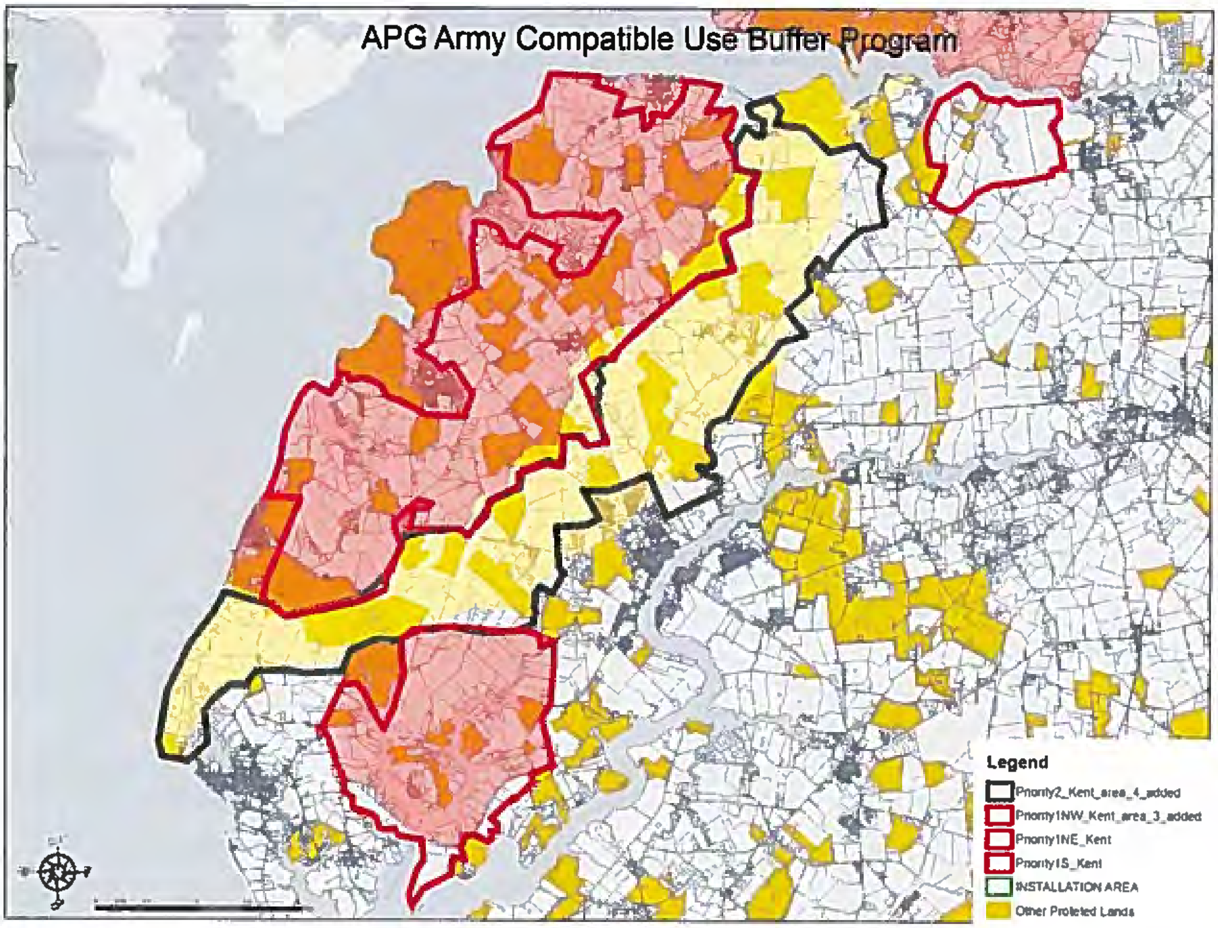
JAMES E. DAVIS
COL, FI
Commanding



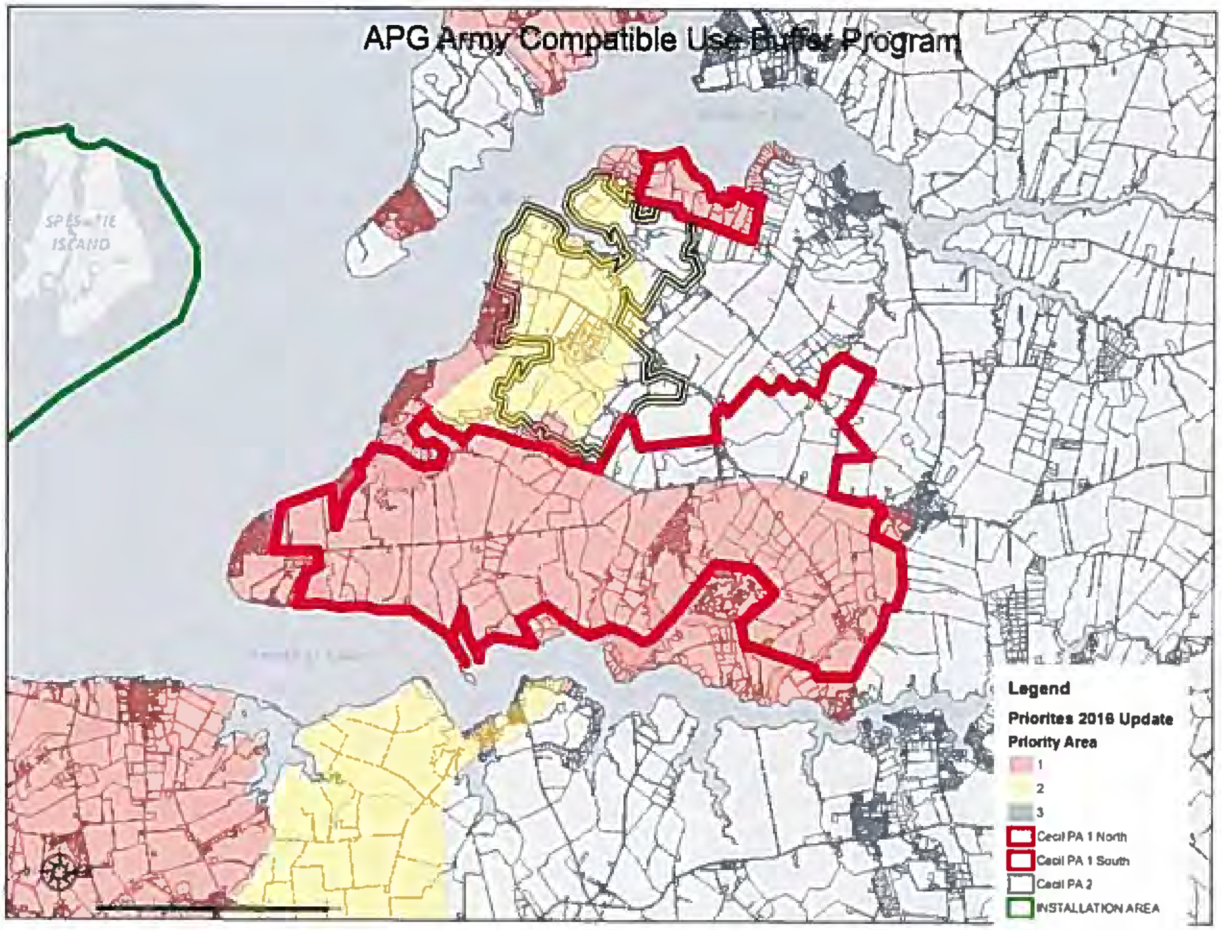
Enclosure 1: Map depicting overall proposed PA changes.



Enclosure 2: Map depicting the detailed analysis of parcels within Harford County, MD PAs



Enclosure 3: Map depicting proposed PA changes in Kent County (Eastern Shore, MD)



Enclosure 4: Map depicting proposed PA changes in Cecil County (Eastern Shore, MD)

IMAP-PWE

MAY 11 2016

MEMORANDUM FOR RECORD

SUBJECT: Description of Proposed Changes to the USAG-Aberdeen Proving Ground (APG) Army Compatible Use Buffer (ACUB) Priority Areas

1. This memo describes proposed changes to APGs ACUB approved priority areas (PAs). The PAs areas defined in the APG's original ACUB proposal dated 18 Mar 11 were based on the extent of operational noise contours (i.e., 130 and 115 dB), with emphasis on properties containing large tracts of forest, wetland, Chesapeake Bay critical area and bald eagle habitat. The proposed changes are based on further analyses including parcel size and established land use, and provide a better defined end-state.

2. On the Eastern Shore of Maryland, this revision will strategically reduce the acreage of the PAs and realign them with targeted areas of other land conservation programs. This revision will also allow the partner to secure more matching funds to further the support of APG's mission. Our desired end state remain the same as our FY16 REPI proposal of 90% of PA 1 and 80% of PA 2 including lands already protected and protected by other organizations.

3. On the Western Shore of Maryland, this revision targets larger parcels that have a more appropriate land use classification that may provide a greater opportunity for off post mitigation. It also realigns targets with other land conservation programs. We have selected parcels equal to or larger than 25 acres with the land use classification of Agricultural, Exempt and Exempt commercial. We have also included Maryland's Green Infrastructure targets. These changes give a total of 1,197 acres in PA 1 and 14,901 acres in PA 3 and 23,008 acres of targeted Green Infrastructure across the PAs. We will continue to target 60% on the Western Shore as an end state in order to develop off post mitigation locations that will aid in meeting various compliance requirements on APG.

4. Tables detailing changes to PA acreages:

Cecil County	**New**	**Old**
PA 1 North	966	1,505
PA 1 South	21,270	24,411
PA 2	6,369	5,751
Total	**28,605**	**31,667**

Encl 5

Kent County	New	Old
PA 1 NW	57,759	70,627
PA 1 NE	6,423	
PA 1 S	20,981	20,827
PA 2	47,990	53,655
Total	**133,153**	**145,109**

Harford, Baltimore, Cecil County	New Selection w/in PA (Harford Co only)	New PA (Harford Co only)	Old
PA 1	5993	14522	14522
PA 3	33113	82376	139294
Total	**39106**	**96898**	**153816**

5. The point of contact for this action is Mr. Todd Beser, at (410) 436-0721, or by email: todd.m.beser.civ@mail.mil.

JAMES E. DAVIS
COL, FI
Commanding

DEPARTMENT OF THE ARMY
ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
600 ARMY PENTAGON
WASHINGTON, DC 20310-0600

DAIM-ZA

MAY 1 2012

MEMORANDUM FOR

COMMANDER, U.S. ARMY GARRISON ABERDEEN PROVING GROUND (IMAP-PWE) 305 ABERDEEN BOULEVARD, ABERDEEN PROVING GROUND, MD 21005-5001
COMMANDER, U.S. ARMY ENVIRONMENTAL COMMAND (IMAE-QP), 2450 CONNELL ROAD BLDG 2264, FORT SAM HOUSTON, TX 78234-7664

SUBJECT: Approval – U.S. Army Garrison Aberdeen Proving Ground, MD, Army Compatible Use Buffer (ACUB)

1. References:

a. Memorandum, OACSIM (DAIM-ISE), 24 Feb 12, subject: Interim Army Implementation Guidance for Encroachment Authorities.

b. U.S. Army Garrison Aberdeen Proving Ground, Army Compatible Use Buffer Proposal 02 Feb 12.

c. Memorandum, OACSIM (DAIM-ISE), 20 Apr 12, subject: Recommendation Army Compatible Use Buffer (ACUB) at U.S. Army Garrison Aberdeen Proving Ground, MD – ACTION MEMORANDUM.

2. In accordance with procedures outlined in reference 1a and in response to reference 1b, Headquarters, Department of the Army (HQDA) staff reviewed and recommended approval of the proposal to establish an ACUB at U.S. Army Garrison Aberdeen Proving Ground, MD.

3. The installation's proposal to enter into a cooperative agreement with the Harford Land Trust, The Conservation Fund, and Eastern Shore Land Conservancy meets the intent of Congress to sustain the training capabilities of our installations while maintaining sound environmental stewardship principles. The U.S. Army Garrison Aberdeen Proving Ground ACUB proposal meets all the requirements and is hereby approved with the following requirements.

a. ACUB easements shall be perpetual.

b. Variations from the approved plan shall be submitted to HQDA for consideration prior to the commitment of financial resources.

c. HQDA requires annual updates and biennial reviews of the ACUB.

4. Point of contact for this matter is Mr. John Housein, HQDA ACUB Program Coordinator, 571-256-9731, email: john.housein@us.army.mil.

Michael Ferriter

MICHAEL FERRITER
Lieutenant General, GS
Assistant Chief of Staff
for Installation Management

CF:
IMCOM G-4
IMCOM G-7

Aberdeen Proving Ground Army Compatible Use Buffer Program

“CHESAPEAKE BAY-CUB”

3/18/2011
U.S. Army Aberdeen Proving Ground
U.S. Army Aberdeen Test Center

Prepared By	Prepared By
David Goad Environmental Division US Army Aberdeen Test Center	Todd M. Beser Todd Beser Environmental Division Directorate of Public Works US Army Garrison Aberdeen Proving Ground
Approved By	**Legally Sufficient**
Joseph Kaffl Installation OPSEC Officer U.S. Army Garrison Aberdeen Proving Ground	Joseph M. Masterson LTC, JA Staff Judge Advocate U.S. Army Garrison Aberdeen Proving Ground
Approved By	**Approved By**
22 Sep 2011 Jeffrey P. Holt Date Colonel, IN Commanding U.S. Army Aberdeen Test Center	Orlando W. Ortiz 22 Sep 11 Orlando W. Ortiz Date Colonel, MI Deputy Installation Commander U.S. Army Garrison Aberdeen Proving Ground

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EXECUTIVE SUMMARY

Aberdeen Proving Ground (APG) is seeking Headquarters, Department of the Army (HQDA) consideration for multi-year funding to develop Army Compatible Use Buffers (ACUBs) within the off-post noise envelope and bald eagle habitat range. ACUB will be an integral tool for APG to meet the demands of 2005 Base Realignment and Closure (BRAC) growth and a continuous increase in OPTEMPO testing due to the ongoing Overseas Contingency Operation (OCO).

APG currently has testing and training restrictions due to internal and external encroachment issues, including operational noise, protected species (bald eagle), protected lands (wetlands and critical area), and urban development. A comprehensive ACUB program will protect APG's vital military mission, and help conserve valuable habitat and protected lands in the Chesapeake Bay watershed - a national treasure. The APG ACUB program will also support the Department of Defense (DoD) in meeting the requirements of Executive Order 13508: Chesapeake Bay Protection and Restoration.

The APG ACUB program will support the military mission at APG by providing the following benefits.

1. Maintain the current compatible land uses on the Chesapeake Bay.
2. Meet future TMDL load allocations.
3. Conserve bald eagle habitat to supplement on-post bald eagle preservation.
4. Conserve wetlands or provide off-post mitigation options to alleviate on-post wetland mitigation.
5. Conserve Chesapeake Bay Critical Area or provide off-post mitigation options to alleviate on-post mitigation for consistency with Maryland's enforceable policies.

To achieve the goals of the ACUB program, APG will partner with the Eastern Shore Land Conservancy (ESLC), Harford Land Trust (HLT), and The Conservation Fund (TCF). All easements and fee-simple purchases within this program will require mutual benefit to APG, our land conservation partners, and willing property owners. Priority preservation areas along the northern Chesapeake Bay use the operational noise peak blast contours and bald eagle habitat range to delineate priority areas.

<u>Priority 1:</u> Priority 1 ACUB areas are properties within the 130db noise contour which extends on both the Eastern Shore and Western Shore. Priority 1 also encompasses the perimeter of the APG installation.
<u>Priority 2:</u> Priority 2 ACUB areas are properties between the 130db and 115db contours on the Eastern Shore, as well as areas along the Sassafrass and Elk Rivers that contain bald eagle nest and roost habitat.
<u>Priority 3:</u> Priority 3 ACUB areas are properties between the 130db contour and the perimeter of APG on the Western Shore. These areas are designated as Priority 3 because much of this land has already been developed or preserved.
<u>Priority Caveat:</u> Properties within any priority area that contain large tracts of forest, wetland, critical area, or bald eagle habitat, may be preferred for the potential regulatory relief that they provide.

The priority areas encompass 149,959 acres in Harford, Cecil, Kent, and Baltimore Counties of Maryland. APG and its partners are positioned to move on parcels within priority areas in Fiscal Year 2011; once the program is approved by HQDA. The installation is prepared to work with our partners in any public outreach capacity to increase the opportunity for a successful program. APG's partners have indicated a willingness of land owners within the program scope to enter into easements, and have already identified potential target parcels.

Figure 1 provides an overview of the ACUB program at APG. It summarizes priority areas, noise contours, TMDL segments, bald eagle hot spots, wetlands, and critical area locations.

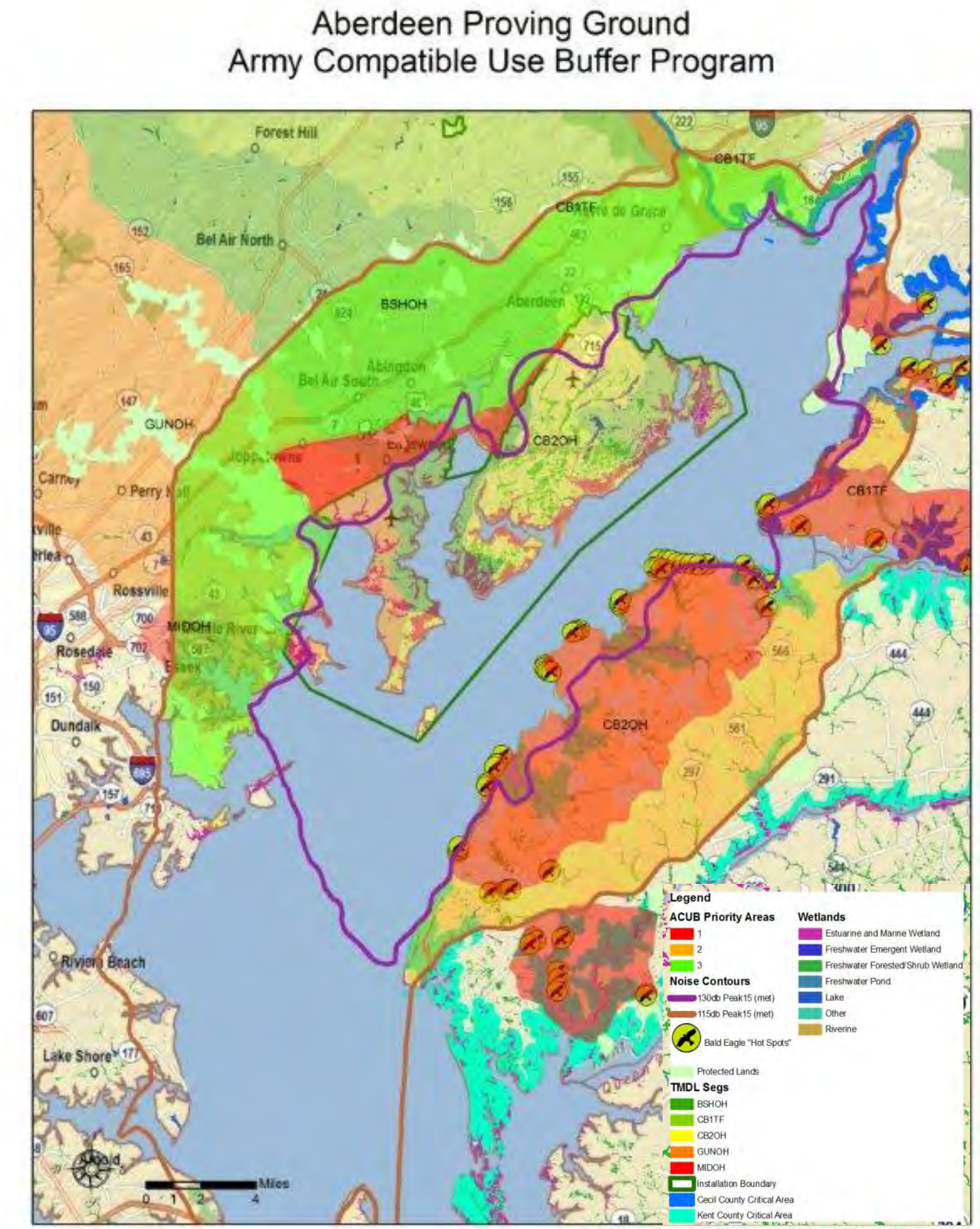

Figure 1. APG ACUB Program Overview

1.0 INTRODUCTION

Aberdeen Proving Ground (APG) faces tremendous growth as a result of Base Realignment and Closure (BRAC) 2005 and a continuous increase in OPTEMPO testing due to the ongoing Overseas Contingency Operation (OCO). To meet this increase in testing and training demands, APG is seeking Headquarters, Department of the Army (HQDA) consideration for multi-year funding to develop Army Compatible Use Buffers (ACUBs) within the off-post noise envelope and bald eagle habitat range.

Providing Soldiers, Sailors, Airmen and Marines with safe, effective, and superior equipment is extremely important, especially in the current OCO environment. Equipment testing and providing real time, high-quality, world-class data to decision makers is more important than ever. APG currently must comply with testing and training restrictions due to internal and external encroachment issues, including operational noise, protected species (bald eagle), protected lands (wetlands and critical area), and urban development. The allure of waterfront living threatens the installation's testing and training ranges. Left unchecked, this growth will ultimately result in the degradation of military capabilities.

A comprehensive ACUB program will protect APG's vital military mission. It will also help conserve the Chesapeake Bay - a national treasure and the largest estuary in the United States. The Chesapeake Bay is critical to the military's ability to test and train on a real, joint, land-water-airspace platform at APG. There is no other installation on the East Coast that provides the complete land-water-airspace profile adjacent to an active firing range. This capability provides an opportunity for joint Warfighters to "train as they fight" and is used by the Department of Army, Department of Navy, and the US Coast Guard.

Operational noise generated from the test and training mission at APG is often heard by residents on the Chesapeake Bay. An ACUB program at APG would limit development on the installation's boundary along the Chesapeake Bay, thereby limiting the number of future noise receptors. It will also protect fragile ecological systems, natural habitats, and agricultural land that are dependent on the bay for survival. The Chesapeake Bay is a critical resource for commercial and recreational activities; however it has been stressed in recent years by an increasing population; delegating APG one of the last bastions for natural resource protection on the bay landscape. APG plays a critical role in the protection of the bald eagle and habitats including wetlands, forest, and coastal zone buffers. Mission requirements often call for development on or near regulated land which may also result in impacts to bald eagle nest buffers or forest removal. Mitigating these impacts is critical to the health of the Chesapeake Bay; however, identifying land on the installation to protect for mitigation is becoming increasingly more difficult. The potential to utilize off-post lands for APG mitigation sites and bald eagle habitat would be a significant benefit to APG's mission to support the Warfighter.

Using ACUB land for environmental mitigation would allow APG to maintain the use of vital Research, Development, Test and Evaluation (RDT&E) areas while also providing greater protection and preservation throughout the Chesapeake Bay. Additionally, with Total Maximum Daily Load (TMDL) requirements in development, the ACUB program can be used to meet those pending requirements through land conservation in the TMDL segment sheds.

1.1 Test and Training Background

1.1.1 General Description of the Installation and Testing/Training Mission

The mission of Garrison Aberdeen Proving Ground is "to provide the highest quality installation management, operation and support services in a timely manner through the full involvement and commitment of our people."[1]

APG, the Army's oldest active Proving Ground, was established on October 20, 1917, six months after the United States entered World War I. The intent was to provide the military with a facility where design and testing of ordnance material could be carried out in close proximity to the nation's industrial and shipping centers. Since its inception countless Army systems have been tested at APG: from the French 75MM to the Atomic Cannon; the Christy, Sherman, Patton, Sheridan, and Abrams Tanks. These systems were proven at APG, serving our soldiers in WWI, WWII, Korea, Vietnam, Desert Storm, and most recently Operations Enduring Freedom and Iraqi Freedom.

APG occupies more than 72,500 acres of land and water in Harford and Baltimore Counties, Maryland (see Figure 2). The installation comprises two principal areas which are separated by the Bush River. The northern area is known as the Aberdeen Area and the southern area is known as the Edgewood Area. APG's northernmost point is marked by the confluence of the Susquehanna River and the Chesapeake Bay. To the south the principal area is bordered by the Gunpowder River. APG property not attached to the principal area of the installation includes the Churchville Test Area (CTA) and Pooles Island in Harford County and Carroll Island and Graces Quarters in Baltimore County. Approximately 144 miles of shoreline fall within the installation boundaries.

APG supports 79 Garrison Supported Organizations (GSOs)[2] and a host of satellite activities. Among the major tenants are the U.S. Army Research, Development and Engineering (RDECOM), US Army Research Laboratory (ARL), Edgewood Chemical Biological Center (ECBC), U.S. Army Developmental Test Command (DTC), U.S. Army Aberdeen Test Center (ATC), U.S. Army Public Health Command (PHC), Northeast Region Civilian Personnel Operations Center (NECPOC), U.S. Army Medical Research Institute of Chemical Defense (MRICD), Program Manager for Chemical Demilitarization and 20th Support Command. The BRAC 2005 decision has brought the US Army Communications Electronics Command (CECOM), US Army Test and Evaluation Command (ATEC), Communications-Electronics Research, Development and Engineering Command (CERDEC), Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD), and numerous other support organizations to APG.

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[1] Garrison Aberdeen Proving Ground website, http://www.apg.army.mil/apghome/sites/local/index.cfm , 29 Jun 10.

[2] Garrison Aberdeen Proving Ground website, http://www.apg.army.mil/apghome/sites/tenants/tenants.cfm, 29 Jun 10.

Aberdeen Proving Ground
General Installation Map

Figure 2. Map of Aberdeen Proving Ground

BRAC 2005 has defined APG as a critical RDT&E center of excellence for the US Army. As a major hub for Army material testing and laboratory research, the post is a key element in the nation's defense. All tracked and wheeled vehicles which have served the U.S. Forces for the past 60 years have been tested for performance and durability at APG.

APG's Edgewood Area (APGEA) has served as a center for chemical warfare research and development since it was established. From the trenches of France and Belgium in World War I to the desert battlefields of Iraq nearly 80 years later, the research and testing done at APGEA has contributed to the defense and safety of American forces threatened by chemical weapons.

1.1.1.1 Aberdeen Test Center

As one of APG's largest GSOs and a Major Range and Test Facility Base (MRTFB), Aberdeen Test Center (ATC) operates under the guidance of the Department of Defense (DoD) Directive 3200.11 and is considered a national asset. The mission of ATC is "to provide test and test support services for authorized customers, within DoD and outside DoD, including government and non-government organizations, domestic and foreign. Provide comprehensive test and training both real and simulated; provide expert knowledge and technical services including instrumentation application, facility operations, manufacturing and fabrication; exploit emerging technologies; and develop leading edge instrumentation and test methodologies."[3] ATC is DoD's lead test center for manned and unmanned ground vehicles, direct fire, and live-fire vulnerability testing. Major missions at ATC include automotive testing of wheeled and tracked vehicles, firepower, survivability/lethality, Warfighter testing of soldier systems and support equipment, military environmental technologies and maritime systems.

ATC has developed into the most diverse, rigorous test center in DoD, testing a broad spectrum of military weapons systems and equipment including armored vehicles, guns, ammunition, trucks, bridges, generators, night vision devices, individual equipment (boots, uniforms, helmets, etc) and surface and underwater naval systems. As a multi-purpose proving ground, with a temperate climate, ATC's primary mission is to plan, conduct, analyze and report on projects supporting all phases of weapons development and acquisition including surveillance and operational tests for DoD and other government agencies, foreign governments, as well as the private sector.

In this single location, ATC can subject an item to a full range of tests from automotive endurance and full weapons performance with environmental extremes, to full-scale live fire vulnerability/survivability/ lethality testing utilizing an extensive array of test ranges/facilities, simulators and models. In addition to testing domestic systems, ATC exploits foreign systems. This one-stop testing capability effectively and efficiently meets the overarching need of the DoD acquisition community. Test Center professionals also develop state-of-the-art test procedures, methodologies and instrumentation to meet the test requirements of advancing military technologies. Structurally, ATC is aligned to facilitate integrated systems test and analysis. ATC's automotive test courses at Munson, Perryman and Churchville stress vehicle systems agility, mobility, and reliability at wartime levels; and nations throughout the world attempt to copy their capabilities.

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[3] US Army Aberdeen Test Center website, http://www.atc.army.mil/mission.htm, 29 Jun 10.

ATC provides world-class, all-purpose testing, to Department of Defense and components, federal, state and local governments, academia, private industry, and allied foreign governments. ATC is the principal range operator at APG supporting numerous Program Managers (PMs) and Program Executive Offices (PEOs) that rely on the test center to provide test and evaluation services throughout the acquisition life cycle.

As a result of BRAC relocations, the mission at ATC is expanding to include more C4ISR missions. Further, ATC conducts the most rapid initiative tests of any developmental test center in the Army which continues to provide an increased workload with high priority and short turnaround times.

From FY05 through FY09, ATC supported almost 7000 (average 1384) tests; issued almost 28,000 (average 5523) firing clearances; averaged 515,925 miles driven; 388,400 miles simulated; 7608 large rounds fired; and 2,535,586 small rounds fired. All of these tests produced an average of 48,532 Test Incident Reports per year from FY05 through FY09 which resulted in safer, more effective items fielded to the nation's military. A Test Incident Report is a document noting shortcomings in a system to meet the Army's needs. Without ATC identifying these shortcomings, military equipment would go to theater and not function properly. The number of Warfighters' lives saved by the early identification of these issues may never be known, but is certainly countless and priceless.

Since the beginning of Rapid Initiative Projects in FY05, ATC has conducted 734 of the 1834 total Rapid Initiative projects for DTC, or 40% of the total number of projects. Rapid initiatives are critical needs identified in theater that must be tested for verification and rapid fielding to the Warfighter to improve the capability in real time. ATC's ability to execute these rapid initiative tests has been critical to the success of the military in all theaters of operation.

1.1.1.2 Army Research Laboratory

The U.S. Army Research Laboratory (ARL) of the U.S. Army Research Development and Engineering Command (RDECOM) is the Army's corporate, or central, laboratory. Its diverse assortment of unique facilities and dedicated workforce of government and private sector partners make up the largest source of world-class integrated research and analysis in the Army. The mission of ARL is to "Provide the underpinning science, technology, and analysis that enable full-spectrum operations." ARL accomplishes this mission through comprehensive experimentation that includes the exploitation of chemical energy munitions and ballistic firing of kinetic energy weapons at 13 outdoor range facilities and 8 indoor range facilities. With 11 of the 13 outdoor facilities located on Spesutie Island, and the proximity of Spesutie Island to the Chesapeake Bay and Eastern shore, the capabilities of these facilities continue to be reduced due to noise and land restrictions. ARL provides vital time sensitive research towards IED (Improvised Explosive Device) threat mitigation, insensitive munitions research, and vehicle survivability and lethality. The NEW (Net Explosives Weight) capabilities for our facilities have been reduced by 30% (average) in an effort to reduce noise and the subsequent number of noise complaints generated over the past several years.

The diversity of the challenges encountered in the OCO demand flexibility and timeliness with research and validation through range experimentation. The current process for approving new facilities, firing sites, and structures to meet this challenge and deliver life saving materials and equipment to the battlefield has become extremely cumbersome and time consuming. ARL has overburdened its two facilities that are located interior and not as affected by noise and land restrictions. These two interior facilities are able to provide a greater NEW capability. As the experimentation schedules of those two facilities reaches its maximum and the noise restrictions increase on Spesutie Island, ARL will be forced to further postpone or delay critical experimentation.

1.1.2 General Description of the Testing and Training Infrastructure

APG operates on more than 72,500 acres which includes 66,000 acres of range areas. APG owns 144 miles of Chesapeake Bay and tributary shoreline, including 60 miles adjacent to live ranges with a Military Operations on Urban Terrain (MOUT) facility. Adjacent water bodies, including the Chesapeake Bay, Bush River, and Gunpowder River, contain water depths of 2 to 14 feet. APG is located in a temperate climate zone which replicates approximately 80% of the world's climate. APG holds unlimited restricted airspace as well as an airfield with landing capabilities for any military transport aircraft.

ATC maintains a real time meteorology capability; traditional laboratories with advanced tools; open air ranges with modular instrumentation suites; fabrication facilities and professional craftsman shops; domestic and foreign land/sea-based targets and threats; and isolated/secure/hardened surface and sub-surface opportunities.

1.2 Ecological Background

Realistic training and testing opportunities require quality natural resources. The framework of natural resources on APG provides the DoD with a variety of quality training and testing scenarios. Open, undeveloped shorelines are used for live fire training by all branches of the military and Coast Guard. Forest cover is used as a natural barrier to wind effects on test scenarios, while forest clearings are used as firing ranges. The diverse land coverage is vital for use in land navigation testing and training. The preservation of the natural environment is vital to the Army's ability to test and train as they fight – in real world environments. Since APG replicates approximately 80% of the world's environment protection of the mission at APG is inextricably linked to preservation of its natural environment.

There are numerous positive effects of the military mission on natural resources. First, the presence of APG continues to preserve native ecosystems by preventing widespread development and ensuring that land uses are conducted in a manner that protects the environment. Second, the presence of a dedicated staff of Army civilians ensures professional natural resources management and stewardship of these public lands.

APG is located on the Upper Western Shore, in the lower salinity region where the Susquehanna River empties into the Chesapeake Bay. APG supports ecologically diverse habitats and species, including:

- Prime bald eagle habitat supporting over 40 nesting pairs, 5 primary roosting areas, numerous secondary roosting areas, and foraging areas.
- Large populations of white tail deer and wild turkeys
- Miles of anadromous fish habitat and large populations of commercial and recreational fish
- Blue Crabs
- High quality estuarine/palustrine/shrub-scrub wetlands
- Dense diverse beds of Submerged Aquatic Vegetation (SAV)

- Rare plant species such as iris prismatica
- Large, high quality, contiguous forest tracts supporting forest interior dwelling species
- Miles of riparian buffers

Oftentimes State and Federal regulations concerning the protection of these natural resources overlap and sometimes contradict, causing confusion among range managers, test directors and project managers. Additionally, the population of the Bay's watershed is approaching 17 million people, increasing the pressures to develop shorefront properties. The open water of the Chesapeake Bay obviously prevents encroachment to APG's eastern boundary line, but it does not prevent noise, smoke, dust, and frequency interactions with the Eastern Shore of Maryland. Protecting land on the Eastern Shore from residential and commercial development would aid APG in minimizing restrictions on testing and training due to noise impacts. Further, APG's ability to use this ACUB for environmental mitigation would help streamline compliance with numerous regulatory agencies.

In addition to current environmental regulations, Total Maximum Daily Loads (TMDLs) for Nitrogen, Phosphorus and Sediment will soon be enforced on the Chesapeake Bay watershed. TMDLs are designed to reduce the amount of pollutants reaching the Bay by placing load allocations on all parties involved in different segments of the Bay watershed. APG falls into five of these segments and sits at the mouth of the Susquehanna River, which delivers 50% of the freshwater to the Chesapeake Bay. The need for a watershed-wide reduction in these three pollutants comes from the current degraded state of the Chesapeake Bay.

The eutrophication of the Chesapeake is directly related to the loss of forest cover and the increase in impervious surfaces in the watershed. The Chesapeake Bay currently experiences vast areas devoid of oxygen during the summer. Nitrogen, phosphorous, and sediment pollution are a main cause of the "Dead Zone". Excess nitrogen and phosphorous fuel algae blooms which block sunlight and consume available oxygen in the water column during the decomposition process. Sediments cover and kill submerged aquatic vegetation (SAV) and scatter sunlight before it reaches the plants. Lack of SAV reduces dissolved oxygen to the local water column increasing the anoxic area, thus compromising the entire ecosystem. Direct relationships exist between the amount of development in a watershed and the amount of pollution in the receiving waters. Conserving open, forested, and agricultural lands and preventing development in the watershed will prevent the pollutant load from increasing.

Each year "Ecocheck" produces a "Chesapeake Bay Report Card", in which the Upper Western Shore watershed was the highest rated from 2007-2009 with a "B" rating. 2010 saw the Upper Western Shore's grade slip to a "C". This report card encompasses a wide range of water quality and biotic factors in order to calculate an overall "Bay Health Index". The mostly undeveloped nature of APG is a significant factor in this repeated high rating. Continuing to address environmental concerns while limiting development will help keep our high grades. Furthermore, conserving land on the Eastern Shore will help protect the APG testing mission and aid in improving the health of the Eastern Shore watersheds.

1.2.1 Bald Eagles

Although no longer considered "endangered", the bald eagle remains federally protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. The geographic location and environmental conditions of APG has made the installation a disproportionately important area for bald eagle population recovery and maintenance on the East Coast. APG's largely undeveloped forested shorelines along the Chesapeake Bay serve as optimal habitats for nesting, foraging, and roosting bald eagles. APG supports the highest density of bald eagles in the Chesapeake Bay region and one of the largest bald eagle nesting populations in the continental United States. Currently, over 60 nesting sites are tracked and monitored on APG. Though the nesting population is fluid, Figure 3 is an illustration of bald eagle nesting and roosting sites at APG. In addition to the large nesting population, APG is a convergence area for migratory bald eagles from the northeastern United States and Canada and the southeastern United States. The northern migrants arrive in the fall and stay through March, while the southern migrants arrive in the spring and stay through the summer.

APG is currently conducting an intensive 3-year study of the eagle population and its' movements, by placing satellite transmitters on 64 of the eagles. Transmitters on the birds have shown that APG supports not only the northern Bay resident eagle population but has an influence on populations as far north as Labrador, Canada and as far south as Florida.

1.2.2 Wetlands

Of APG's 72,500 acres, about half is comprised of open waters including the Chesapeake Bay, Bush River, Gunpowder River, and Romney Creek. The remaining 36,000 acres includes about 13,000 acres of wetlands. Therefore, roughly 68% of APG is a wetland or waterway. Of the 13,000 acres of wetlands throughout APG, there is vast diversity among emergent, forested, and shrub-scrub wetlands. Figure 4 is a depiction of wetlands at APG.

1.2.3 Chesapeake Bay Critical Area

The Maryland Department of Natural Resources Critical Area Commission defines the "Critical Area" as land area within 1000 feet of tidal waters or tidal wetlands. Maintaining this area adjacent to the streams, rivers, and bay, also known as the riparian zone, is essential to healthy water quality in the Chesapeake Bay. Of the roughly 36,000 land acres of APG, 21,402 acres (59%) are within areas that fit this definition of the Chesapeake Bay Critical Area. Figure 5 is an illustration of the lands that fit the definition of the Chesapeake Bay Critical Area at APG.

1.2.4 Total Maximum Daily Loads (TMDLs)

The Chesapeake Bay watershed, TMDL segment sheds have been delineated by the Environmental Protection Agency (EPA). APG is located within five different segment sheds of the bay: Bush River (BSHOH), Northern Chesapeake Bay (CB1TF), Upper Chesapeake Bay (CB2OH), Gunpowder River (GUNOH), and Middle River (MIDOH). Figure 6 shows the TMDL segment sheds for APG and the surrounding areas.

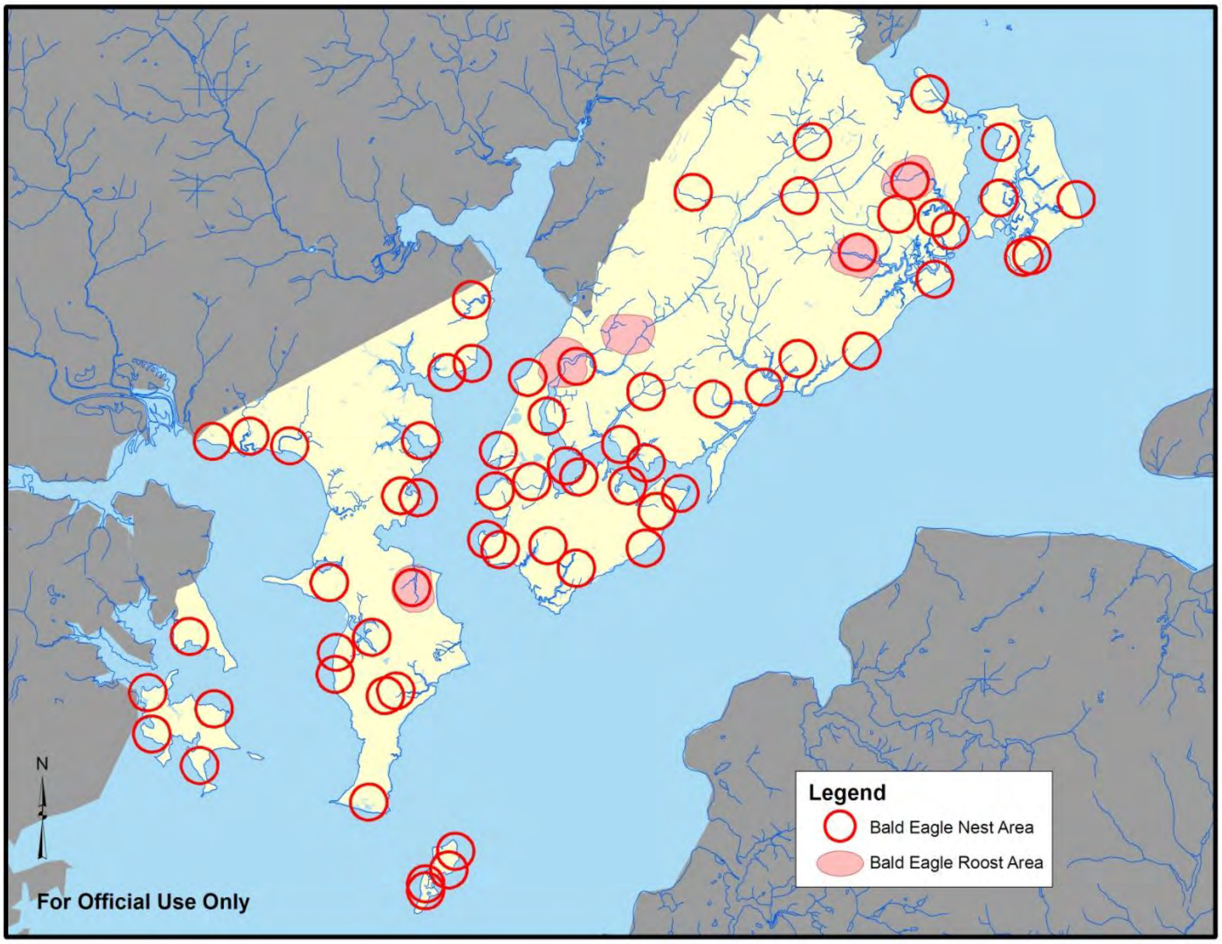

Figure 3. APG Bald Eagle Nests and Roosts

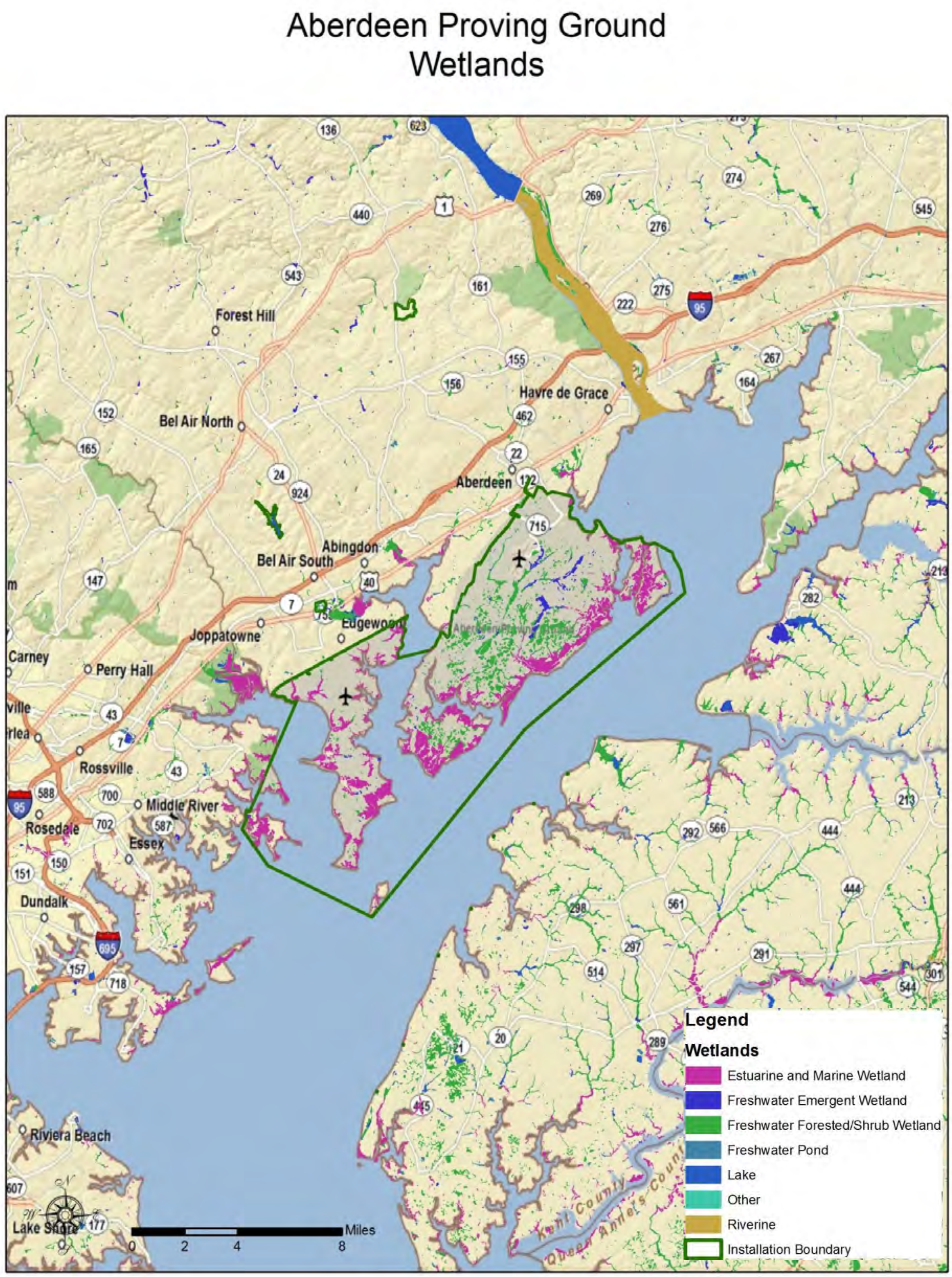

Figure 4. APG Wetlands

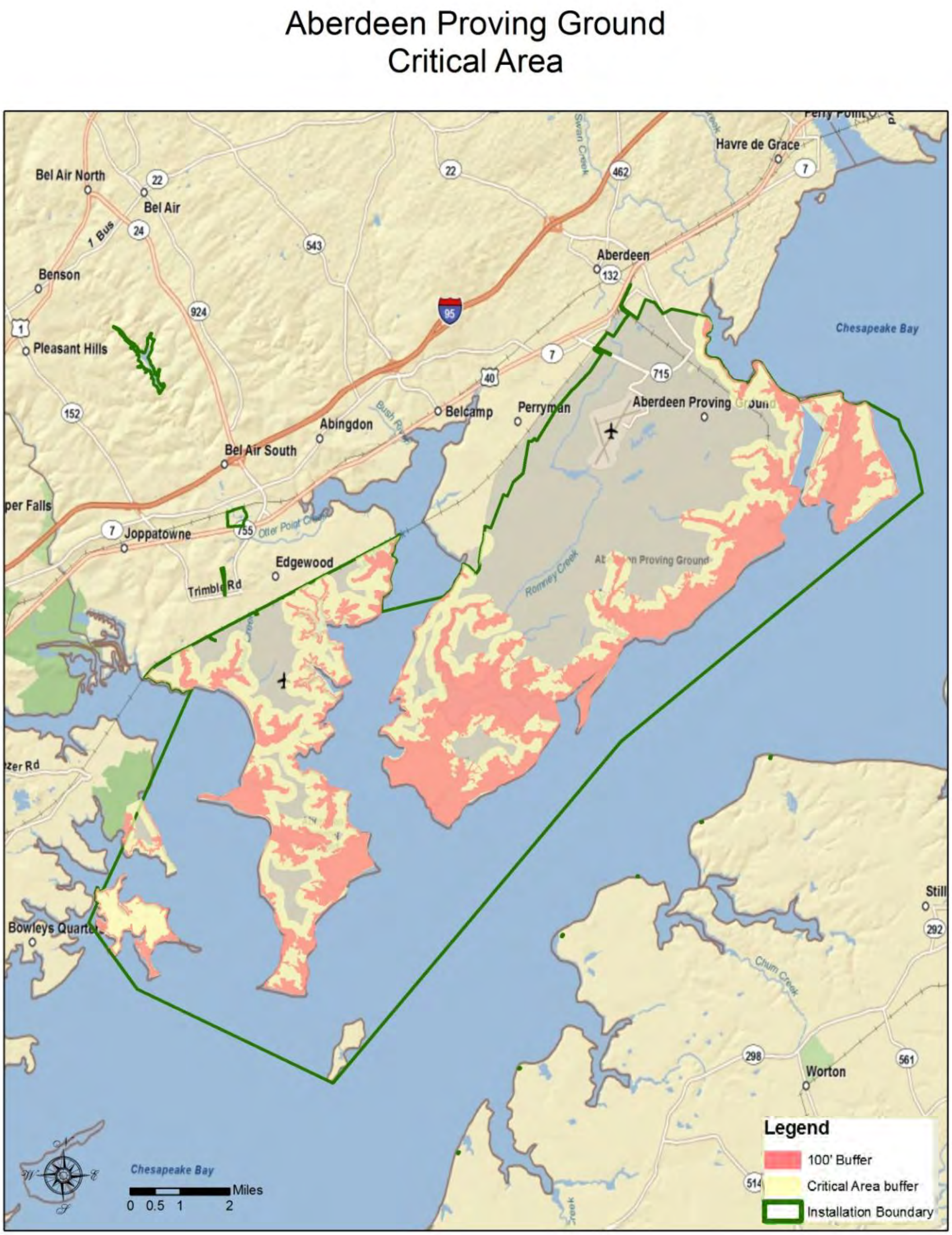

Figure 5. Chesapeake Bay Critical Area on Aberdeen Proving Ground

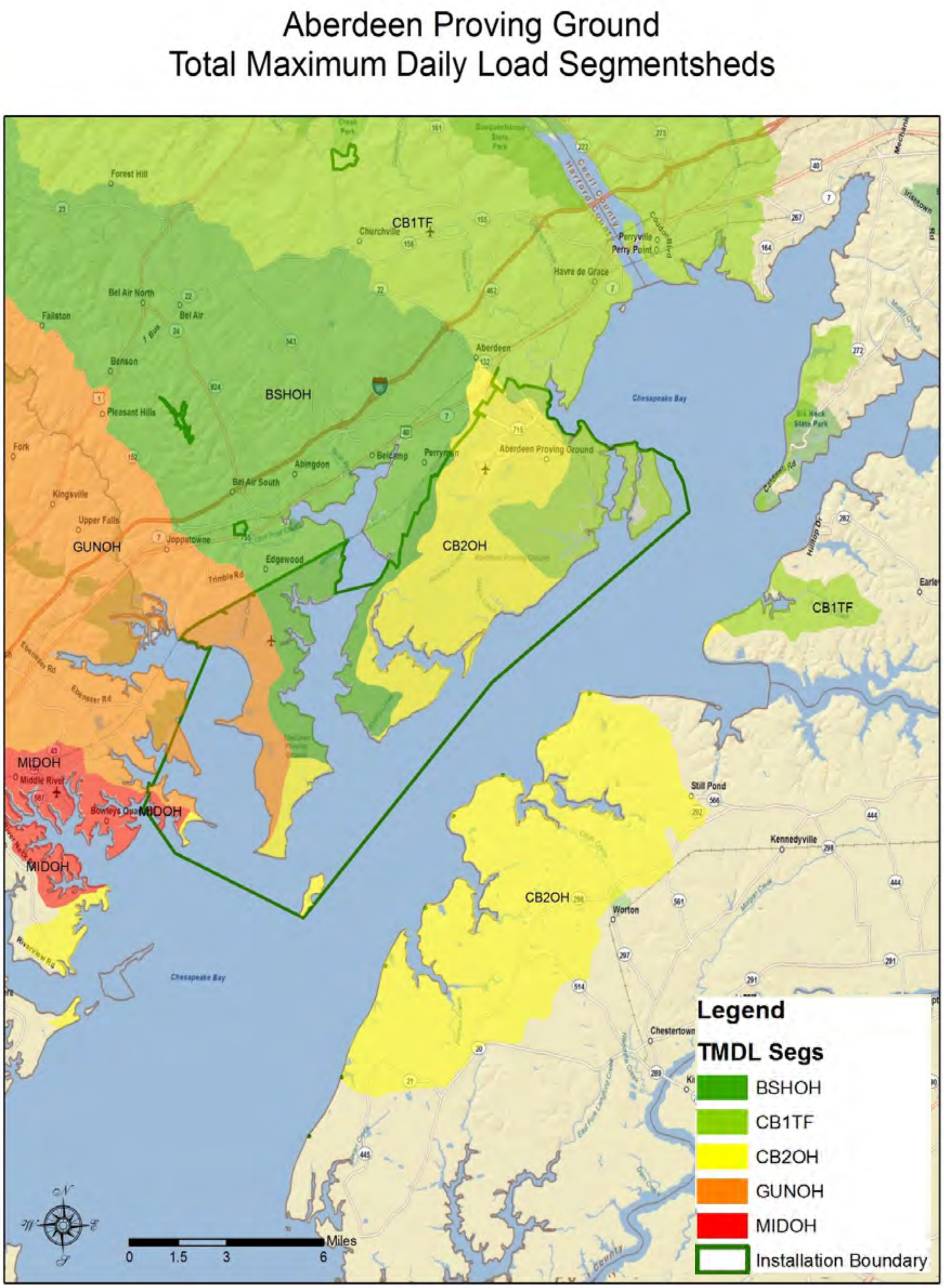

Figure 6. Total Maximum Daily Load (TMDL) Segment Sheds for APG and Surrounding Areas

2.0 DESCRIPTION OF THE PURPOSE AND NEED FOR ACTION

Base Realignment and Closure (BRAC) has transformed APG into the science and technology leader of the Department of the Army. Further, the OCO has increased the amount of items undergoing testing in the acquisition process, and created the Rapid Fielding Initiatives necessary to meet the needs of the Warfighter in real time. The purpose of this ACUB program is to protect the vital Research, Development, Test and Evaluation (RDTE) mission at APG from external encroachment through increased residential development and internal encroachment from regulatory mitigation. Preservation of the military mission at APG is served in multiple ways by this ACUB program:

1. Maintaining the current compatible land uses on the Eastern Shore which limits new noise receptors.
2. Meeting future TMDL load allocations.
3. Conserving bald eagle habitat to supplement on-post bald eagle preservation.
4. Conserving wetlands and/or providing off-post mitigation to alleviate on-post wetland mitigation.
5. Conserving Chesapeake Bay Critical Area and/or providing off-post mitigation to alleviate on-post mitigation for consistency with Maryland's enforceable policies.

<u>Benefit #1: Reducing noise receptors</u>

APG is located in the Boston-Washington megalopolis; a regional land mass that accounts for 22% of the country's metropolitan areas exceeding one million population in 1990; 17% of the entire US population in 1990; and in only 1.5% of the area of the country.[4] Clearly population density is very high in this corridor. Over the last 10 years, the Baltimore metropolitan area has expanded into Harford and Cecil counties. According to census statistics, the populations of Harford County and Cecil County each grew by 20% from 1990-2000. Using the interim census statistics for 2008, population growth in these two counties from 1990-2008 was 32% and 40%, respectively. In addition, the population continues to grow in Baltimore County and Kent County at just under 10% from 1990 to 2000 and about 13% from 1990-2008. The majority of citizens that are subjected to noise generated at APG are in one of these four counties.

According to the Army Alliance, the economic impact of APG after full BRAC implementation will be $2.8 billion in payroll, $15 billion in contracts, and a $6.5 billion total economic activity impact to the region. In addition, thousands of new BRAC employees will be working at APG thus increasing the local county populations.

[4] Birdsall, Stephen S. and John Florin, <u>Megalopolis</u>, http://www.america.gov/st/peopleplace-english/2008/May/20080614181129eaifas0.3639185.html, 01 Jul 2010.

The Eastern Shore has historically been dominated by agricultural lands and large private lots. A change to high density residential or commercial properties in this area would be detrimental to the mission of APG. An illustration of the noise contours associated with mission activities at APG is provided in Figure 7. A change in land use and increase in population would also bring about changes in residents' attitudes towards the mission of APG. New residents would not be accustomed to the impacts of the APG mission and the number of complaints due to operational noise will increase. The ACUB program could help in preventing an increase in the number of noise complaints received from the Eastern Shore by reducing high density developments and an influx of new residents.

With projected growth rates of 80% in Cecil County, 30% in Harford County, and 22% in Kent County from 2000 to 2030,[5] the number of noise complaints would rise significantly if no action is taken. The negative impact could be detrimental to the APG mission if the rate of development continues to increase and no conservation initiatives are undertaken. If the increased development is tailored to retired citizens whom are not working during the day, the number of complaints could increase dramatically, forcing major changes in testing and training schedules. If testing and training faces a large number of restrictions, the entire mission of APG could be jeopardized.

When evaluating the relative merits of investing in an ACUB program at APG, it is important to understand that while the encroachment threats are real and serious, there is still time to mitigate those threats. The next five to ten years have the potential to transform the landscape surrounding APG, but the ACUB program has the potential to ensure that change is compatible with APG's mission and operations. The need for action is imminent.

[5] U.S. Census Bureau, Population Projections, http://www.census.gov/population/www/projections/usinterimproj/

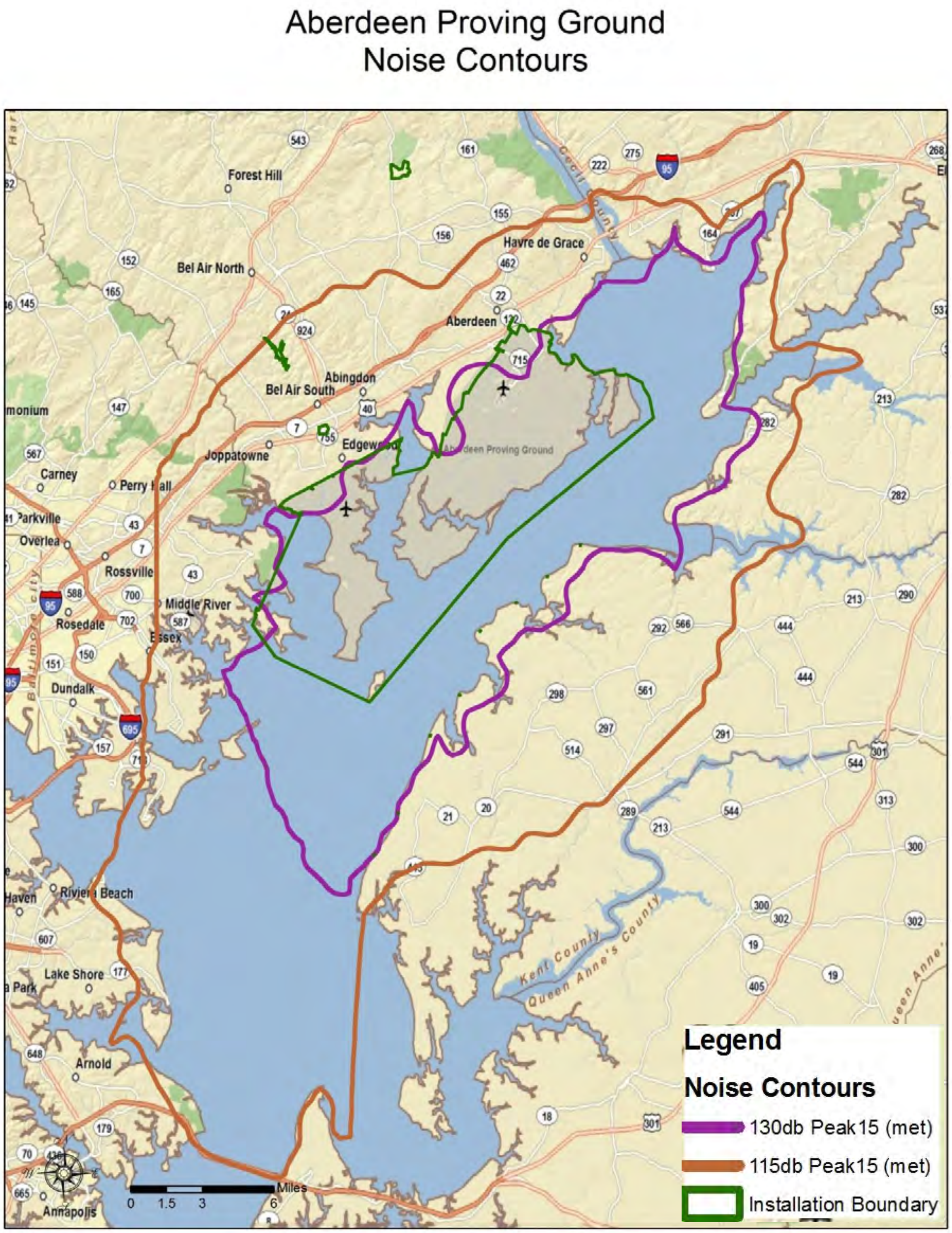

Figure 7. APG Peak Blast Noise Contours (REF. Aberdeen Proving Ground Operational Noise Management Plan, July 2006)

Benefit #2: Total Maximum Daily Load (TMDL)

The Environmental Protection Agency (EPA) is working with States in the Chesapeake Bay watershed to develop TMDLs for various segment sheds. TMDLs are being developed for nitrogen, phosphorous, and sediment. The approval and enforcement process for TMDLs has not yet been finalized.

One proposed method for meeting TMDL allocations is through the use of conservation easements on forested, agricultural, or open space. Since APG shares segment sheds with areas of both the Eastern and Western Shores of the Chesapeake Bay, this ACUB program will provide load allocation benefits through conservation of land in the segment sheds.

Benefit #3: Preserving bald eagle habitat

APG has a Biological Opinion (BO) and Bald Eagle Management Plan that govern protection of bald eagles on post. Since the BO was approved in 2006, eagle management at APG has improved. The BO provides a "take" statement permitting the take of six bald eagles per year and three nests per year incidental to the mission and caused by mid-line strike or electrocution from power lines.

A Conservation Recommendation of the BO states, "The Service recommends the Army to explore the possibility of future off site land preservation through conservation easements on non-federal lands to protect bald eagles on adjacent properties bordering the APG installation."[6] The APG ACUB program will provide a mechanism to achieve the conservation recommendation of the US Fish and Wildlife Service in the BO. The APG ACUB will also potentially provide preserved habitat for bald eagles to nest and roost throughout the northern Chesapeake Bay.

Currently there is a 500 meter buffer zone around all nest and roost sites. The number of nests and roosts at APG has increased from one nest in the 1960s to over 60 active nest sites and five main roost sites in 2010. Further, the College of William and Mary has been conducting a long term study of bald eagles at APG. The study indicates that APG is a premier location for bald eagles on the eastern seaboard. As the population increases, more land will be under nest buffer, meaning that development within nest buffers continues to be more constrained. Preserving bald eagle nest or roost habitat off-post was a recommendation of the BO and can serve to assist in future development and operations within the nest buffers.

APG has witnessed a dramatic increase in the bald eagle nesting population. The number of successful nests has increased from 13 in 2000 to 36 in 2010. Similarly, the number of chicks has increased from 18 in 2000 to 60 in 2010. The average number of chicks per successful nest has climbed from 1.4 in 2000 to 1.7 in 2010. In 2009, the nesting population produced an astounding 2.0 chicks per successful nest. The eagle population continues to thrive at APG.

A telemetry study conducted by the College of William and Mary at APG, as required by the BO, has yielded other bald eagle concentration areas along the northern Chesapeake Bay. These bald eagle "hot

[6] Biological Opinion, APG Bald Eagle Mortality, US Fish and Wildlife Service, Chesapeake Bay Field Office, December 27, 2006.

spots" are utilized by bald eagles that reside or migrate to APG. Figure 8 shows the locations of off-post bald eagle sites within the ACUB area for APG.

US Fish and Wildlife Service (USFWS) is currently considering programmatic permits that would determine a sustainable level of bald eagle nests, roosts, and/or population. Preservation of off-post sites may potentially assist APG when this permit program becomes effective. Preliminary discussions with USFWS representatives indicate a willingness to consider ACUB protected eagle habitat as available habitat for bald eagles utilizing APG. This agreement would need to be finalized, but the possibility exists for this benefit.

<u>Benefit #4: Reducing on-post wetland mitigation</u>

An agreement to use ACUB parcels for off-post mitigation sites needs to be negotiated with individual land owners, regulators, and APG's partners. This benefit is possible, and will be pursued on a case-by-case basis. Based on the assumed buy-in from the landowners and regulators, regulatory relief through off-post mitigation or conservation on ACUB parcels could be used to satisfy wetland requirements for on-post development.

Maryland Department of Environment (MDE) and the US Army Corps of Engineers (USACE) regulate wetland impacts with mitigation requirements. Depending on the type and location of the impacts, mitigation ratios can be as high as 2:1. Since APG is roughly 68% wetlands and waterways, development on the installation can have wetland permit requirements. Wetland mitigation usually includes creation of new wetlands due to the federal policy for "no net loss" of wetlands as started by President George H. Bush in 1988[7]. Requiring wetland creation on-post creates a snowball effect as limited land is developed in wetlands and then wetlands are created in upland areas. With 68% coverage by wetlands and waterways, mitigation creation on-post is extremely challenging. Further, wetland mitigation is required "in perpetuity". Though wetland regulators have agreed that "in perpetuity" is not feasible for APG, there is no precedent for the increased mitigation ratios required to impact previous mitigation areas.

Early discussions with wetlands regulators indicate a willingness to consider ACUB properties as off-post mitigation sites in the future. Preservation of wetlands under the ACUB program can greatly enhance the flexibility of the mission by reducing permit timelines and reducing the cost of mitigation for on-post activities. It will also preserve on-post property for the military mission rather than using it for regulatory mitigation requirements.

[7] National Wetlands Policy Forum. Recommendations. 1988.

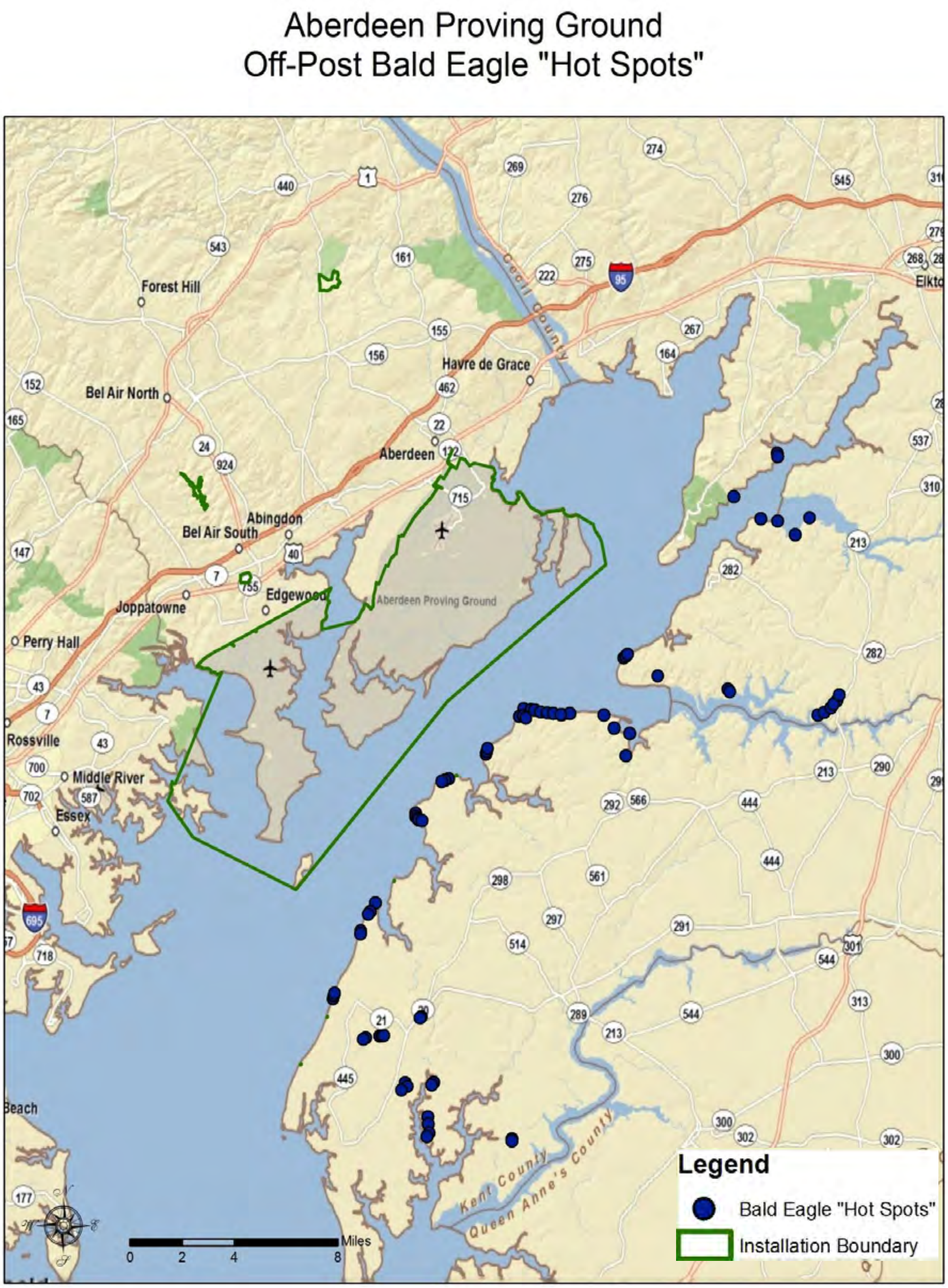

Figure 8. APG Off-Post Bald Eagle Hot Spots

Benefit #5: Reducing on-post mitigation for consistency with Maryland's enforceable policies.

An agreement to use ACUB parcels for off-post mitigation sites needs to be negotiated with individual land owners, regulators, and APG's partners. This benefit is possible, and will be pursued on a case-by-case basis. Based on the assumed buy-in from the landowners and regulators, regulatory relief through off-post mitigation or conservation on ACUB parcels could be used to satisfy coastal zone requirements for on-post development.

Maryland Department of Natural Resources Critical Area Commission (CAC) requires storm water treatment for all new or redevelopment activities as small as 250 square feet in areas within 1000 feet from mean high water., Depending on the type and location of development, if consistency is not achievable though stormwater management, mitigation is required and the ratio can be as high as 3:1. The low minimum requirement means that practically anything built to support the military mission at APG must be fully consistent with the state's enforceable policies including the Critical Area Act. Consistency usually entails stormwater management and/or mitigation for activities that have a reasonable and foreseeable affect on the state's coastal resources. The net result of this requirement is that simple mission requirements, such as small target pads or firing positions, are delayed until the determination is finalized and cost more due to the requirement for stormwater management and/or mitigation. Plus, land that could be used for mission requirements is now required for mitigation. Typically, mitigation requirements are "in perpetuity", and though the CAC is willing to negotiate on that requirement, the negotiated agreement will create a snowball effect for mission development in mitigation areas. Supporting a dynamic military testing environment within the current budget constraints means that this seemingly minor requirement can have major implications. With 59% of the land acreage for the installation categorized as meeting the definition of "Critical Area", finding locations outside these areas for development and inside these areas for mitigation are increasingly more difficult. Figure 9 illustrates Critical Area locations in Cecil and Kent Counties. Early discussions with Critical Area regulators indicate a willingness to consider ACUB properties as compensatory mitigation sites in the future. Preservation of critical area under ACUB can greatly enhance the flexibility of the mission by reducing consistency determination timelines and reducing the cost of treatment and/or mitigation for on-post activities. It will also preserve on post property for the military mission instead of using it for regulatory mitigation requirements.

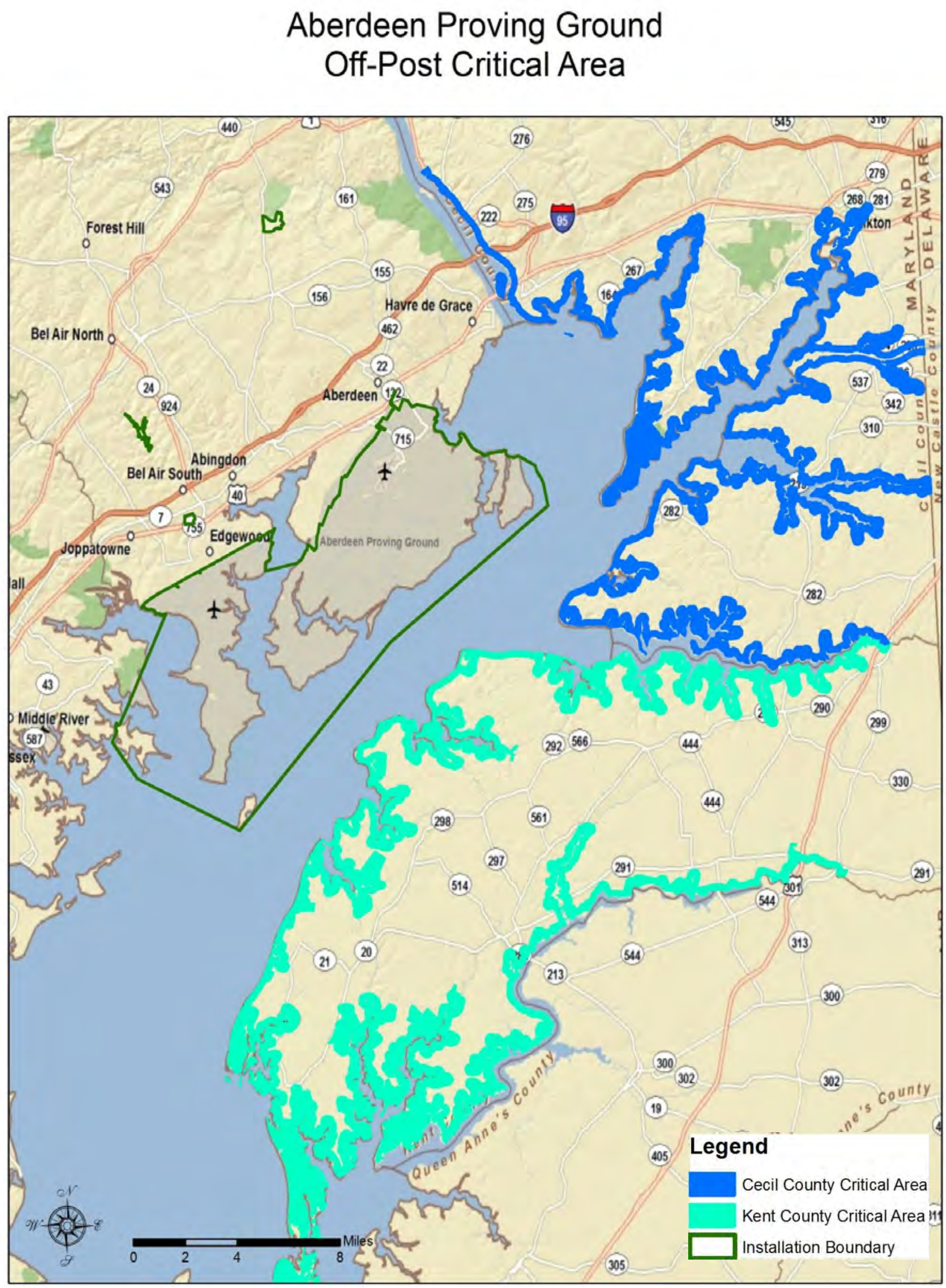

Figure 9. Off-Post Critical Area Locations

2.1 Current Testing and Training Restrictions

2.1.1 Safety and Human Welfare

Operational Noise

Operational noise presents the largest potential for restrictions due to human proximity to APG. Though noise is aggressively managed at APG and workarounds to noise impacts are routinely utilized, there are occasions when mission activities are canceled or delayed due to potential operational noise impacts to the surrounding community.

From 2002 through March 2010, 87 programs have been delayed less than 24 hours due to noise concerns; 25 programs have been delayed more than 24 hours; 5 missions have been modified; and 7 missions have been cancelled. Anecdotally, there have been numerous other programs that delayed for a few hours to accommodate noise concerns without being documented. These delays impact test schedules which ultimately impacts acquisition of critical items for the military.

Operational noise is receptor unique causing different people to receive sounds in different ways. Therefore, it is hard to gauge the reception of APG operational noise to the entire public. APG maintains an operational noise management plan and maintains staff to manage operational noise on a daily basis. Even with the guidelines, daily management, and layered approval authorities, APG still receives complaints from the surrounding communities. From 2002 through 2009, APG received 476 noise complaints.

This ACUB program will limit the development of land at locations where APG operational noise is heard. The benefit of limiting land development in the noise envelope is significant. As stated earlier, limiting the number of people on a parcel of land limits the number of noise receptors and potential noise complainants on that land. Further, conserving land on which a citizen resides that is not sensitive to APG Operational Noise ensures that parcel of land will remain compatible with the APG mission.

2.1.2 Natural Resources

Bald Eagles

APG has a formal Biological Opinion[8], dated 27 DEC 2006 and amended 31 MAY 2007, which outlines a number of reasonable and prudent measures; terms and conditions; and conservation recommendations. The reasonable and prudent measures are:

- APG will reduce mortalities due to mid-line strikes and electrocutions.
- APG will minimize disturbance of active bald eagle nests and roost sites.
- APG will conduct a three year telemetry study.

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[8] United States Department of the Interior, US Fish and Wildlife Service, Chesapeake Bay Field Office, *Biological Opinion, APG bald eagle mortality*, December 27, 2006.

Terms and conditions applicable to this ACUB program include:

- Minimize direct impacts to bald eagles by maintaining a 500 meter protection buffer for known nests and communal roost areas.
- Initiate shoreline training exercises after the morning foraging period, 1000 hrs.
- Maintain a minimum altitude of 1000 feet for all rotary wing aircraft while in transit during shoreline training activities
- Conduct a telemetry study to evaluate the movement and behavioral response of roosting eagles at APG

Conservation recommendations pertinent to this ACUB include:

- The Service recommends the Army to explore the possibility of future off site land conservation to protect bald eagles.
- The Service recognizes the need to protect forested shoreline habitat like those found at APG for sustaining bald eagles within the Chesapeake Bay.
- The Service recommends the Army avoid Romney Creek for shoreline training.

The requirements of the BO have placed restrictions on mission opportunities at APG. Riverine units with the Navy are interested in using Romney Creek as an ideal location to train in a river or creek like setting where shorelines are close on both sides of the river. Romney Creek would provide restricted water and air adjacent to live fire ranges that would provide the most complete training scenario available to these units. ATC has had to turn away opportunities to train these warfighters prior to deployment in this skill as a result of the BO restrictions. These Riverine Units would typically train at ATC 2-3 times per year to meet their mission needs. Since the 2006 BO, ATC anticipates 8-12 total training opportunities have been lost.

Beginning shoreline training activities after 1000 hours has not had a detrimental impact on training activities at APG yet. However, if there is a change in training doctrine that necessitates sunrise settings for training; APG will not be able to accommodate that request under the current terms of the BO.

The requirement to maintain a 500 meter protection buffer around known nest and roost sites is about 25% more strict than other nest buffers throughout the region. In other cases, USFWS has instituted ¼ mile buffers (402 m) throughout the region. However, APG maintains a 500 meter buffer to protect the significant eagle population on post. Though USFWS has worked well with APG in the past, changes in USFWS personnel could result in stricter interpretations of this requirement which could limit the use of the test and training ranges.

At the beginning of the bald eagle nesting season, there can be as many as 60 nest sites that are protected. With a 500 meter buffer around each, that equates to 11,640 acres of APG land that is protected from development and other activities. In addition, there are five recognized roosts that account for an additional 1,250 acres of land. The combined acreage within bald eagle buffer zones equates to 18% of the total installation and about 30% of the land mass. Though workarounds for mission activities are usually found, this protection adds time to obtaining approval for the military mission.

In addition to the Biological Opinion, APG maintains some other unique bald eagle requirements as a result of informal Section 7 consultations with USFWS from 02 October 2003. Requirement for operation at the Mulberry Point Soldier System Test Facilities Outdoor Range was further clarified in a meeting with USFWS on 29 June 2007. Those requirements include no firing activity between the hours of sunrise until 2 hours after sunrise; and no firing during the 90 minutes prior to and including sunset. During the winter months, this requirement reduces the effective time on this range to between 0930 and 1500 hours, providing only 5.5 hours of useful range time.

“Over the Beach” training opportunities have been limited at APG due to a bald eagle nest in proximity to the MOUT site along the shoreline. ATC anticipates at least two units have lost the ability to obtain this training 3-4 times per year because of the requirements to protect the eagles in the area.

Critical Area

All construction projects follow the same general path to obtain environmental approvals. First, National Environmental Policy Act (NEPA) compliance is obtained. Upon verification of NEPA compliance, environmental permitting and approval requirements are met, such as sediment and erosion control, wetlands, forest, eagles, and/or coastal zone consistency. Following permitting, construction can begin. At APG, construction activities are limited by weather with freezing conditions in the winter and rains in the spring and fall. Delays in environmental regulatory compliance can place significant delays on construction as the regulatory delays approach the weather-related deadlines. Since ATC supports the majority of Rapid Initiative test events, development delays can have a significant impact on fielding rapid initiative acquisition items.

Any new or redevelopment project impacting 250 or more square feet of land meeting the definition of “Critical Area” must be fully consistent with the Critical Area Act. Part of the approval process is providing stormwater management or mitigating any impacts to the land within 1000 feet of mean high water. Mitigation ratios can range as high as 3:1. 15 CFR 930 establishes a 60-day response time for state agencies to determine federal consistency. When a Rapid Initiative must be tested in 1-2 days, there is not 60 days to wait for a consistency determination. With so much of APG located within the area that meets the definition of ”Critical Area”, many small projects incur costly delays and mitigation.

The impacts of Critical Area Act requirements on the military mission are multi-fold. First, the delays in obtaining regulatory approval for the impacts delay the ability of the military to adequately test military equipment and train soldiers by impacting test schedules which impacts the time to get the item into theater. Second, stormwater management and/or mitigation for these impacts carry a cost. Although this is considered a cost to the business, it can be greatly reduced by proactively protecting critical area around the Chesapeake Bay so that mitigation requirements are mostly completed. This reduced cost will allow APG to better fund mission requirements. Third, mitigation encumbers testing and training lands. APG has about 36,000 acres of land available for the critical research, development, test and evaluation mission that takes place. Every acre of land that is encumbered by mitigation is an acre of land that cannot be used to test and train our Warfighters. Through land management APG has been successful in locating compatible on post land for mitigation, the time will come when land becomes a scarce commodity. This ACUB effort will alleviate the internal encroachment from mitigation and allow the Warfighters the ability to train as they fight and test military equipment to the standards the DoD mission requires.

Wetlands

Wetlands cover approximately 13,000 acres of APG, or about 36% of the entire land mass. Any impact to wetlands requires a permit by either the Maryland Department of Environment (MDE) and/or the US Army Corps of Engineers (USACE). The permit application costs $7500 per acre of impact and can take up to one year to obtain. In addition, mitigation for wetland impacts is required at ratios ranging from 1:1 to 2:1, depending on wetland type.

The construction timeline discussed in the Critical Area section above also pertains to wetlands. The impacts of wetlands requirements on the military mission are multi-fold. First, the delays in obtaining regulatory approval for the impacts delay the ability of the military to adequately test military equipment and train soldiers. Delays can impact test schedules, which impacts the time it takes to get the item into theater. Second, mitigation for these impacts carries a cost. Although this is considered a cost to the business, it can be greatly reduced by protecting wetlands around the Chesapeake Bay so that mitigation requirements are mostly completed. This reduced cost will allow APG to better fund mission requirements. Third, mitigation takes up precious land mass. APG has about 36,000 acres of land available for the critical research, development, test and evaluation mission that takes place on the installation. Every acre of land that is dedicated to environmental mitigation is an acre of land that cannot be used to test and train our military. Though land managers at APG have been successful in locating compatible on post land for mitigation thus far, the time will come when land becomes a scarce commodity. This ACUB effort will alleviate further internal mitigation encroachment and thus free more space to conduct the critical DoD mission at APG.

2.2 Anticipated Training and Testing Restrictions

Since FY05, ATC has conducted 734 projects or 40% of the total Rapid Fielding Initiative (RFI)/Rapid Equipping Force (REF) testing in the Department of the Army. RFI and REF are programs designed to get crucial assets into theater as quickly as possible. ATC has deployed individuals into the theater of operations to interface with troops and accelerate the process of testing RFI/REF items to ensure a safe, reliable asset is returned to theater. This vital process saves lives every day in the theaters in which the US operates. In order to provide testing for the RFI and REF projects, APG must be postured to set up, execute, and report results of tests on a moment’s notice. This capability requires maximum flexibility both in range scheduling and in environmental compliance. An ACUB program at APG would provide a proactive measure to allow those crucial test events to occur with minimal off post impacts and without the delay in meeting regulatory requirements.

Rapid acquisition initiatives will continue into the foreseeable future as a mechanism to get troops the equipment they need when they need it. Due to the unpredictable, dynamic environment of rapid fielding projects, quantifying anticipated restrictions is difficult. However, the nature of these projects relies on flexibility to execute the project and in that sense, operational noise impacts and regulatory restrictions have the potential to negatively impact rapid initiatives.

The mission of the Phillips Army Airfield (PAAF) could significantly change, as the airfield is turned over from ATC to APG. An increase in use of the airfield for fixed and rotary wing aircraft could increase off post noise impacts. Aircraft noise impacts are a known issue throughout DoD and several installations have used compatible use buffer programs to address this issue. The specific areas of impact are unknown at this time but most likely will be captured by the current noise envelope. If significant impact zones are identified at a later date the ACUB priority areas will be modified.

2.2.1 Safety and Human Welfare

Neighbors directly bordering APG are mostly buffered from the range areas by the cantonment areas of the Aberdeen and Edgewood portions of the installation. Most of the adjacent land areas have already been developed around APG. However, land that is connected to APG through the operational noise envelope, bald eagle flyways, TMDL segment sheds and other means, is still largely undeveloped. Vast tracts of undeveloped land exist on Maryland's Eastern Shore within the noise contours of the APG mission. Future development of those tracts would introduce innumerably more receptors to operational noise from APG. The possibility for future development is high as this land is close to the Chesapeake Bay which can be an attractive lifestyle choice for baby boomers entering retirement. Likewise, the influx of personnel as a result of BRAC will continue to put development pressure on the surrounding communities to house and service the additional people working on post.

2.2.2 Natural Resources

<u>Bald Eagles</u>

APG has made great strides in managing the bald eagle population on post. The number of bald eagles using APG as either a residential or migratory location continues to increase. However, based on conversations with the College of William and Mary and US Fish and Wildlife Service, APG is probably still not at the carrying capacity for bald eagles. The eagles continue to show remarkable resilience to their surroundings in that they nest in closer proximity to each other and to human activities than ever before and on man-made structures which had previously never been done. Given that the number of eagles is likely to continue to increase, the amount of acreage that is managed for them also will increase thereby continuing to strain the development capabilities to meet future testing needs. In addition, development in the surrounding counties will continue to force eagles and other wildlife onto APG. Furthermore, USFWS is developing protection protocols for bald eagle roost sites which could expand the number of roosts protected at APG.

<u>Critical Area</u>

The Coastal Zone Management Act requires that activities undertaken on APG be consistent with Maryland's Coastal Management Program. Compliance with this program usually consists of storm water best management practices and/or compensatory tree plantings to treat or mitigate development impacts associated with construction projects. Mitigation sites have been historically located on undevelopable plots in the cantonment area or in restricted zones in the range areas. These types of plots maintain compliance with Maryland's Coastal Management Program, but may not serve in the best interest of APG's natural resources. As these types of plots become scarcer and the pace of construction continues, mitigation locations will encroach on active testing and training ranges, thus reducing the amount of available land. Also, there is a fixed amount of acreage in areas meeting the definition of "Critical Area". As development is approved in the areas meeting the definition of "Critical Area" and on-post mitigation is undertaken, there will come a time when there is no more acreage in the areas meeting the definition of "Critical Area" to complete the military mission at APG.

One of the goals of APG's ACUB program is to work with local non-profit conservation partners to secure lands outside the installation that are suitable for the construction of compensatory Coastal Management Program mitigation sites. It is expected that this approach would not only alleviate the loss of testing and training land, but also lower the overall cost to the Army due to reduced construction costs. The cost savings could vary depending on the size and complexity of the mitigation project, but large fiscal savings are expected as well as ending the process of encumbering additional range lands with on-post mitigation. Another benefit of off-post mitigation sites is that they allow APG and our partners to improve the conditions of Critical Area throughout the northern Chesapeake Bay watersheds, thus improving the overall health of the Chesapeake Bay.

It is possible that the buffers will be extended in the future. There is also discussion among the regulators about increasing the mitigation ratios required for critical area impacts. Either of these actions would have an impact on mission activities at APG.

<u>Wetlands</u>

The Clean Water Act, Section 404, requires that a permit be obtained for any activity that may affect "waters of the United States, including wetlands." Permits are obtained based on individual projects on APG, with consideration of wetland types, areas and jurisdictional status. Typically the creation of compensatory wetlands to mitigate wetland impacts associated with the construction project is required. Considering the abundance of wetlands on APG it is nearly impossible to undertake a major construction project without causing an impact. Currently, compliance with the Clean Water Act is a significant cost and time factor.

Similar to Critical Area, one of the goals of APG's ACUB program is to work with partners to secure lands outside the installation that are suitable for the construction of compensatory wetland mitigation sites. It is expected that this approach will not only eliminate the loss of testing and training land, but also reduce the overall cost to the Army due to reduced construction and monitoring costs. The cost savings will vary depending on the size and complexity of the mitigation project though large, consistent fiscal savings are expected as well as ending the process of encumbering additional range lands with on-post mitigation. Another benefit of off-post mitigation sites is that they allow APG and ACUB partners to improve the conditions of wetlands throughout the northern Chesapeake Bay watersheds thus improving the overall health of the Chesapeake Bay.

TMDLs

EPA and the States are also developing regulations for Total Maximum Daily Loads (TMDLs) for contaminants that impact the Chesapeake Bay. Currently the TMDLs are focused on Nitrogen, Phosphorous and sediment. The approval and enforcement processes for these requirements have not been finalized yet, but will have impacts on APG. As the TMDL program matures, the potential for additional impacts increases.

One proposed method for meeting TMDL allocations is through the use of conservation easements on forested, agricultural, and/or open space lands. Since APG shares segment sheds with areas of both the Eastern and Western Shores of the Chesapeake Bay, this ACUB program will provide load allocation benefit through conservation of land in the segment sheds.

Critical area, wetlands, TMDLs and storm water permits all aim to protect the Chesapeake Bay. Federal and State agencies are committed to the protection of the Chesapeake Bay, as reinforced by Executive Order (EO) 13508: Chesapeake Bay Protection and Restoration, signed 12 May 2009. The Federal Leadership Committee for the Chesapeake Bay FY11 Action Plan provides a number of actions to meet the EO13508. Specifically, the plan calls for conserving land and increasing public access. The APG ACUB will play a role in meeting the goals of the committee by conserving land on the Chesapeake Bay while also preserving the military mission.

Each one of these programs will likely become more stringent until the Chesapeake Bay regains health. The APG ACUB program can have multiple benefits, not only for the APG mission but also for the health of the Chesapeake Bay and the ability of federal agencies to meet the vision and requirements of EO13508.

3.0 DESCRIPTION OF PROPOSED ACTION AND PRELIMINARY LIST OF ALTERNATIVES

3.1 Proposed Action

The APG ACUB program is multifaceted and the benefits are far-reaching. APG proposes to work with local, non-profit conservation partners to purchase conservation easements and secure fee-simple purchases to limit non-compatible land development, provide off-post conservation credits for TMDLs and bald eagles, provide off-post mitigation potential for critical area and wetlands, and assist in protection and restoration of the health of the Chesapeake Bay.

In the preamble to EO 13508, President Obama declared the Chesapeake Bay “a national treasure”[9]. President Obama also stated that protection and restoration of the Chesapeake Bay will require the

[9] President Barack Obama, Executive Order 13508, Chesapeake Bay Protection and Restoration, 12 May 2009.

assistance of federal, state, and local governments; private enterprise; and citizens. In the FY11 Action Plan for EO 13508 the National Park Service is charged with leading different organizations in addressing how to ensure conservation planning approaches and priorities are shared and coordinated across jurisdictions and programs in the Chesapeake Bay watershed.

The goals of this ACUB program will serve to meet the goals of several of the groups involved in land conservation efforts on Maryland's Eastern Shore and will directly support CL.2 of the FY11 EO 13508 Action Plan. This ACUB program will be a keystone of EO 13508 by combining the efforts of all parties and achieving the vision provided by President Obama. The Federal Leadership Committee for the Chesapeake Bay, as established by EO 13508, visualizes a Chesapeake Bay watershed with seven main themes. Many of these themes are supported by this ACUB program, including[10]:

- Extensive areas of conserved lands that protect nature and the region's heritage
- Cities, towns and neighborhoods where citizens are stewards of nature
- Abundant forests and thriving farms that benefit both the economy and environment
- A broad network of land and water habitats that support life and are resilient to the impacts of development and climate change

This ACUB program will allow the Department of Defense, Department of Army, and Aberdeen Proving Ground to take a leadership position in the restoration of the Chesapeake Bay while simultaneously ensuring the protection of the critical military mission at APG.

Urban Sprawl & Operational Noise Protection

The 2000 census shows that Maryland had the sixth largest population per square mile of land. Census data projections show that Maryland is projected to grow by 26% between 2000 and 2030. Areas on the Eastern Shore of the Chesapeake Bay that were rural forty years ago have become exurban and suburban areas, and the trend continues. Population in Cecil County has grown 40% from 1990 through 2008. Similar population growth has greatly expanded in other Eastern Shore counties. With population growth slowing in the currently established Chesapeake Bay counties of Maryland, such as Baltimore, Harford, and Anne Arundel, the most available space for expansion is on the Eastern Shore (Cecil, Kent, Queen Anne's, Talbot, Dorchester) and the Lower Western Shore counties (Calvert and Saint Mary's). This is supported by projections that show a Cecil County projected growth of 80% from 2000-2030; Harford County with 30% growth; and Queen Anne's County at 53%. Kent County projections are slightly lower at 22%, which illustrates the opportunity that will remain available as a long term ACUB priority.

The projected growth throughout the region means that more potential noise receptors will be moving into the APG noise contours, thus increasing the risk to mission caused by increased noise complaints.

Regulatory Mitigation and Preservation

[10] Federal Leadership Committee for the Chesapeake Bay, Executive Order 13508, Strategy for Protecting and Restoring the Chesapeake Bay Watershed, 12 May 2010, p.1

As stated earlier, internal encroachment from regulatory requirements and mitigation will ultimately push APG to a point where no more land is available for mission requirements. For every acre of land used on post for regulatory mitigation, there is one less acre of land that can be used for the military mission. Furthermore, the waters of the Upper Western Shore are the healthiest of any on the Chesapeake Bay, so there is evidence that APG natural resource management and the military mission are compatible with the health of the Chesapeake Bay. This ACUB program seeks to find alternate, off-post land to be placed in preservation to protect eagle habitat, wetlands, and critical area; and willing partners that may allow mitigation on off-post land. Off-post preservation and mitigation will support the health of the Chesapeake Bay by providing many of the same natural environments that exist on APG lands.

3.1.1 Reduction of Restriction or Elimination of Work-around

The ACUB will reduce noise receptors on the Eastern Shore and reduce the amount of new "neighbors" who are not accustomed to the noise impacts from the testing and training conducted on APG. Conserving land on the Eastern Shore will also show our "neighbors" that APG and the Department of Army are concerned about their well being and the surrounding environment. The APG ACUB will provide off-post conservation and/or mitigation for critical area, wetlands, and bald eagle habitat, which will create the flexibility required to meet the ATC mission for testing Rapid Fielding Initiatives. This flexibility will ensure that these "moment's notice" turnaround requirements can be met by eliminating the time consuming permit and mitigation process associated with critical area and wetlands.

The ACUB will also provide off-post eagle habitat that can be used as other nesting and roosting locations for eagles under the upcoming programmatic permits undergoing consideration by USFWS. USFWS personnel have expressed a willingness to work with APG to fit off-post eagle habitat preservation into future agreements and considerations of potential on-post eagle interactions.

The APG ACUB will meet the 2006 Biological Opinion conservation recommendation to preserve off-post land for protection of the bald eagle.

The APG ACUB will streamline reviews of wetland permit applications by obtaining regulatory relief through establishing potential off-post mitigation sites.

The APG ACUB will assist APG in meeting the load allocations associated with the implementation of the Chesapeake Bay TMDL requirements.

The APG ACUB will also place the Department of Defense in a leadership position in meeting the Action Plan goals for protection of the Chesapeake Bay.

3.1.2 Prevention of Foreseeable Actions Causing Restrictions or Work-arounds

Limiting urban sprawl on the Eastern Shore of the Chesapeake Bay will limit the number of noise receptors in the APG noise contour envelope. Population trends along the Bay continue to mostly outpace the overall growth in the State of Maryland. Waterfront, water view, and near water properties will continue to increase in value as they become limited in supply on the Chesapeake Bay. If any of the larger properties on the Bay were to be sold to developers, the increase in population within the noise envelope would be large. Gaining easements on properties within the noise envelope will reduce the opportunity for mass development on the Eastern Shore within the APG noise contour envelope.

3.1.3 Location and Description of Areas to be Protected

The unique element of the APG ACUB program is the Chesapeake Bay. With only open water between APG and Maryland's Eastern Shore, there is no land mass for natural attenuation of noise produced on APG. Compounding the issue is the relatively small economic benefit that Eastern Shore counties obtain from the presence of APG on the Western Shore.

The APG ACUB program uses the operational noise contours and data from the bald eagle telemetry study to outline priority areas for ACUB activities. All preservation easements or fee-simple purchases within this program will require mutual benefits to APG, our land conservation partners, and willing property owners.

Priority 1: Priority 1 ACUB areas will be properties within the 130 decibel (db) noise contour which extends on both the Eastern Shore and Western Shore. Priority 1 will also encompass the perimeter of the APG installation.

Priority 2: Priority 2 ACUB areas will be properties between the 130db and 115db contours on the Eastern Shore, as well as areas along the Sassafrass and Elk Rivers that contain bald eagle nest and roost habitat.

Priority 3: Priority 3 ACUB areas will be properties between the 130db contour and the perimeter of APG on the Western Shore. These areas are designated as Priority 3 because much of this land has already been developed or preserved.

Priority Caveat: Properties within any priority area that contain large tracts of forest, wetland, critical area, or bald eagle habitat, may be preferred for the potential regulatory relief that they provide.

Figure 10 illustrates the priority areas for the APG ACUB program. Figure 11 is an illustration of the APG ACUB priority areas aligned with lands currently under conservation through the work of various state, county, land conservation organization, or other program.

With the current housing market and economic climate, the stage is set for a valuable, effective, and mutually beneficial ACUB program to thrive at APG.

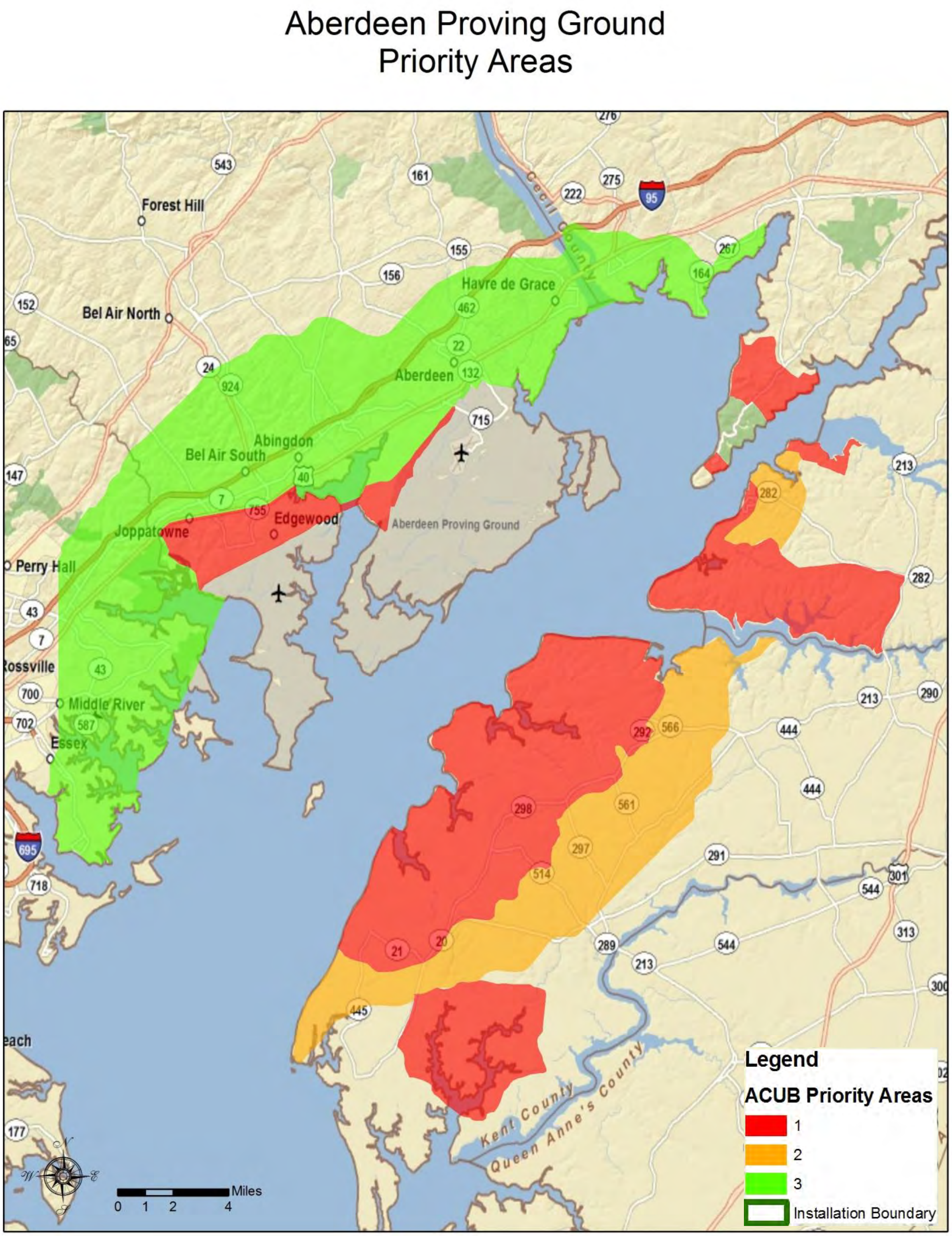

Figure 10. APG ACUB Priority Areas

Aberdeen Proving Ground
Protected Lands

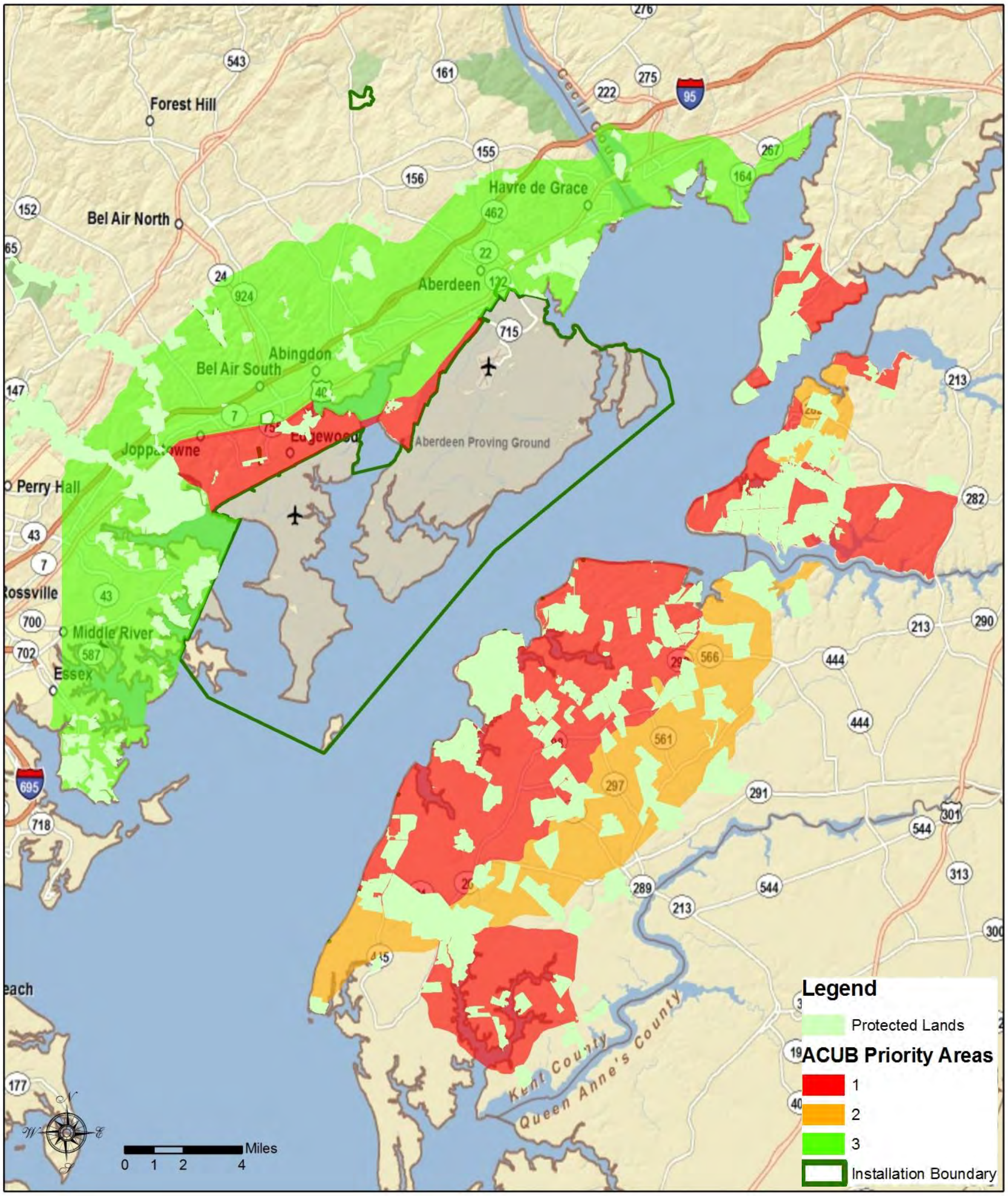

Figure 11. Currently Protected Lands within the APG ACUB Priority Areas

3.1.4 Potential Partners

Eastern Shore Land Conservancy

The mission of the Eastern Shore Land Conservancy (ESLC) is to preserve and sustain the vibrant communities of the Eastern Shore and the lands and waters that connect them. Their vision in 2050 is an Eastern Shore where towns are vibrant and well defined; farms, forests, and fisheries are thriving and scenic; historic, natural, and riverine landscapes are maintained.

ESLC would be APG's primary ACUB partner for properties on the Eastern Shore. The ESLC preserves property south of the Chesapeake & Delaware Canal in Cecil, Kent, and Queen Anne's Counties. ESLC has indicated a willingness of potential land owners on the Eastern Shore, and they are enthusiastic about developing the relationship with APG through the ACUB program.

Harford Land Trust

The mission of the Harford Land Trust (HLT) is to help landowners, private and public, conserve land and protect the natural resources, scenic beauty, rural character, and a healthy way of life in Harford County.

HLT would be APG's primary ACUB partner for properties on the Western Shore, mostly located in Harford County. APG has a relationship with Harford Land Trust dating back to 2006 when an ACUB program was approved to preserve the Hopkins property in Churchville, Maryland, and maintain compatible land use adjacent to the Churchville Test Area at APG. Both APG and Harford Land Trust are eager to expand this relationship to develop a more comprehensive ACUB program at APG.

The Conservation Fund

The Conservation Fund (TCF) forges partnerships to conserve America's legacy of land and water resources. Through land acquisition, community and economic development and training and education, the Fund and its partners demonstrate balanced conservation solutions that emphasize the integration of economic and environmental goals.

TCF offers expertise in large scale land conservation, and has partnered with other military installations on ACUB and REPI programs. TCF does not have a set agenda for conservation, rather they partner with community, government and corporate organization to fulfill their conservation priorities. TCF will be APG's primary ACUB partner for properties involving mitigation. TCF will also be APG's partner for parcels outside the scope of ESLC and HLT. TCF may also provide assistance to our other partners through their nationwide network of conservation regions, nationwide network of partners, and their revolving fund for conservation financing.

Confirmation letters from each ACUB partner are provided in Appendix B. Additional partners may be added as the APG ACUB program matures, depending on the needs of the program.

3.2 Alternative Actions

3.2.1 No Action Alternative

In this scenario, population would continue to grow within the APG operational noise and bald eagle habitat envelopes. Additional residential and commercial development will continue, especially along waterfronts that are particularly attractive to residents. Inevitably, this continued growth and development would encroach on the APG mission by introducing new noise receptors and additional complainants; by driving wildlife from their current locations to the more protected areas of APG; by eliminating the opportunity for off-post regulatory mitigation capabilities; and by driving up the value of the property making future ACUB opportunities less financially viable.

The “No Action” alternative is not a viable solution to the encroachment issues faced by APG now and in the future.

3.2.2 Participation in Local Planning and Land Use Policy Efforts

This scenario relies strictly on local land use controls such as planning and zoning; site plan review; and subdivision regulations to prevent encroachment. APG has limited influence on the planning and zoning activities of the surrounding communities. Pure economics makes it more attractive for localities to encourage development near APG because of the increase in APG mission brought by BRAC and the corresponding tax base that comes with development.

3.2.3 Land Acquisition

Under this alternative the Army would purchase additional land adjacent to APG’s ranges in order to sustain the ability to meet the installation’s testing, training and mission requirements. This alternative would be effective if it was viable to implement, however, the financial and political commitment required would be significant. There would be no partner contributions toward Army purchase of buffer lands and ongoing maintenance and operation of these lands would be a permanent annual expense to the Army. In addition, it is expected that there would be little political and public support for such a significant acquisition program which would most likely require eminent domain or condemnation in order to acquire key parcels. Acquisition of buffer lands by the Army is not considered a financially or politically viable alternative.

4.0 FUNDING REQUIREMENTS

As the goal of the APG ACUB program is to obtain both off-post noise buffering and on-post mitigation buffering, the prioritization of potential partners is multi-fold. Each parcel will be objectively judged to maximize the potential benefits to APG, using the scoring matrix provided in Appendix A. The parcels will be judged by the following criteria:

1. Limit development to reduce noise receptors in the operational noise envelope
2. Obtain TMDL conservation credit in the corresponding TMDL segment shed
3. Ability to protect bald eagle nest, roost or foraging sites for regulatory benefit
4. Ability to preserve wetlands and/or critical area for regulatory relief
5. Ability to construct or enhance wetlands and/or critical area for regulatory credit
6. Ability to satisfy another military mission requirement
7. Cost of the parcel and partner contributions

4.1 Cost Estimates

Total acreage in Priority Area 1 is 82,013 acres; in Priority Area 2 is 35,446 acres; and in Priority Area 3 is 82,889 acres. Of the 200,348 acres incorporated in this program, 50,389 acres are already protected through other programs. Priority Area 1 has 25,328 acres under current protection and Priority Area 2 has 11,358 acres under protection, while Priority Area 3 has 13,703 acres under current protection. Therefore, there is currently 149,959 acres unprotected throughout the priority areas in the APG ACUB program.

This program uses the fair market value per acre provided by the Maryland Agricultural Land Preservation Foundation, Easement Acquisition Program for Maryland Fiscal Year 2009/2010. For Priority Areas 1 (Eastern Shore) and 2, an average fair market value for Kent County and Cecil County was used in Table 1. For Priority Areas 1 (Western Boundary) and 3, an average fair market value for Harford County and Cecil County was used in Table 1. Properties cannot be above fair market value for ACUB funding.

The estimated values in Table 1 are approximations, and the actual cost to acquire easements on properties throughout this ACUB area will be driven by market factors and individual parcel attributes. Table 2 is reserved for tracking the annualized cost of the APG ACUB after the program is approved and the plan is executed.

LAND USE	EST. ACREAGE IN POTENTIAL ACUB AREAS	ESTIMATED COST/ACRE	ESTIMATED TOTAL COST	PARTNER CONTRIBUTION	ARMY CONTRIBUTION
Priority Area 1 Western Boundary	8,649	$11,512	$99,567,288	50%	$49,783,644
Priority Area 1 Eastern Shore	48,036	$8,800	$422,716,800	50%	$211,358,400
Priority Area 2	24,088	$8,800	$211,974,400	50%	$105,987,200
Priority Area 3	69,186	$11,512	$796,469,232	50%	$398,234,616
TOTAL	149,959		$1,530,727,720	50%	$765,363,860

Table 1. Estimated Total Cost for Army Compatible Use Buffer Program

Notes:

1. Estimates presented in Table 1 represent cost ceilings.
2. Successes can be achieved by conserving less than 100% of total target area.
3. Proposed area represents the entire footprint APG requests authorization to target. Actual execution will be less than the entire proposed target area.

	Personnel (Annual)	Management Cost (Annual)	Total Acres Acquired (Annual)	Estimated Buffer Cost per Acre	Total Estimated Cost for Land Purchase (Annual)	Estimated Total Army Cost (Annual)
Cost	TBD	TBD	TBD	TBD	TBD	TBD

Table 2. Annualized Cost for Army Compatible Use Buffer Program

4.2 Anticipated Partner Funding

Partners will be identified based on the location of the potential parcel and the needs of APG. Funding and services provided by the partners will be determined based on each parcel identified. Partners must contribute to each parcel, even if only in-kind services are provided. Each parcel submitted for ACUB funding will identify specific partners and their contributions. Potential partners have been identified below.

4.2.1 Eastern Shore Land Conservancy

APG met with Eastern Shore Land Conservancy (ESLC) personnel to explore a partnership for potential ACUB partners on the Eastern Shore of the Chesapeake Bay. The ESLC preserves property south of the C&D Canal in Cecil County, Kent County, and Queen Anne's County. ESLC has indicated a willingness of potential land owners on the Eastern Shore, and they are enthusiastic about developing a relationship with APG through the ACUB program. ESLC will be a primary partner on the Eastern Shore.

4.2.2 Harford Land Trust
APG partnered with Harford Land Trust (HLT) for the successful ACUB project to buffer Churchville Test Area in 2006. HLT is excited about the opportunity to continue their relationship with APG. During exploratory meetings to develop a larger ACUB program, HLT has already indicated a number of parcels within Priority 1 that they would like to preserve. They will be APG’s primary partner for land preservation in Harford County.

4.2.3 The Conservation Fund
The Conservation Fund (TCF) has a long history of partnering with Army installations across the country to preserve land and protect the military mission. TCF is a national conservation organization with successes across the continent. The TCF revolving fund is a financing tool that can assist smaller land trusts achieve their goals. TCF has also completed numerous mitigation activities, which will fit with the APG ACUB benefit of wetland and critical area mitigation. TCF will be APG’s primary partner for lands outside the purview of ESLC and HLT, as well as APG’s primary partner for mitigation efforts on ACUB parcels.

4.2.4 Other Potential Partners
Other partners may be added as the APG ACUB program develops.

In addition, the various Garrison Supported Organizations throughout APG may contribute funds as they become available.

4.3 Other Anticipated Partner Contributions
The APG ACUB program will identify partners to be used in the event that on-parcel mitigation is permitted by regulatory agencies. These agreements will be worked out with the partner, the land owner, and the regulators prior to each parcel being identified for ACUB funding.

Further, as TMDL regulations develop, APG anticipates adding county government as a partner since the benefits of land preservation will benefit both APG and the individual county for TMDL purposes.

4.4 Metrics for Success
Priority Area 1 – Western Boundary

This portion of Priority Area 1 (PA 1) has a goal to buffer Perryman Test Area, ATEF Test Area, and a new unmanned ground vehicle test track for wheeled and tracked vehicles, as well as buffering noise impacts from firing programs. On the western shore of the Bush River the buffer would protect a training site for urban combat in addition to Nap of the Earth training, night vision training, drop zone training and Pinnacle Landing training for helicopter pilots. This PA exists to alleviate increasing noise and dust complaints originating off post as farmland and forested areas become developed residentially as well as keeping nighttime light encroachment to a minimum. The definition of success for PA 1 is:

- Green: Acquiring easements or fee-simple purchases on parcels adjacent to APG’s boundary line on both sides of the Bush River or 500 acres.

- Amber: Acquiring easements or fee-simple purchases on parcels adjacent to APG's boundary line on both sides of the Bush River or 100 acres.
- Red: Not acquiring easements or fee-simple purchases on any parcels adjacent to APG's boundary line.

A timeline for this action is dependent upon funding levels. With good landowner interest and adequate funding this area could be fully buffered within three to five years since a capable partner, Harford Land Trust, has already shown interest in this area. Development in this portion of PA1 is imminent, so the three to five year timeframe may be too long to meet the needs of the test and training missions.

Priority Area 1 – Eastern Shore

This portion of PA 1 has a goal to buffer APG by reducing new noise receptors; acquiring TMDL credits for land conservation to meet the EPA/MDE pollution allocations; targeting parcels with known bald eagle nests to satisfy recommendations of APG's Biological Opinion; targeting parcels where compensatory critical area mitigation can occur; and targeting parcels where compensatory wetland mitigation can occur. The definition of success for this portion of PA 1 is:

- Green: 1000 acres within 5 years with potential for three bald eagle nests or roosts per year, 10 acres/year of potential wetland mitigation, and 10 acres/year of potential critical area mitigation.
- Amber: 500 acres within 5 years with potential for either three bald eagle nests or roosts per year, 10 acres/year of potential wetland mitigation, or 10 acres/year of potential critical area mitigation.
- Red: 100 acres within 5 years with no additional benefits.

A timeline for this action is dependent upon funding levels. A capable partner, Eastern Shore Land Conservancy, has already shown interest in this area and has indicated good landowner interest in land conservation programs. It would take several years to fully buffer this area. Development pressure will continue to increase in this portion of PA1, but there is a timeline of five to ten years is acceptable to the test and training mission.

Priority Area 2

Priority Area 2 (PA 2) has a goal to buffer APG by reducing new noise receptors; targeting parcels with known bald eagle nests to satisfy recommendations of APG's Biological Opinion; targeting parcels where compensatory critical area mitigation can occur; and targeting parcels where compensatory wetland mitigation can occur. The definition of success for PA 2 is:

- Green: 500 acres within 5 years with potential for 1 bald eagle nest or roost per year, 5 acres/year of critical area mitigation potential and 5 acres/year of wetland mitigation potential.
- Amber: 250 acres within 5 years with potential for either 1 bald eagle nest or roost per year, 5 acres/year of critical area mitigation potential or 5 acres/year of wetland mitigation potential.
- Red: 100 acres within 5 years with no additional benefit.

A timeline for this action is dependent upon funding levels. A capable partner, Eastern Shore Land Conservancy, has already shown interest in this area and has indicated good landowner interest in land conservation programs.

Priority Area 3

Priority Area 3 (PA 3) has a goal to buffer APG by reducing new noise receptors in APG's noise impact zones; acquiring TMDL credits for land conservation to meet the EPA/MDE pollution allocations; targeting parcels with known bald eagle nests; targeting parcels on which critical area mitigation can occur; and targeting parcels on which compensatory wetland mitigation can occur. The definition of success for PA 3 is:

- Green: 200 acres within 5 years with potential for either 1 bald eagle nest or roost per year, 1 acre/year of critical area mitigation potential, or 1 acre/year of wetland mitigation potential.
- Amber: 100 acres within 5 years with no additional benefit.
- Red: 50 acres within 5 years with no additional benefit.

A timeline for this action is dependent upon funding levels. A capable partner, Harford Land Trust, has already shown interest in and conducted work in this area.

5.0 POTENTIAL ISSUES OF CONCERN OR CONTROVERSY

In 1917, it took an Act of Congress and two Presidential Proclamations for the United States Government to take control of what is now Aberdeen Proving Ground. Great care will be taken to ensure the public understands that this is a voluntary program in which willing landowners may participate.

During this economic downturn, local governments will be concerned about the loss of the tax base due to the purchase of development rights through conservation easements. Additionally, many people feel that the government, both State and Federal, should not be spending money on land conservation during the poor economic condition. Several new regulations, including Total Maximum Daily Loads (TMDLs), will require jurisdictions to reduce their pollutant loads to the Chesapeake Bay. Participating in the ACUB partnership will allow them to reach these new requirements with the most minimal fiscal input. Additionally, there has been a large push for public access to the Chesapeake Bay in recent years for recreational activities. At this time it is not known if ACUB properties could be used to create public access points, but the possibility cannot be ruled out completely.

No major issues or potential controversy is anticipated by this ACUB program. Conversely, this program could be ground breaking in terms of regulatory benefit through ACUB preservation and in terms of joining multiple partners together to achieve one goal.

6.0 TIMELINE FOR PROPOSED ACTION

During discussions with Harford Land Trust and Eastern Shore Land Conservancy, there currently exists a list of willing landowners interested in conserving their properties. In fact, ESLC indicated that they could have as many as five parcels in line for conservation as early as March 2011. Once the APG ACUB program is approved, APG will immediately move out with execution of the program. Assuming approval in FY12, APG could realistically execute FY12 funds in the program.

7.0 PLAN FOR SCOPING AND PUBLIC PARTICIPATION

7.1 Regulator Involvement

US Fish and Wildlife Service has indicated that the nest and roost sites preserved through the ACUB program may be considered as alternate nest and roost sites under the programmatic bald eagle permit that is being developed. Formalizing this agreement will be completed prior to including this benefit on any ACUB parcel.

7.2 Public Outreach

At this time, APG plans to allow its partners to conduct public outreach within the community to determine the willingness of land owners to conserve or sell their property through the program. In areas where there is considerable willingness by land owners, APG will participate in public outreach events with its partners.

7.3 Compliance with NEPA

This ACUB program complies with the requirements of the National Environmental Policy Act (NEPA). The NEPA categorical exclusion which applies to this program is (f)(1), grants or acquisition of leases, licenses, easements, and permits for use of real property or facilities in which there is no significant change in land or facility use. Examples of this categorical exclusion include, but are not limited to, Army controlled property and Army leases of civilian property to include leases of training, administrative, general use, special purpose, or warehouse space. A Record of Environmental Consideration (REC) will be completed for each parcel included in this ACUB program. The REC will be completed at the time the parcel is considered for funding under this program.

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APPENDIX A. PARCEL SCORING MATRIX

BENEFIT	POSSIBLE POINTS	SCORE
Reduce Noise Receptors	1000 ac or more = 7 750-1000 ac = 6 500-750 ac = 5 250-500 ac = 4 50-250 ac = 3 10-50 ac = 2 0-10 ac = 1	
Provide TMDL Benefit	Maximum benefit = 4 75% of max = 3 50% of max = 2 25% of max = 1 No benefit = 0	
Beneficial Eagle Habitat	More than 3 nests/roosts = 4 3 nests/roosts = 3 2 nests/roosts = 2 1 nest/roost = 1 No eagle benefit = 0	
Wetland Mitigation Potential	10 acres or more = 4 5-10 acres = 3 1-5 acres = 2 0-1 acres = 1 No wetland benefit = 0	
Critical Area Mitigation Potential	10 acres or more = 4 5-10 acres = 3 1-5 acres = 2 0-1 acres = 1 No critical area benefit = 0	
Priority Area	Along Border = 4 PA1 = 3 PA2 = 2 PA3 = 1	
Other Mission Support Benefit	Additional mission support benefit = 1	
Other Environmental or Cultural Benefit	Additional benefit = 1	
Cost	Partner Match Over 80% = 5 Partner Match 60.1% - 80% = 4 Partner Match 40.1% - 60% = 3 Partner Match 20.1% - 40% = 2 Partner Match 0.1% - 20% = 1	
TOTAL	**MAXIMUM POINTS = 34**	

Note: TMDL benefit scoring will be determined when regulations are finalized and conservation benefits within TMDL regulations are defined.

Note: Scoring may change as the program matures. Any change in scoring will be shared with all partners and incorporated into the program document.

APPENDIX B. PARTNER LETTERS

THE HARFORD LAND TRUST

Helping landowners, private and public, to conserve land and protect the natural resources, scenic beauty, rural character and a healthy way of life in Harford County.

March 9, 2011

Mr. David Goad
TEDT-AT-CSE
US Army Aberdeen Test Center
400 Colleran Road
Aberdeen Proving Ground, MD 21005-5059

RE: Army Compatible Use Buffer Program

The Harford Land Trust, Inc. is pleased to be considered as a partner in Aberdeen Proving Ground Army Compatible Use Buffer Program.

We had a mutually beneficial project in 2007 with the ACUB program resulting in the preservation of the 162-acre Hopkins Farm bordering APG's Churchville Test Area. This rewarding experience gives us the confidence to again partner with APG and the ACUB partners.

I am hopeful that Army Headquarters will approve your proposed project and Harford Land Trust as a partner. I look forward to working with you and achieving the ACUB mission goals in the area of Aberdeen Proving Ground.

Sincerely,

Margaret L. Niland
Executive Director

HARFORD LAND TRUST, INC. • P. O. BOX 385 • CHURCHVILLE, MARYLAND 21028
(410) 836-2103 • www.harfordlandtrust.org

P.O. Box 169
Queenstown
Maryland 21658-0169
[illegible]
FAX 410-827-5765
[illegible]

EASTERN SHORE LAND CONSERVANCY

March 15, 2011

David Goad
US Army Aberdeen Test Center
400 Colleran Road
Aberdeen Proving Ground, MD 21005-5059

Mr. Goad:

The Eastern Shore land Conservancy (ESLC) is interested in becoming a Primary Partner in Aberdeen Proving Ground's (APG) Army Compatible Use Program (ACUB).

Since 1990 ESLC has preserved farmland, forest, wildlife habitat, and riparian lands in the northern 6 counties on Maryland's Eastern Shore. ELSC has adopted a targeted approach to land conservation over its history and the APG ACUB program fits nicely with this approach. During our 20 year history, ESLC has partnered with many organizations and public entities in our work including; local governments, the State of Maryland, the Federal government through both the Farm and Ranchland Preservation Program and Section 6 Endangered Species grants, the Nature Conservancy, as well as many others. Land preservation efforts have focused on using donated and purchased conservation easements as the primary tools for conservation, though in fee purchases of properties have also been used. ESLC's familiarity with the Eastern Shore and our experience partnering with such a wide range of organizations and governmental entities makes us an ideal organization to work effectively and efficiently within the ACUB process.

ESLC supports the ACUB program for APG and we look forward to working with you to make this program a success. If you need anything else from ESLC, please contact me via email at jparks@eslc.org or by phone 443-988-8128.

Sincerely,

Jared Parks
Land Protection Specialist

THE CONSERVATION FUND

America's Partner in Conservation

410 Severn Avenue Suite 204
Annapolis, Maryland 21403
(443) 482-2826 Fax: (443) 482-2806
www.conservationfund.org

March 17, 2011

Mr. David Goad
US Army Aberdeen Test Center
Attn: TEDT-AT-CSE (David Goad)
400 Colleran Road
Aberdeen Proving Ground, MD 21005-5059

Re: Aberdeen Proving Ground Army Compatible Use Buffer Program

Dear David:

The Conservation Fund would be proud to participate as a "cooperating partner" in the Army Compatible Use Buffer Program being developed for Aberdeen Proving Ground.

We at The Conservation Fund (TCF) understand how critically important Aberdeen Proving Ground is to the economy of the State of Maryland. The Conservation Fund's dual charter balances the economic and environmental aspects of protecting America's land and water legacy. Protecting Aberdeen Proving Ground's mission in Hartford County by using land protection as a tool is squarely within the mission of TCF. We have partnered with the Army and other land trusts in a similar fashion at Fort A.P. Hill in Bowling Green, Virginia.

We look forward to forging a partnership with the Army that will make an Army Compatible Use Buffer Program a reality. Please let us know how we can best be of assistance in your efforts to obtain approval for the ACUB Program at Aberdeen Proving Ground. I can best be reached at (410) 274 8421.

Sincerely,

Bill Crouch
Maryland Director

America's Top Rated Environmental Charity

APPENDIX G

Joint Land Use Study Report

APG JLUS

Aberdeen Proving Ground Joint Land Use Study

PUBLIC DRAFT

AUGUST 2015

APG JLUS

Aberdeen Proving Ground
Joint Land Use Study

PUBLIC DRAFT

AUGUST 2015

This study was prepared under contract with the Chesapeake Science and Security Corridor (an arm of Harford County), with financial support from the Office of Economic Adjustment, Department of Defense. The content reflects the views of the key JLUS partners involved in the development of this study and does not necessarily reflect the views of the Office of Economic Adjustment.

Matrix DESIGN GROUP

ABERDEEN PROVING GROUND

JOINT LAND USE STUDY

Public Draft

Prepared for

Chesapeake Science and Security Corridor, Harford County

Prepared by

August 2015

This study was prepared under contract with the Chesapeake Science and Security Corridor (an arm of Harford County), with financial support from the Office of Economic Adjustment, Department of Defense. The content reflects the views of the key JLUS partners involved in the development of this study and does not necessarily reflect the views of the Office of Economic Adjustment.

EXECUTIVE COMMITTEE

The Executive Committee served an active and important role in the development of the Aberdeen Proving Ground (APG) Joint Land Use Study (JLUS). The Chesapeake Science and Security Corridor would like to thank the following individuals for their review, guidance, and assistance:

Name	Title	Entity
Michael Bennett	Mayor	City of Aberdeen
David R. Craig	County Executive (Former)	Harford County
COL James E. Davis	Garrison Commander	APG Garrison
Wayne Dougherty	Mayor (Former)	City of Havre de Grace
Barry Glassman	County Executive	Harford County
Daniel Glasson	Project Manager	Office of Economic Adjustment
Robert J. Hodge	Council	Cecil County Council
COL David R Kennedy	Project Manager	Office of Economic Adjustment
William T. Martin	Mayor	City of Havre de Grace
COL Greg McClinton	Garrison Commander (Former)	APG Garrison
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Lisa Swoboda	Deputy Director	MD DBEC
John Wallace	Tech Director	Aberdeen Test Center
CSM Jeffrey O. Adams (Alternate)	Garrison Command Sergeant Major	APG Garrison
William K. Boniface (Alternate)	Director of Administration	Harford County
Mary Chance (Alternate)	Director of Administration (Former)	Harford County
Karen Holt (Alternate)	Director, Office of Economic Development	Harford County
Melissa L. Lambert, Esq. (Alternate)	County Attorney	Harford County
Robert McCord (Alternate)	County Attorney (Former)	Harford County
Doug Miller (Alternate)	City Administrator	City of Aberdeen
Tari Moore (Alternate)	County Executive	Cecil County

Name	Title	Entity
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ADVISORY COMMITTEE

The Advisory Committee also served a key role in the development of the APG JLUS. The Chesapeake Science and Security Corridor would like to thank the following individuals for their technical expertise and assistance:

Name	Title	Entity
Todd Beser	DPW-Environmental Division, Chesapeake Bay Program	APG Garrison
Daniela Caughron	Facility Program Manager	RDECOM
Barbara Cindric	Program Manager	CERDEC
Tony DiGiacomo	Principal Planner, Office of Planning and Zoning	Cecil County
Pamela Fry	Chief, Experimentation Support Division Laboratory Support	Army Research Laboratory
David Goad	Lead, Compliance and Conservation Team	Aberdeen Test Center
Carla Gerber	GIS Specialist, Planning and Zoning	Kent County
Phyllis Grover	Director of Planning and Community Development	City of Aberdeen
Karen Holt	Director, Office of Economic Development	Harford County
CPT Nicholas Kiaunis	Flight Instructor Supervisor	Maryland National Guard Weide Army Heliport
Jenny King	Deputy Director, Planning & Zoning	Harford County
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Nathan Osborne	Chief, DWP-Master Planning	APG Garrison
Steve Overbay	Deputy Director, Office of Economic Development	Harford County

Name	Title	Entity
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Lee Arnold (Alternate)	Risk Manager	CERDEC
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Scott Flanigan (Alternate)	Director, Public Works	Cecil County
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Matthew Lapinsky (Alternate)	Director, Department of Public Works	City of Aberdeen
Pamela Spelker (Alternate)	Coordinator, Economic Development	City of Havre de Grace
John Van Gilder (Alternate)	Manager, Intergovernmental Affairs	City of Havre de Grace
Lisa Webb (Alternate)	Director, Office of Economic Development	Cecil County
Theresa Adams (SME)	DPW Housing Office	APG Garrison
Jesse Bane (SME)	County Sheriff	Harford County
David Black (SME)	GIS, Office of Planning and Zoning	Cecil County
Richard Brooks (SME)	Director, Department of Emergency Services	Cecil County
Ralph Cardenuto (SME)	Chief, Installation Safety Office	APG Garrison
Denise Carnaggio (SME)	Chesapeake Science and Security Corridor, Coordinator	Harford County
Jim Carnaggio (SME)		Aberdeen Test Center
Joel Caudill (SME)	Department of Public Works, Water and Sewer Division	Harford County
Jason Ebrite (SME)	Carroll Island Wetlands Mitigation	APG Garrison

Name	Title	Entity
Edward Engbert (SME)		CERDEC
Kim Fillinger (SME)	Environmental Protection Specialist	ATEC-ATC
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Russell Strickland (SME)	Director, Emergency Services	Harford County

JLUS CONSULTANT

Matrix DESIGN GROUP

- Michael Hrapla, Project Manager
- Celeste Werner, AICP, Deputy Project Manager
- Richard Rust, AICP, Technical Director
- Patrick Small, AICP, Planning Lead

Table of Contents

Figures and Tables

A

AA	Aberdeen Area
AB	Assembly Bill
ac	acres
ACEC	Areas of Critical Environmental Concern
ACUB	Army Compatible Use Buffer
AE	Alternative Energy Development
AE	Ammunition and Explosives
AEC	U.S. Army Evaluation Center
AGL	above ground level
ALUC	Advisory Land Use Committee
ALUC	Airport Land Use Commission
ALUCP	Airport Land Use Compatibility Plan
AMSAA	Army Material Systems Analysis Activity
APG	Aberdeen Proving Ground
APZ	Accident Potential Zone
AR	Army Regulation
AR	Attainment Report
ARL	Army Research Lab
ARWG	Adaptation and Response Working Group
AQ	Air Quality
AT	AT
AT / FP	AT / FP
ATC	ATC
ATCT	ATCT
ATEC	ATEC

B

BAH	Basic Allowance for Housing
BASH	Bird / Wildlife Aircraft Strike Hazard
BEH	Bachelor Enlisted Housing
BEMP	Bald Eagle Management Plan
BHWG	Bird Hazard Warning Group
BIO	Biological Resources
BLM	Bureau of Land Management
BOH	Bachelor Officer Housing
BOS	Board of Supervisors
BO	Biological Opinion
BOSS	Better Opportunities for Single Soldiers
BRAC	Base Realignment and Closure

C

CALA	Combat Aircraft Loading Ordnance Area
CAS	Close-Air Support
CB	Chemical and Biological
CBP	Chesapeake Bay Program
CDNL	Community Day-Night Average Noise Level
CECOM	U.S. Army Communications Electronics Command
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERDEC	U.S. Army Communications Electronics Research, Development and Engineering Command
CEWMP	Comprehensive Energy and Water Master Plan
CFR	Code of Federal Regulations
CIS	Capital Investment Strategy
CL	Community Legacy
CNEL	Community Noise Equivalent Level
CNRSW	Commander Naval Region Southwest
CO_2	Carbon Dioxide
COA	Critical Operations Area
CCOM	Interagency Coordination / Communication
CP	Comprehensive Plan
CR	Cultural / Historic Resources
CRP	Cultural Resources Program
CRPO	Cultural Resources Program Office

CSAR	Combat Search and Rescue
CSD	Customer Service Desk
CSSA	Chesapeake Science and Security Corridor
CSTA	Combat Systems Test Activity
CTP	Consolidated Transportation Program
CUP	Conditional Use Permit
CWA	Clean Water Act
CZ	Clear Zone
CZMS	Coastal Zone Management Act
C4ISR	Command, Control, Communications, Computers, Intelligence, Survivability and Reconnaissance

D

dB	decibel
DeCA	Defense Commissary Agency
DEIS	Draft Environmental Impact Statement
DNL	Day-Night Level
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DON	Department of Navy
DS	Dust, Smoke, and Steam

E

E-1	Enlisted Sailor
EA	Edgewood Area
EA	Environmental Assessment
EAP	Encroachment Action Plan
EAS	Essential Air Service
EB	Eastbound
ECBC	Edgewood Chemical Biological Center
EIS	Environmental Impact Statement
EISA	Energy Independence and Security Act
EMS	Emergency Management Services
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESLC	Eastern Shore Land Conservancy
EUL	Enhanced Use Lease

F

FAA	Federal Aviation Administration
FAD	Floodplain Accommodation District
FCC	Federal Communication Commission
FCD	Floodplain Accommodation District
FI	Frequency Spectrum Interference / Impedance
FISC	Fleet Industrial Supply Center
FL	flight level
FLPMA	Federal Land Management and Policy Act
FONSI	Finding of No Significant Impact
FRC	Fleet Readiness Center
ft	feet / foot
FYDP	Future Years Defense Plan
FY	fiscal year

G

GATE	Government and Technology Enterprise
GCA	Ground Control Approach
GIS	Geographic Information Systems

H

HA	Housing Availability
HUD	U.S. Department of Housing and Urban Development

I

I	Interstate
ICRMP	Integrated Cultural Resources Management Plan
ICUZ	Installation Compatible Use Zone
IDA	Intensely Developed Area
IE	Infrastructure Extensions
IFR	instrument flight rule
IGA	Intergovernmental Agreement
ILA	Industrial, Landscaping, and Agricultural
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
ITAM	Integrated Training Area Management

J

JLENS	Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System
JLUS	Joint Land Use Study
JPEO-CBD	Joint Program Executive Office for Chemical and Biological Defense
JSHS	Junior Science & Humanities Symposium

K

km	kilometers

L

Ldn	Day-Night Average Sound Level
LDA	Limited Development Area
LG	Light and Glare
LGTR	Laser-guided Training Round
LI	Legislative Initiatives
LRC	Long Range Component
LS	Competition for Land / Air Space
LSHG	Lower Susquehanna Heritage Greenway
LU	Land Use
LUO	Land Use Ordinance
LUPZ	Land Use Planning Zone
LZ	Landing Zone

M

MARC	Maryland Area Regional Commuter
MCA	Military and Civilian Aviation
MCA	Military Compatibility Area
MCCC	Maryland Commission on Climate Change
MDA	Maryland Department of Agriculture
MDARNG	Maryland Army National Guard
MDE	Maryland Department of the Environment
MDNR	Maryland Department of Natural Resources
MDOT	Maryland Department of Transportation
MEA	Maryland Energy Administration
MET	Maryland Environmental Trust
MGE	Municipal Growth Element
MHT	Maryland Historical Trust
MHEC	Maryland Higher Education Commission
MOA	Memorandum of Agreement
MOA	Military Operating Area
MOU	Memorandum of Understanding
MSL	mean sea level
MTP	Maryland Transportation Plan
MTR	Military Training Route

N

NAAQS	National Ambient Air Quality Standards
NACo	National Association of Counties
NATO	North Atlantic Treaty Organization
NBW	Neighborhood Business Works
NDAA	National Defense Authorization Act
NEIEN	National Environmental Information Exchange Network
NEPA	National Environmental Policy Act
NGO	Non-governmental Organization(s)
NHPA	National Historic Preservation Act
NMP –	Nutrient Management Plan
NRHP	National Register of Historic Places
NLR	Noise Level Reduction
NM	nautical mile
NMFS	National Marine Fisheries Service
NO_x	nitrous oxides
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPIAS	National Plan of Integrated Airport Systems
NPS	National Park Service
NV	Noise and Vibration
NVG	night vision goggles

O

O_3	Ozone
OCRM	Office of Coastal Resource Management
OEA	Office of Economic Adjustment
OHV	Off-Highway Vehicle
ONMP	Operational Noise Management Program
OSD	Office of the Secretary of Defense

P

PAAF	Phillips Army Airfield
PEO C3T	Program Executive Office for Command, Control and Communications - Tactical
PEO IEW&S	Program Executive Office for Electronic Warfare & Sensors
PFA	Priority Funding Areas
PG	Policy Group
PL	Public Law
PM	Particulate Matter
PPE	Priority Preservation Element
PSD	Personnel Support Detachment
PT	Public Trespassing
PUC	Public Utilities Code

Q

QD	Quantity Distance Arcs

R

R	Restricted Airspace
RA	Restricted Airspace
RAB	Restoration Advisory Board
RC	Roadway Capacity
RCA	Resource Conservation Area
RCI	Residential Communities Initiative
RCZ	Range Compatibility Zone
RDECOM	U.S. Army Research, Development and Engineering Command
RDT&E	Research, Development Test and Evaluation
REAT	Renewable Energy Action Team
REPI	Readiness and Environmental Protection Initiative
RESI	Regional Economic Studies Institute
RGGI	Regional Greenhouse Gas Initiative

RMP	Resource Management Plan
ROD	Record of Decision
ROW	Right-of-Way
RPMP	Real Property Master Plan
RPS	Renewables Portfolio Standard
RSZ	Range Safety Zone
RTLP	Range and Training Land Program
RV	Recreational Vehicle
R&D	Research and Development

S

SA	Safety
SAR	Search and Rescue
SB	Senate Bill
SEAP	Science and Engineering Apprentice Program
SF	square feet
SG	Smart Growth
SGSC	Smart Growth Subcabinet
SHA	State Highway Administration
SIP	State Implementation Plan
SLR	Sea Level Rise
SMART	Science, Mathematics & Research for Transformation
SNR	Scarce Natural Resources
SOI	Sphere of Influence
SOP	Standard Operating Procedures
SPA	Specific Plan Area
SR	Slow Route
SR	State Route
SRBC	Susquehanna River Basin Commission
SRP	Sustainable Range Program
SRT	State Report on Transportation
STA	State Transit Assistance
STC	sound transmission class
STEM	Science, Technology, Engineering, and Mathematics
SUA	Special Use Airspace
SWDA	Safe Water Drinking Act
SWPP	Source Water Protection Plan
S&E	Scientists and Engineers

T

TACTS	Tactical Aircrew Combat Training System
TACAN	Tactical Air Navigation
TOD	Transit Oriented Development
TDA	Transportation Development Act
TDML	Total Maximum Daily Loads
TR	Town-Residential Zoning
TWG	Technical Working Group

U

UAS	Unmanned Aerial System
UGB	Urban Growth Boundaries
US	United States
USAF	United States Air Force
USAPHC	United States Army Public Health Command
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	US Fish and Wildlife Service
USMC	United States Marine Corps
UXO	Unexploded Ordnance

V

VFR	visual flight rule
VO	Vertical Obstructions

W

WAH	Weide Army Heliport
WB	Westbound
WCM	Water Conservation Measure
WIP	Watershed Implementation Plan
WISS	Weapons Impact Scoring System
WRE	Water Resources Plan Element
WUI	Water Use Intensity

Z

ZO	Zoning Ordinance

APG JLUS

1 Introduction

Introduction

Military installations are critical to local, regional, and state economies, generating thousands of jobs and millions of dollars in annual economic activity and tax revenue. In the past, incompatible development has been a factor in the loss of training operations and restructuring of mission-critical components to other military installations. The loss of military missions and closure of military installations have been detrimental to their host communities. To protect the missions of military installations and health of local economies and industries that rely on them, encroachment must be addressed through collaboration and joint planning between installations and local communities. This Joint Land Use Study (JLUS) attempts to mitigate existing compatibility issues, facilitate the prevention of future issues, and improve coordination between the local communities and Aberdeen Proving Ground (APG).

The APG JLUS advocates a proactive approach to encourage increased communication about decisions relating to land use regulation, conservation and natural resource management issues affecting the Study Area communities and the military. This study seeks to avoid conflicts previously experienced between the United States (US) military and local communities in other areas of the US and throughout the world by engaging the military and local decision-makers in a collaborative planning process.

Gateway signage at Aberdeen Proving Ground entry

What Is A Joint Land Use Study?

A JLUS is a planning process accomplished through the collaborative efforts of a comprehensive list of stakeholders in a defined Study Area. These stakeholders include local community, state, and federal officials, residents, and the military who come together to identify compatible land uses and growth management recommendations within, and adjacent to, active military installations. The intent of the process is to establish and encourage a working relationship between the local communities, agencies and APG.

Joint Land Use Study Goal

The goal of the APG JLUS is to protect the viability of current and future military operations, while simultaneously guiding community growth, sustaining the environmental and economic health of the region, and protecting public health, safety, and welfare.

To help meet this goal, three primary guiding principles were identified:

- **Understanding.** Convene community and military representatives to identify, confirm, and understand the issues in an open forum, taking into consideration both community and APG perspectives and needs. This includes public awareness, education, and input organized in a cohesive outreach program.

- **Collaboration.** Encourage cooperative land use and resource planning among APG and surrounding communities so that future community growth and development are compatible with the operational missions at APG, while at the same time seeking ways to reduce operational impacts on adjacent lands within the Study Area.
- **Actions.** Provide a set of mutually supported tools, activities, and procedures from which local jurisdictions, agencies, and APG can select, prepare, and approve / adopt and then use to implement the recommendations developed during the JLUS process. The actions proposed include both operational measures to mitigate installation impacts on surrounding communities and local government and agency approaches to reduce community impacts on military operations. These tools will help decision makers resolve compatibility issues and prioritize projects within the annual budgeting process of their respective entity / jurisdiction.

Why Prepare A Joint Land Use Study?

Although military installations and nearby communities may be separated by a fenceline or geography including water bodies they often share natural and manmade resources such as land use, airspace, water, and infrastructure. Despite the many positive interactions among local jurisdictions, agencies, and the military, and because so many resources are shared, the activities or actions of one entity can produce unintended negative impacts on another, resulting in conflicts. As communities develop and expand in response to growth and market demands, land use approvals have the ability to locate potentially incompatible development closer to military installations and operational areas. The result can initiate new, or exacerbate existing, land use and other compatibility issues, often referred to as encroachment, which can have negative impacts on community safety, economic development, and sustainment of military activities and readiness. This threat to military readiness is currently one of the military's greatest challenges.

Collaboration and joint planning among military installations, local communities, and agencies should occur to protect the long-term viability of existing and future military missions. Working together also enhances the health of economies and industries of the communities before incompatibility becomes an issue. Recognizing the close relationship that should exist between installations and adjacent communities, the Department of Defense, Office of Economic Adjustment (OEA) implemented the JLUS program in an effort to mitigate existing and future conflicts and enhance communication and coordination among all affected stakeholders. This program aims to preserve the sustainability of local communities within the JLUS Study Area while protecting current and future operational and training missions at APG.

Public Outreach

The JLUS process is designed to create a locally relevant document that builds consensus and obtains support from the various stakeholders involved. To achieve the JLUS goals and objectives, the process included a public outreach program with a variety of participation opportunities for interested and affected parties.

Stakeholders

An early step in any planning process is the identification of stakeholders. Informing or involving them early in the project is instrumental to understanding, addressing, and resolving their most important issues through the development of integrated strategies and measures. Stakeholders include individuals, groups, organizations, and governmental entities interested in, affected by, or affecting the outcome of the JLUS document. Stakeholders identified for the APG JLUS included, but were not limited to, the following:

- Local jurisdictions (counties and cities)
- DOD officials (including OEA representatives)
- APG
- Local, regional, and state planning agencies
- Nongovernmental organizations
- The public (including residents and landowners)

Executive and Advisory Committees

The development of the APG JLUS was guided by two committees, comprising city, county, APG personnel, federal and state agencies, local governments, and other stakeholders.

Executive Committee. The Executive Committee (EC) consists of officials from participating jurisdictions, military installation leadership, and representatives from APG and federal and state agencies. The EC is responsible for the overall direction of the JLUS, preparation and approval of the study design, approval of policy recommendations, and approval of draft and final JLUS documents.

Advisory Committee. The Advisory Committee (AC) is responsible for identifying and studying technical issues. Membership includes county and municipal planners, military base planners and staff, and other subject matter experts as needed to help assist in the development and evaluation of implementation strategies and tools. Items discussed by the AC were brought before the EC for consideration and action.

The EC and AC served as liaisons to their respective stakeholder groups. The EC and AC members were charged with conveying committee activities and information to their organizations and constituencies and relaying their organization's comments and suggestions to both committees for consideration. The EC members were encouraged to conduct meetings with their organizations and / or constituencies to facilitate this input.

Public Workshops

In addition to the EC and AC meetings, a series of public workshops were held throughout the development of the JLUS. These workshops provided an opportunity for the exchange of information with the greater community, assisted in identifying the issues to be addressed in the JLUS, and provided an opportunity for input on the proposed strategies. Each workshop included an interactive presentation and facilitated exercise for the public to participate in the development of the plan.

Public Outreach Materials

Joint Land Use Study Overview / Compatibility Factors Fact Sheet. At the beginning of the JLUS process, a Fact Sheet was developed describing the JLUS program, objectives, public participation methods, and the APG JLUS proposed Study Area. This Fact Sheet was made available at the meetings for review by interested members of the public.

This Fact Sheet also served as an informational brochure describing each of the 24 compatibility factors used for JLUS analysis. While not every factor may apply to the APG JLUS, this list provides an effective tool to ensure a comprehensive evaluation of compatibility factors is conducted within the JLUS Study Area.

Strategy Tools Fact Sheet. JLUS strategies comprise a variety of actions that local governments, military installations, agencies, and other stakeholders can take to promote compatible land use planning. This Fact Sheet provided an overview of the strategy types that could be applied to address compatibility issues in the Study Area.

Website. A project website was developed to provide stakeholders, the public, and media representatives with access to project information. This website was maintained for the entire duration of the project to ensure information was easily accessible. Information contained on the website included program points of contact, documents, maps, public meeting information, and other JLUS resources. The project website is located at www.apgjlus.com.

JLUS Study Area

APG is situated on the northwestern shore of the Chesapeake Bay in Harford County, Maryland. The installation comprises approximately 72,165 acres, including nearly 40,425 acres of land at noncontiguous locations with the remaining area of 31,740 acres consisting of portions of the Chesapeake Bay and Bush and Gunpowder Rivers.

APG is approximately 35 miles northeast of the Maryland state capital of Annapolis, and strategically located between major cities - approximately 30 miles northeast of Baltimore, 60 miles northeast of

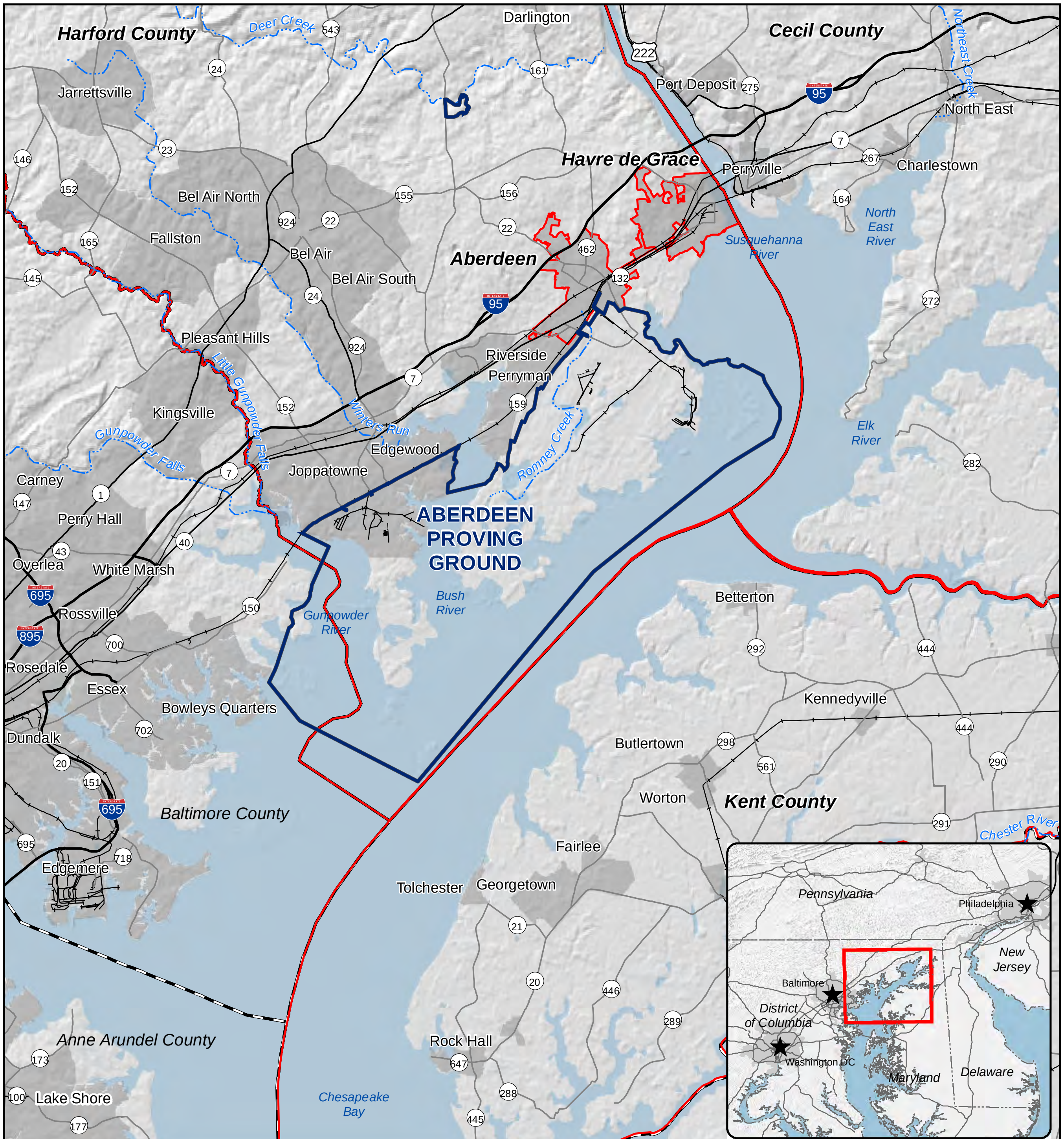
Washington DC, and 65 miles southwest of Philadelphia.

The APG JLUS Study Area encompasses all land near APG and areas that may impact current or future military operations or be impacted by operations. Due to its location and operational areas including the surrounding waters, the general JLUS Study Area was identified as the APG Aberdeen Area; Edgewood Area; Churchville Test Area; Spesutie Island; Graces Quarters; Carroll Island; range areas including portions of the Chesapeake Bay, Bush and Gunpowder Rivers; and the general area affected by operations including military airspace, range safety areas, and noise contours within the counties of Harford, Cecil, and Kent, and the cities of Aberdeen and Havre de Grace as illustrated in Figure 1.

JLUS Implementation

It is important to note that once the JLUS process is completed, the final document is not an adopted plan, but rather a set of strategies to be used by local jurisdictions, agencies, and organizations in the APG JLUS Study Area to guide their future compatibility efforts. Acceptance of the study by stakeholders (i.e. committees, jurisdictions, and the public) will be sought to confirm their collective support for identified implementation efforts. For instance, local jurisdictions and counties may use the strategies in this JLUS to guide future subdivision regulation, growth policy, and zoning updates, as well as formal coordinating procedures for the review of development proposals.

APG may use the JLUS process as a guide for interaction with local jurisdictions on future projects, and to manage internal planning processes with a compatibility-based approach.



Legend

- Installation Area
- Airfield
- Partnering JLUS Jurisdictions
- County Boundary
- City / Town / Unincorporated Community
- Interstate
- Highway
- Major Road
- Railroad
- Water Body
- River

Source: APG, 2014.

0 1 2 Miles

Figure 1
JLUS Study Area

Please see the next page.

APG JLUS

2 Community Profile

Introduction

This chapter provides an overview of the civilian communities within the Aberdeen Proving Ground (APG) Joint Land Use Study (JLUS) Area. Profiles of community growth and development trends are provided as is a description of the general setting of the JLUS Study Area.

Capturing and describing certain demographic characteristics of the communities in the JLUS Study Area provides a baseline context from which informed decisions can be made when developing compatibility strategies. The goal is to provide information that enables stakeholders to understand population and development trends that have the potential to affect the future of APG and its missions. This info is intended to be considered with other factors to help decision makers develop consistent, informed planning policies about future development and economic growth of the communities they represent before compatibility issues arise.

This section is intended to advise the military about the types of activities occurring "outside the fence" when considering future missions and operations at APG. This section will discuss Study Area growth trends including population projections and housing statistics; Economic drivers within each Study Area jurisdiction; projected growth; and transportation information for each Study Area jurisdiction.

APG Regional Overview

The APG JLUS Study Area encompasses the areas surrounding the military installation that are significantly influenced by military operations. The Study Area is situated at the headwaters of the Chesapeake Bay in northeast Maryland, northeast of Baltimore, near the borders of Pennsylvania and Delaware. The overall study area encompasses three counties (including several Census Designated Places or CDP's) and two cities.

Harford County

Harford County was established in 1773 and comprises a land area of approximately 437 square miles with an additional 86 square miles of water area. It is bordered by the Susquehanna River and Cecil County to the east, Baltimore County to the west, the State of Pennsylvania to the north, and the Chesapeake Bay and Kent County to the south. According to the 2010 Census, Harford County has a population of 244,826. The western portion of the Harford County Study Area comprises of largely developed areas east of Interstate 95 (I-95) from Baltimore to APG but largely rural woodlands and small farms west of I-95, with the exception of the Bel Air community and residential subdivisions. The largely developed areas east of I-95 include a mix of residential, commercial, and industrial areas encompassed by woodland areas.

Cecil County

Cecil County was first explored by Europeans in 1608 with the first European settlements occurring as early as 1633. However, it was not until 1674 that Cecil County was established separately from Baltimore County. Cecil County has a land area of approximately 350 square miles and a water area of 70 square miles. Cecil County is located in the northeastern corner of Maryland, and is bordered to the west by Harford County, the south by Kent County, the east by New Castle County Delaware, and the north by Lancaster and Chester Counties, Pennsylvania. According to the 2010 Census, Cecil County has a population of 101,108.

Cecil County has been a rural county for most of its history. However, as the metropolitan regions of Philadelphia, Wilmington, and Baltimore continue to grow, Cecil County is becoming a more favorable development area. Urban development is located along I-95/United States (US) Route 40 and along coastal areas. North and south of this corridor are more rural uses including agriculture and open space.

Source: Cecil County Comprehensive Plan, 2010

Kent County

Kent County was founded in 1642 and is the second oldest county in Maryland. Kent County has a land area of 277 square miles and a water area of 135 square miles. Kent County is bordered to the north by Cecil and Harford Counties, the east by New Castle and Kent County Delaware, the south by Queen Anne's County, and the west by Baltimore and Anne Arundel Counties. Kent County is considered primarily rural and agricultural in character, with smaller communities surrounded by farms, wetlands, and woodlands. Urban development is mostly located in small towns along coastal areas and the Chester River. According to 2010 Census, Kent County has a population of 20,197.

Economically, service and retail trade industries have experienced the largest growth in Kent County since 1985. However, Kent County takes pride in its agrarian character and takes steps towards conservation to prevent the loss of farmland to development. Measures include limiting the ability of landowners to create farmettes and promoting conservation easements.

City of Aberdeen

Aberdeen is located in Harford County along the I-95 / US Route 40 Corridor. The city is located in-between Havre de Grace and Edgewood approximately 25 miles northeast of Baltimore. The City is 6.47 square miles and shares the fenceline with APG. The 2010 Census population of Aberdeen was 14,959. The Village of Aberdeen was first settled in 1800. Aberdeen was incorporated as a town in 1892 and as a city in 1992. Aberdeen was originally an agrarian community located along the Pennsylvania and Baltimore and Ohio Railroads. When APG was established in 1917, overall availability of farmland decreased. APG also increased the need for civilian housing, which further drove Aberdeen's economy from agrarian to military support. Additionally, the City was incorporated into the Harford County Development Envelope in 1977.

The City of Aberdeen Comprehensive Plan anticipates buildout through 2030. Future growth is identified through 17 planning districts. Planning districts extend approximately one mile around the city limits. The City plans for future growth in 11 out of 17 Planning Districts. Of the 11 districts which anticipate growth, one is the existing City of Aberdeen and represents infill opportunities. Not including existing and infill opportunities, this equates to an area of 4,511 acres and roughly 8,770 equivalent dwelling units. The City of Aberdeen is also designated as a "Maryland Sustainable Community", as part of the Maryland Sustainable Communities Program.

The City of Aberdeen houses the only two entrance points to APG at the Maryland Boulevard and Harford gates. This gate placement impacts the city's roadways during the morning and evening rush hour.

City of Havre de Grace

The City of Havre de Grace is located in Harford County approximately 35 miles northeast of Baltimore. Havre de Grace is roughly six miles north of APG and situated at the mouth of the Susquehanna River in-between Aberdeen and Perryville. Havre de Grace lies along the I-95 and US Route 40 Corridors and is incorporated in the Harford County's Development Envelope. The city has a land area of approximately 6.9 square miles and as of the 2010 census, has a population of 12,952.

Havre de Grace was explored by Europeans as early as the 1620's, incorporated as a town in 1785, and incorporated as a city in 1878. Havre de Grace's history has been heavily influenced by its location at the mouth of the Susquehanna River. Havre de Grace was home to the first legally established ferry crossing on the Susquehanna River and has served as a midpoint on one of the most direct routes along the Atlantic Seaboard since colonial times. Establishment of APG in 1917 was also important for Havre de Grace, as the city provided entertainment and housing opportunities for military troops.

Havre de Grace has 7 revitalization areas, 5 new neighborhood developing areas, and 18 growth areas within the 2004 Comprehensive Plan Area. Revitalization areas focus mainly on the historic old town and properties while new neighborhoods and growth areas are located further away from the historic center; some areas within municipal limits and some outside municipal limits.

The City of Havre de Grace is also designated as a "Maryland Sustainable Community".

Source: Havre de Grace Comprehensive Plan, 2004

Land Preservation and Development Impacts

Land preservation regulations in the Study Area have the ability to help or hinder military compatibility. Land preservation regulations can prevent incompatible development from developing in military influence areas. The counties within the Study Area each have an agrarian history, which each look to protect while still allowing economic growth in other sectors.

Harford County

Harford County uses four major preservation programs to conserve agricultural and natural land. These include the Harford Agricultural Land Preservation Program (HALPP), Maryland Agricultural Land Preservation Foundation (MALPF), Rural Legacy Program, and the Maryland Environmental Trust (MET). These programs have collectively protected over 47,000 acres in the County.

Source: Harford County Land Preservation, Parks, and Recreation Plan, 2013

Cecil County

As of 2007, Cecil County land use is roughly 24 percent Development Lands (including Low Density Residential, Medium/High Density Residential, Commercial Industrial, and Rural Residential) and 76 percent Resource Lands (including Agriculture, Forest, and Wetlands). When regarding future land use, approximately 24 percent of the county is included in growth areas, 71 percent of the county is included in rural areas, and five percent of the county is included in mineral extraction and village uses. Of the 71 percent of land in rural areas, 95,819 acres (60 percent) is considered rural conservation and 63,469 acres (40 percent) is considered resource protection.

Source: Cecil County Comprehensive Plan, 2010

Kent County

Kent County has multiple tools available to help preserve agricultural land. These include: MALPF, Rural Legacy, Chesapeake Country National Scenic Byway, and donated conservation easements through the Eastern Shore Land Conservancy and/or MET. As of July 1, 2014, 17,488 acres have been preserved with MALPF easements, and 15,987 acres have been preserved through donated easements. Kent County has one Rural Legacy Area. The Sassafras Rural Legacy Focus Area has protected 2,204 acres of land and stretches from the Sassafras River near Betterton along the Chesapeake Shoreline just west of Worton. Finally, 986 acres have been protected along the Chesapeake Country National Scenic Byway.

Source: Kent County Government, 2014

Study Area Growth Trends

The following section provides a summary of the study area's population growth, housing trends, and median home values. This information establishes a regional context for growth and development in the JLUS Area while providing a broad understanding of growth potential for compatibility analysis based planning.

Population

Population is based on the 2010 data provided by the US Census Bureau through the US Department of Commerce, Economics and Statistics Administration. The following section provides a comparison of the changes in population in the APG JLUS Study Area between 2000 and 2010 which is illustrated in Table 1 and the light blue circles on Figure 2.

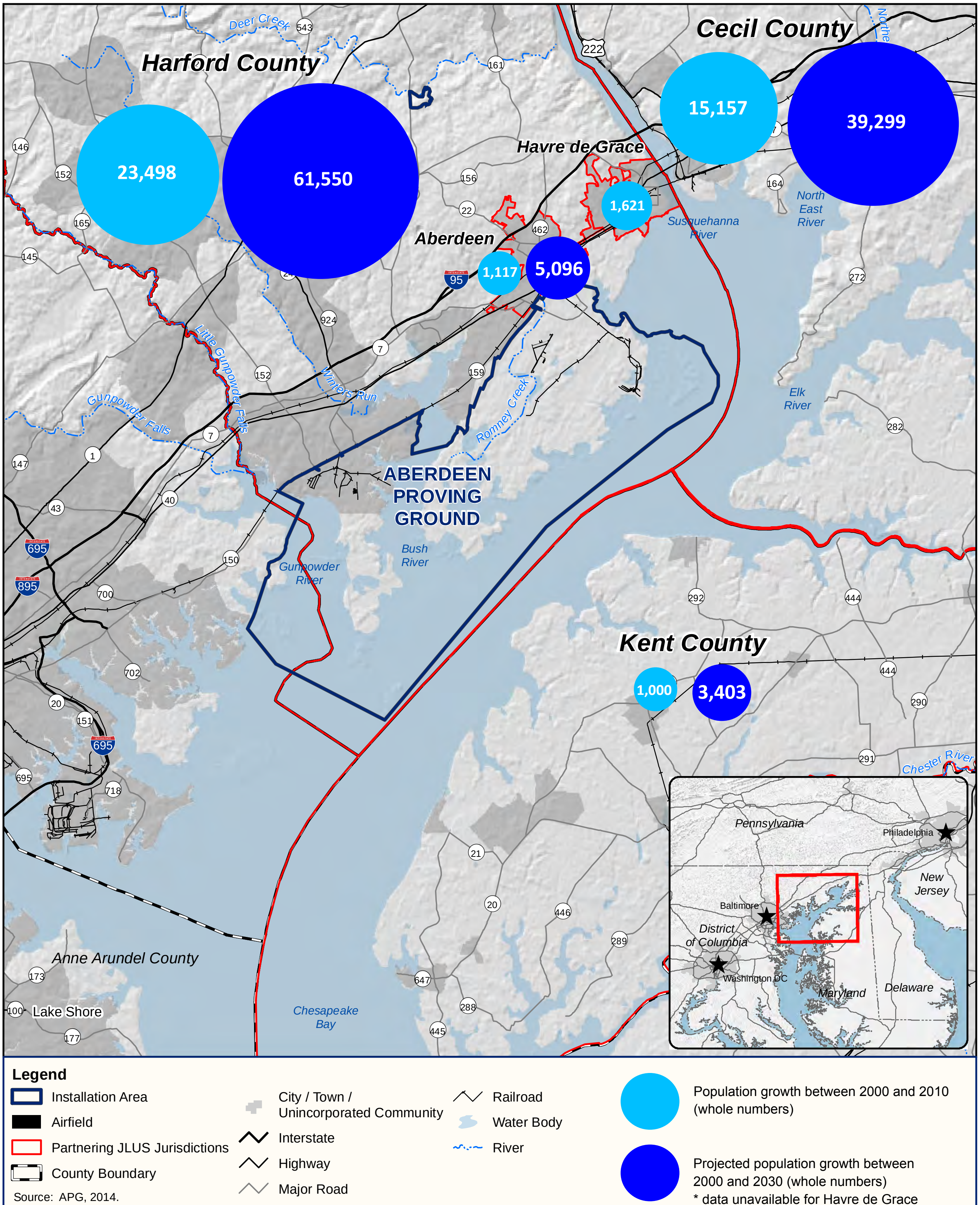


Figure 2
JLUS Study Area Growth 2000-2030

Table 1. Regional Population Growth by Study Area Jurisdiction, 2000 – 2010

Jurisdiction	2000	2010	Number Change	Percent Change
Maryland	**5,296,486**	**5,773,552**	**477,066**	**9%**
Harford County*	193,417	216,915	23,498	12%
Cecil County	85,951	101,108	15,157	18%
Kent County	19,197	20,197	1,000	5%
City of Aberdeen	13,842	14,959	1,117	8%
City of Havre de Grace	11,331	12,952	1,621	14%

Source: United States Census Bureau, profile of General Population and Housing Characteristics; 2000, 2010; Historical and Projected Total Population for Maryland's Jurisdictions, Maryland Department of Planning, 2014

**Harford County population includes the community of Bel Air but does not include City of Aberdeen or City of Havre de Grace*

The study area experienced an overall increase in population between 2000 and 2010. Harford County had the greatest population growth with the addition of 23,498 people, while Kent County experienced the least population growth at only 1,000. Similarly, Cecil County had the highest percentage of growth with an 18 percent increase during the 10-year period, while Kent County had the least percentage of growth with only a 5 percent increase within the same timeframe.

Cecil County's total population in 2010 was 101,108, which was an 18 Percent increase from the year 2000. Similar to Harford County, this growth can be partially attributed to BRAC activities but also the continued growth of both the Baltimore and Wilmington, Delaware Metropolitan areas. Kent County's population only grew by 5 Percent within the time span. Kent County's geographic setting in relation to APG means that growth due to BRAC is less likely. It can be assumed that Kent County's smaller population growth is due to a greater out-migration of youth in relation to a smaller in-migration of retirees as well as local desires to remain a rural, agrarian area.

The dark blue circles in Figure 2 graphically depict population growth for study area jurisdictions through 2030. Each county in the study area is expected to see population growth over the coming decades. Cecil County is expected to reach an approximate population of 125,250 by year 2030, a 24 percent increase from year 2010. Harford County is expected to reach an approximate population of 254,967 by year 2030, an 18 percent increase from the year 2010. Kent County is expected to reach an approximate population of 22,600 by year 2030, a 12 percent increase from the year 2010. The City of Aberdeen is expected to have a population of approximately 18,183 by year 2030, a 21 percent increase from year 2010. The City of Havre de Grace does not have readily available population projects.

Future growth will most likely be driven by the continued growth of major metropolitan areas in the region and the presence of APG.

Housing Value and Trends

Housing trends are an important indicator of economic activity and vitality, as they demonstrate the population growth or decline relative to new residential construction within an area. They also represent market decisions relative to home ownership versus rental properties. Ultimately, housing trends indicate potential future development locations and the types of residential and commercial development to come. A majority of the housing units in the Study Area jurisdictions are owner occupied. However, Aberdeen and Havre de Grace have owner occupied percentages lower than the state average and considerably lower than county averages. Since 2000, the median housing values and median monthly gross rents have increased significantly across the study area. Cecil County, Harford County, and Aberdeen have seen housing values almost double. Housing values in Kent County and Havre de Grace have more than doubled. Median monthly gross rental rates have risen by at least 50 percent in all jurisdictions. This increase can strain the affordability of the housing market close to APG, which, in turn, can lead to increased commuting distances by civilian and military personnel who work at APG and are priced out of the local housing market.

The availability of affordable multi-family dwellings is an important factor to consider for military compatibility, as some personnel with families stationed at APG may need to live off-base in the communities. It is also important for the communities within the JLUS study area to provide housing stock that meets the needs of the residents and the military personnel who are stationed at APG for indefinite periods of time.

Base Allowance for Housing

The Base Allowance for Housing (BAH) is a stipend given to military personnel who choose to live off base or cannot be accommodated in on-base housing. BAH is designed to augment the costs of living associated with private arrangements including home or apartment rent, utilities, and renter's insurance.

> The BAH is determined by pay grade, local area rental market, and dependent status.

While BAH rates for APG military personnel may vary by rank and dependent status, the rate for an E-1 stationed at APG ranges from $1170 (single) to $1563 (with dependents). Excluding the potential cost of utilities and renter's insurance, this figure is moderately above the median monthly rate in the study area jurisdictions. This means that an enlisted soldier should be able to locate affordable housing within the JLUS study area.

Source: Defense Travel Management Office, 2014

Economy

The Study Area is home to a diverse economy. While agriculture is still a major economic sector in the Study Area, the presence of APG has increased the amount of government and professional jobs in the Study Area. Unemployment is below the state average in Harford and Kent Counties and in the City of Havre de Grace. Unemployment is roughly equal to the State average in Cecil County. The unemployment rate in Aberdeen is above both the state average and national average (6.0 percent).

Harford County

BRAC brought numerous research and development firms to APG and thus Harford County. Since BRAC began implementation, approximately 99 new defense contractors and 8,000 contract employees relocated to Harford County. APG has approximately $13.6 billion dollars committed to future research and development projects. The Harford County Office of Economic Development hopes to capture some of this funding by supporting the Entrepreneurs Edge program, which pushes the innovation process for individuals to develop ideas into a business.

Harford County has also grown in non-defense related sectors. Major companies, including Clorox and Pier 1, have set up distribution centers that will add over 1.5 million square feet of commercial floor space to the county. Health care is also a growing industry, adding 130,000 square feet of health-care space through an expansion of the Upper Chesapeake Health System. Harford County is also home to two Enterprise Zones, Edgewood/Joppa and Aberdeen/Havre de Grace.

Source: Harford County Economic Development Department

Cecil County

Cecil County economic growth is due in part to the county's location midway between the Baltimore and Philadelphia/Wilmington Metropolitan areas. Between 2002 and 2008, Cecil County experienced 14 percent job growth. The largest increases in jobs occurred in the manufacturing, education and health services, retail trade, transportation and utilities, and local government sectors. The fastest growing sectors in terms of growth rate were education and health services, manufacturing, professional and business services, and local government. According to the 2010 Cecil County Comprehensive Plan, Cecil County has an average annual employment of 28,351. Despite the experienced economic growth, Cecil County still has a negative jobs/housing balance.

Cecil County offers real property and income tax credits to businesses that locate within the designated Cecil County Enterprise Zone. The availability of developable land, mounting growth pressure of surrounding jurisdictions, and the many transportation corridors which link Cecil County to the Northeast

Region are indicators of future economic growth in the county.

Source: Cecil County Comprehensive Plan, 2010

Kent County

Historically, Kent County has had an economy based on farming and commercial fishing. Today, Kent County's largest job sector is management, business, science, and arts.

Kent County's Economic Development Plan seeks to capitalize on growth in high quality service industries such as financial, health and elder care, recreational charter boat fishing, and outfitter hunting. Kent County also looks to travel and tourism industries and a continued focus on agriculture. Kent County hopes to increase availability of high capacity internet access to support new and existing business. Kent County also hopes to attract new business by marketing the lower business costs and attractive features of living within the county.

Source: Kent County Comprehensive Plan, 2006

City of Aberdeen

The City of Aberdeen is heavily influenced economically by APG. As part of the 2005 BRAC, APG brought 8,200 new positions to APG and Aberdeen looks to take advantage of the contractors and services that have followed. BRAC is seen as a way for Aberdeen to redevelop and expand commercial properties and shape the future for commercial districts in the City.

Aberdeen is also home to national companies such as C&S Wholesalers, Frito Lay, Home Depot, Pier I Imports, and Saks Fifth Avenue, which have warehouses within city limits.

Aberdeen has several business incentive programs to help attract new businesses, including: the Greater Aberdeen/Havre de Grace Enterprise Zone Program, Aberdeen BRAC Revitalization Zone, Historically Underutilized Business (HUB) Zone, Community Legacy Façade Program, and the Aberdeen Revolving Loan Fund Program. Future economic potential lies in Aberdeen's ability to expand the existing business base, attract high-tech businesses, and grow hospitality and food service sectors.

Source: Aberdeen Comprehensive Plan, 2011

City of Havre de Grace

Havre de Grace has a strong tourism, industrial, and health care base which provides approximately 2,500 employment opportunities. The historic downtown and waterfront are an important part of Havre de Grace's economic viability. Specialty stores and water activities help to increase the tourism market. Chesapeake Health Systems operates the Harford Memorial Hospital in Havre de Grace. The area surrounding the hospital has numerous health related businesses.

Havre de Grace has numerous resources to help foster business including the City Department of Economic Development, various business development programs, the Chamber of Commerce, and the Economic Development Commission. Harford County Government also provides business support through the Harford County Office of Economic Development. Both organizations work with the Maryland Department of Business and Economic Development to further local economic well-being. As stated earlier, Havre de Grace is located within the Greater Aberdeen/Havre de Grace Enterprise Zone. As of 2004, the Enterprise Zone had created $58 million in new capital investment in Havre de Grace alone. This equated to roughly 600 new jobs.

Havre de Grace's location within the I-95/US Route 40 Corridor and the Northeast Rail Corridor in proximity to APG creates an environment for sustained economic growth. Future economic opportunities include new development of corporate and technology office parks, availability of small flexible office space for start-up businesses, and attracting APG technology affiliates.

Source: Havre de Grace Comprehensive Plan, 2004.

Current Development Overview within the Study Area

The APG JLUS Study Area supports a myriad of land uses that range from agricultural and parklands to residential and urban population centers, with varying sizes of employment and population levels throughout. The cities of Aberdeen, Havre de Grace, and parts of Harford County lie north and west of APG. Cecil County lies northeast and east of APG and Kent County lies south and southeast of APG. Development adjacent to APG is characterized by the following:

North

The land north of APG is urban and agricultural. Immediately north of the Aberdeen Area is the Town of Aberdeen and farmland in unincorporated Harford County. Within close proximity of the northern boundary of APG is the City of Havre de Grace and associated urban areas. The Northeast Rail Corridor lies on the northern border of the Aberdeen Area.

Land north of the Edgewood Area consists of mostly suburban uses. Immediately north of Edgewood Area are the communities of Edgewood and Joppatowne. The Northeast Rail Corridor lies on the northern border of the Edgewood Area.

East

The Chesapeake Bay lies immediately to the east of APG. Across the Chesapeake Bay from APG are Elk Neck State Park, agricultural uses, and minor residential uses located in Cecil and Kent Counties.

South

The Chesapeake Bay lies immediately to the south of APG. Across the Chesapeake Bay is Kent County. Kent County is a rural county with many agricultural land uses. A small number of communities exist along the shoreline of Kent County including Betterton, Kinnard's Point, and Rock Hall.

West

Land west of APG is suburban, industrial, and agricultural. The community of Perryman lies west of the Aberdeen Area and consists of minor residential uses and large warehouse distribution centers. The distribution centers sit on the fenceline with the Aberdeen Area.

West of the Edgewood Area are residential and state lands in Baltimore County. Minor residential uses are located in Edgewood and Joppa. A part of the land is Gunpowder Falls State Park and Dundee Natural Environmental Area.

Introduction

This chapter provides an overview of the military profile including the history and current operations at Aberdeen Proving Ground (APG) within the Joint Land Use Study (JLUS) Study Area.

Identifying and describing the various activities performed on the military installation provides valuable insight into the importance of APG as a national defense strategic asset. This information enables stakeholders to make informed decisions about the future development and economic growth of communities in proximity of APG, which could potentially impact the existence and future role of the facility.

Aberdeen Proving Ground Economic Impact

The APG JLUS Study Area spans the counties of Harford, Cecil, and Kent, and the cities of Aberdeen and Havre de Grace in the northeast region of Maryland. APG is the leading employer in the Study Area with more employees than the next 20 major employers combined, resulting in a significant footprint in the regional and local economy.

APG generates $4.3 billion in economic activity and supports approximately 29,000 jobs that result in $1.6 billion in employee compensation. Economic impact categories are divided into two categories, economic output, and employee compensation. These categories are further divided into direct, indirect, and induced. Direct impacts are those which occur as a direct result of the spending associated with APG. Indirect impacts are those which are created as a result of the in-state expenditures associated with APG. Induced impacts are estimates based on the increase in local incomes due to the operation of APG.

Installation Setting

APG is owned by the DOD, Department of the Army. APG is located on the shores of the Chesapeake Bay and occupies over 72,165 acres in Harford and Baltimore Counties. This area is further divided in 40,425 acres of land and 31,740 acres of water. APG is centrally located between Baltimore and Wilmington, Delaware as well as Washington, D.C. and Philadelphia, Pennsylvania.

APG is divided amongst several areas spread across Harford and neighboring Baltimore County. Individual settings are discussed below:

Aberdeen Area

The Aberdeen Area (AA) is approximately 28,708 acres of land and is located in the northern part of APG. There are three distinct sub areas: the security area (681 acres), the Cantonment (3,111 acres), and the Research, Development Test and Evaluation (RDT&E) range area (26,630 acres). The AA is mostly used for testing and research. The AA also includes Spesutie Island and the Phillips Army Airfield.

Edgewood Area

The Edgewood Area (EA), formerly Edgewood Arsenal, is made up of approximately 10,126 acres of land and is located to the south of the AA. There are three distinct sub-areas: the security area (220 acres), the Cantonment (5,156 acres), and the RDT&E range area (4,970 acres). The EA is the chemical research and engineering center for the United States (US) Army. Range testing occurs along the northeast fenceline and the southern portion of the EA. The EA is also the home of MDARNG Weide Army Heliport and the future home of the Northeast Maryland Additive Manufacturing Authority.

Churchville Test Area

The Churchville Test Area is located in northern Harford County, approximately 10 miles north of APG in the community of Churchville. Churchville Test Area is a location of the Aberdeen Test Center (ATC) vehicle testing facility. The site is 221 acres and contains 11 miles of interconnecting roads and test courses. Roads and test courses contain mud, dirt, and gravel surfaces on varying grades, and are used to test the endurance and reliability of cross-country tracked and wheeled vehicles.

Carroll Island, Graces Quarters and Pooles Island

Carroll Island and Graces Quarters are a noncontiguous addition to APG located across the Gunpowder River in adjacent Baltimore County. Carroll Island and Graces Quarters add an additional 1,164 acres of land to APG but see minimal activity. Carroll Island is 799 acres and is located close to urban development in Baltimore County. Graces Quarters is 365 acres and the future home of the JLENS project that will help to monitor the Eastern Seaboard for airborne national security threats. The JLENS project has been briefed, and is only expected to be a three year mission.

Pooles Island is a 206 acre island and contains a lighthouse, which is the only permanent building located at any of these three areas. All three areas exhibit quantifiable amounts of unexploded ordinance (UXO) and environmental constraints.

Local Communities Working Together

APG is an integral part of the local community. APG has been located in Harford County since 1917 and has developed programs and partnerships with local organizations. Some of the organizations include Community Covenant, Baltimore Orioles Military Program, Small Business Programs, and Educational Outreach Programs.

Military Operations

APG's primary missions are to conduct research, development, testing and evaluation (RDT&E) of ordnance and military equipment and to train personnel. APG is home to 19 major commands and supports more than 80 tenants, 20 satellite, and 17 private activities.

Major operations at APG include: performance and durability testing of weapons, equipment, and supplies; testing of projectiles for accuracy, speed, reliability, and penetration; extensive research and development in the areas of chemical and biological weapons and materials; human factors; computational and information sciences; survivability and lethality analysis; and vehicle technology.

> **JLUS Observation**
>
> Aberdeen Proving Ground is an essential Army asset, home to world leaders in research, development, testing and evaluation of Army materiel, and profoundly impacting the way that wars are fought.

Military Strategic Importance

APG serves as a premier Army RDT&E center. The site is located along major transportation corridors that put APG within reach of some of the largest cities on the Eastern Seaboard. APG has experienced growth over the course of the BRAC. Several tenants relocations to APG have helped maintain the installation's importance for national defense.

Major Commands

APG has five core areas of operations or military support:

- Public Health and Medical Research
- Test and Evaluation
- Research and Development
- Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE)
- US Army Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance Team (C4ISR)

The base is home to 19 major commands. Major commands usually have subordinate units that conduct specific research in accordance with the Major Command primary objective. Some major commands may in fact be considered Major Subordinate Command units of higher major commands. Below is information related to some of the major commands at APG.

Army Research Lab (ARL)

The ARL is the Army's central laboratory. ARL's program consists of basic and applied research and survivability/lethality and human factors analysis that provide enabling technologies to many of the Army's most important weapons systems. ARL acts as a link between the scientific and military communities by bringing together internal and external science and technology assets to fulfill the requirements defined by or requested by the Soldier.

Source: http://www.arl.army.mil/www/default.cfm?page=20

Edgewood Chemical Biological Center (ECBC)

Edgewood Chemical Biological Center (ECBC) is a research and development resource for non-medical chemical and biological (CB) defense. ECBC supports all phases of the acquisition life-cycle including basic and applied research through technology development, engineering design, equipment evaluation, product support, sustainment, field operations and demilitarization.

Source: http://www.ecbc.army.mil/

Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD)

The mission of the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD) is to provide research, development, acquisition, fielding and life-cycle support for chemical, biological, radiological and nuclear Defense equipment, medical countermeasures, and installation and force protected integrated capabilities supporting national strategies. The JPEO-CBD executes these responsibilities through seven Joint Project Managers.

Source: JPEO-CBD

Maryland Army National Guard (MDARNG)

The Maryland Military Department mans, equips, trains, and deploys National Guard units in support of missions directed by the President of the United States and to support state responses to any major emergency or disaster. The MDARNG 29th Combat Aviation Brigade is headquartered at the Edgewood Area and provides command and control to a variety of aviation and other units. It is the major aviation command within the Maryland Army National Guard containing units from across the nation.

Source: http://www.md.ngb.army.mil/absolutenm/templates/?a=754&z=41 http://www.globalsecurity.org/military/library/news/2009/11/mil-091117-arnews01.htm; Maryland Army National Guard PowerPoint Presentation 26 November 2013

Program Executive Office for Command, Control and Communications-Tactical (PEO C3T)

The Program Executive Office for Command, Control and Communications-Tactical (PEO C3T) provides soldiers with the computer systems, radios and communications networks required in the battlefield. PEO C3T develops, acquires, and fields this range of products to all Army units. PEO C3T ensures the integration of these systems so they function seamlessly; while providing on-site training and support for the systems deployed worldwide.

Source: http://peoc3t.army.mil/c3t/

US Army Communications-Electronics Command (CECOM)

CECOM ensures the global readiness of the C4ISR systems and the information and technology for troops to communicate on battlefield. CECOM ensures global readiness by providing training; field support for software modifications and software upgrades; logistics expertise; information assurance; joint network capabilities; and interoperability certification functions.

Source: US Army Communications-Electronics Command, the Critical Link Brochure, http://cecom.army.mil/about.html

US Army Communications-Electronics Research, Development and Engineering Center (CERDEC)

CERDEC is headquartered at APG and is charged with developing and integrating Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) technologies for networked soldiers. As the Army's main developer, supplier, and integrator of C4ISR onto Army platforms, CERDEC must balance the newest technology with on-the-ground needs of soldiers.

Source: http://www.army.mil/cerdec

US Army Medical Research Institute of Chemical Defense (MRICD)

US Army Medical Research Institute of Chemical Defense (USAMRICD) is a lead science and technology laboratory, with specific studies in medical chemical countermeasures research and development. The USAMRICD has numerous laboratories located at APG and is responsible for providing research and analysis on chemical defense research for DOD and Federal Agencies.

Source: http://chemdef.apgea.army.mil/

United States Army Public Health Command (PHC)

The United States Army Public Health Command (USAPHC) has a mission to promote health and prevent disease, injury, and disability of Soldiers and military retirees, their families, and Department of the Army civilian employees and assure effective execution of full spectrum veterinary service for Army and Department of Defense veterinary missions.

Source: http://phc.amedd.army.mil/organization/Pages/default.aspx; United States Army Public Health Command, May 2014

US Army Research, Development and Engineering Command (RDECOM)

RDECOM delivers technological capabilities that ensure the Army remains the dominant force on the battlefield now and in the future. The mission of RDECOM is to empower, unburden, protect and sustain the joint warfighter through integrated research, development, and engineering solutions. This includes providing technology solutions to meet current operational needs as well as developing new technologies to aid future Soldiers. RDECOM is the Army's largest technology developer and its leading technology integrator.

Additionally, ARL, CERDEC, and ECBC are all organizations apart of RDECOM.

Source: http://www.army.mil/article/39385/

Other Major Commands

Other major commands on APG include the 20th CBRNE Command, the Army Materiel Systems Analysis Activity (AMSAA), the Army Contracting Command (ACC), the US Army Evaluation Center (AEC), the US Army Civilian Human Resource Agency (CHRA) Northeast Region Office, the US Army Signal Network Enterprise Center APG (USANEC APG), the Kirk US Army Health Clinic (KUSAHC), and the Program Executive Office Intelligence Electronic Warfare & Sensors (PEO IEW&S).

Aberdeen Test Center (ATC)

ATC is a Major Range and Test Facility Base (MRTFB), one of only eight that are a part of the Army, and the only MRTFB located on the east coast. As a major national asset to the DOD, the ATC has become a lead test center for Land Vehicle Testing and Direct Fire Testing, as well as the Army's Center of Excellence for Live Fire Testing. The MRTFB designation is a driving force for the importance of the installation. In addition, ATC is the Range Officer in Charge at APG and operates on 66,000 of the over 72,000 acres.

Source: http://www.atc.army.mil/

Future Mission Operations

Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)

The Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS) provides over the horizon surveillance and fire control quality data on Army and Joint networks enabling protection from enemy cruise missiles, aircraft, unmanned air vehicles, tactical ballistic missiles, large caliber rockets, and surface moving targets.

The JLENS consists of two systems: a fire control radar system and a wide-area surveillance radar system. Each radar system has a 74-meter balloon (known as an aerostat) that is moored at a fixed location. APG's JLENS system is planned to be placed on the Gunpowder River; one at Graces Quarters and one at the Edgewood Area. However, the mission is expected to only continue for three years.

Source: Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System, Selected Acquisition Report, 2012

APG Mission Footprint

Mission and training activities at APG generates a number of impacts that can affect the health, safety, and overall quality of life in the surrounding community. Examples of these mission impacts may include noise and vibration from ordnance testing or the risk of an aircraft accident.

Conversely, the military mission is susceptible to hazards created by nearby civilian activities, land use development, and environmental constraints that may obstruct air space, locate noise sensitive uses in high noise zones, or gather large numbers of people in safety zones. Understanding the overlapping spatial patterns of these impacts around the installation and ranges is essential for promoting compatible and fully coordinated land use decisions.

These overlapping spatial patterns comprise the mission footprint. The mission footprint serves as a compatibility tool for surrounding communities in making land use decisions. Several elements of mission profiles comprise the mission footprint that extends outside the APG installation. These elements are either tangible, meaning that they are either physically seen and / or heard, or intangible, meaning that they exist within space without being seen or heard.

The following outlines the different elements or mission profiles that comprise the APG Mission Footprint:

- Aircraft Safety Zones
- Noise Contours for Aircraft
- Imaginary Surfaces
- FAA Part 77 for Vertical Obstructions
- Bird / Wildlife Air Strike Hazard (BASH) Relevancy Area
- Range and Training Areas
- Noise Contours for Large Caliber Weapons and Detonations
- Quantity Distance Arcs (QD)
- Special Use Airspace
- Microwave Line-of-Sight

Aberdeen Proving Ground Airfields

Aberdeen is home to two airfields, Phillips Army Airfield and Weide Army Heliport.

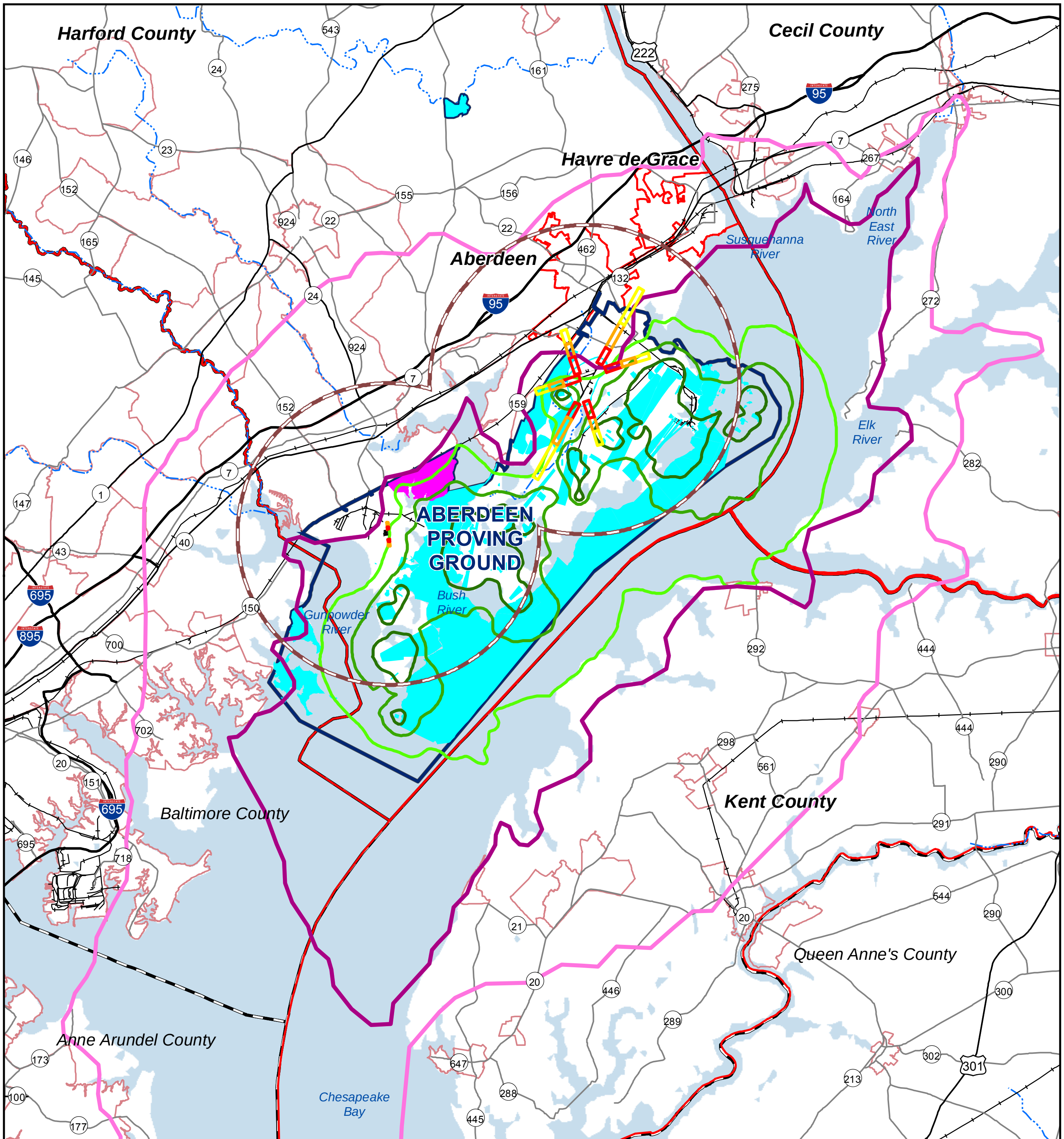
Phillips Army Airfield (PAAF) is located in the Aberdeen Area south of the Maryland Blvd Gate. PAAF is owned by APG but operated by ATC. The Airfield includes one 8,000-foot by 200-foot hard-surfaced runway, four drop zones, one helipad, and three bomb ramps. PAAF also houses several air operations support facilities including: PAAF main hanger, control tower, taxiways, off-loading area, and aprons. Non-aviation activities also take place at PAAF. ATC uses certain runways for speed and braking tests on wheeled and tracked vehicles. The C-12U Huron and RQ-7B Shadow, as well as the UH-72A Lakota utilize PAAF.

Weide Army Heliport (WAH) is located on 98.5 acres of land in the Edgewood Area. WAH was closed to fixed wing aircraft in 1980 and is now utilized as a heliport and home to the Maryland Army National Guard. WAH includes a 1,600-foot, rotary-wing-only runway. Support facilities include: one flight operations building, one counterdrug observation building, two main hangers, and a warehouse. The types of aircraft that are used at WAH include UH-60 A/L Black Hawk, CH-47D Chinook, and UH-72A Lakota.

Aircraft Safety Zones

Aircraft safety zones for APG are based on historical data of aircraft collisions, geography, and runway information. The purpose of safety zones are to provide for the general safety of the public as it relates to the land uses under and near these zones. Safety zones help limit and guide development to enable the provision of safety of the public and pilots while simultaneously allowing for continued economic growth. The safety zones are referred to as Clear Zones (CZs) and Accident Potential Zones (APZ I and II). Clear Zones are the zones which begin at the end of a runway and extend to a predetermined distance. This is the area where an accident involving an aircraft operation is most likely to occur; therefore, development is completely restricted in this area. APZs are areas following the CZs where there is still potential for accidents, but development is less regulated.

These safety zones are illustrated in Figure 3. Within these zones, there are restrictions on types, densities, and heights of land uses. Clear Zones vary between PAAF and WAH. The PAAF Clear Zone begins at the end of each runway and extends 3,000 feet beyond the end of the runway with a width of 500 feet. The WAH Clear Zone begins at the end of each runway and extends 400 feet beyond the end of the runway with a width of 300 feet. The Clear Zones do not extend off of APG, although portions of APZ I and II for PAAF extend beyond the installation boundaries.



Legend

5-Mile BASH Relevancy Area
Training Area
Range Area

Large Caliber Noise Contour
LUP Z – 57 CDNL
Zone II – 62 CDNL
CDNL, Zone III – 70 CDNL

Peak Blast Noise Contour
115 PK15(met)
130 PK15(met)

Safety Zone
Clear Zone
APZ 1
APZ 2

Installation Area
Airfield
Partnering JLUS Jurisdictions
County Boundary
City / Town / Unincorporated Community
Interstate
Highway
Major Road
Railroad
Water Body
River

Source: APG, 2014.

Matrix Design Group

0 1 2 Miles

Figure 3
Military Footprint Composite –Range / Training Areas, Range Noise Contours, Safety Zones, BASH

PAAF has a total of three runways, but only one of them is active. Runway 04/22 is 8,000 feet long and 200 feet wide and can handle a wide variety of aircraft including a Lockheed C5 Galaxy. The other two runways are inactive but have the potential to be used in the future.

Source: Long Range Component, APG Master Plan; UFC 3-260-01, Airfield and Heliport Planning and Design, 2008.

Imaginary Surfaces

The imaginary surfaces of an active runway are used to determine where vertical obstructions could exist in the vicinity of aviation operations. The various imaginary surfaces build upon one another and are designed to eliminate natural or man-made obstructions to air navigation and operations. The extent or size of an imaginary surface depends on the type of runway. Thus, the key terms related to imaginary surfaces relative to APG runways are described below.

- The Primary Surface defines the limits of the obstruction clearance requirements in the immediate vicinity of the landing or take-off area. It comprises surfaces of the runway, runway shoulders, and lateral safety zones and extends 2,000 feet beyond the runway end. This surface is 2,000 feet wide, or 1,000 feet on each side of the runway centerline.
- The Clear Zone defines the limits of the obstruction clearance requirements in the vicinity contiguous to the end of the primary surface. It measures 2,000 feet wide (same width of the primary surface) by 1,000 feet long. This is the area where an accident involving an aircraft operation is most likely to occur.
- The Approach-Departure Clearance Surface is symmetrical about the runway centerline and begins as an inclined plane (glide angle) 200 feet beyond each end of the primary surface of the centerline elevation of the runway end, and extends for 50,000 feet for the APG runways. The slope of the approach-departure clearance surface is 50:1 outward and upward along the extended runway (glide angle) centerline until it reaches an elevation of 500 feet above the established airfield elevation. It then continues horizontally at this elevation to a point 50,000 feet from the start of the glide angle. The width of this surface at the runway end is 2,000 feet; it flares uniformly, and the width at 50,000 feet is 16,000 feet.
- Horizontal Clearance Surfaces include an inner surface at 150 feet above airfield elevation extending to 7,500 feet from the runway, and an outer surface at 500 feet above airfield elevation extending from 14,500 feet to 44,500 feet from the runway end.
- The Transitional Surfaces connect the primary surfaces, Clear Zone surfaces, and approach-departure clearance surfaces. The slope of the transitional surface is 7:1 outward and upward at right angles to the runway centerline.

Figure 4 illustrates the imaginary surfaces relevant at PAAF and WAH. These areas extend radially outwards a distance of 8.5 miles from runways, covering portions of all Study Area jurisdictions.

Associated with the imaginary surfaces of an active airfield and in relation to flight operations from an airport (military or civilian), vertical obstructions are assessed through compliance with Federal Regulation Title 14 Part 77, which establishes standards and notification requirements for objects affecting navigable airspace. Figure 4 illustrates the Part 77 footprint based on the elevation of the runway.

Bird / Aircraft Strike Hazard

Birds and wildlife can represent a significant hazard to military training and flight operations. Certain types of land uses, such as standing water or grasslands, attract birds and wildlife. While there have been an insignificant number of fatalities associated with bird air strike hazards (BASH) in the past 30 years, the concern associated with BASH is the significant amount of damage a BASH incident can cost the federal government. According to the DOD Partners in Flight Program, strikes involving military aircraft cost approximately $75 million in damage every year.

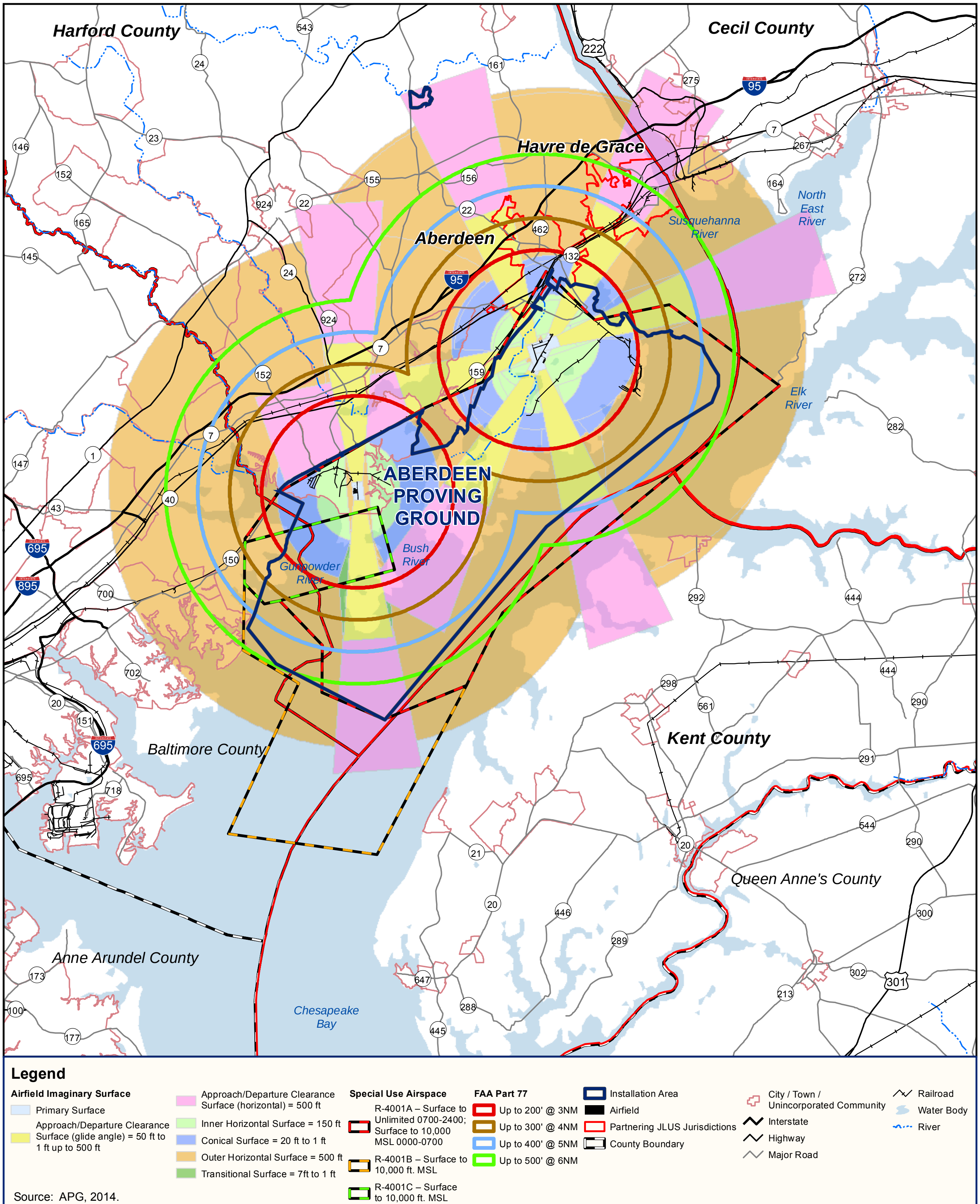


Figure 4
Military Footprint Composite – Imaginary Surfaces, FAA Part 77, Special Use Airspace

According to the APG Integrated Natural Resources Management Plan, BASH is not a significant issue at APG as bird / aircraft strikes occur very rarely. Figure 3 shows potential BASH relevancy areas.

Aberdeen Proving Ground Target Ranges and Training Areas

The RDT&E character of the APG mission means that a large part of the base is considered range area. The total range areas are approximately 66,000 acres including water (34,454 acres of land mass) and are located mainly within the AA and EA but are also located within other areas such as Graces Quarters and Carroll Island. Figure 3 illustrates the location of range and training areas.

Range areas also include water impact areas, which are located in parts of the Bush River, Gunpowder River, Romney Creek, Spesutie Narrows, and Chesapeake Bay. Currently, no munitions of any type are permitted to be fired into the waters within and surrounding APG.

All range areas are contained on installation; however, some operations and QD arcs extend over or into APG restricted area waters which are publicly accessible.

Range Management

ATC controls operations over the range complex and coordinates with Garrison on major activities that might impact the installation or community. Firing programs and operations are managed to ensure that adjacent firing programs are compatible and danger zones are established as to not affect other areas on base. All range use is scheduled to preclude conflict and adverse community impact.

Range Noise Contours

The main source of noise at APG is from ordnance testing. All operations, which will or can produce noise off-base, are conducted between certain hours.

- Weekdays between 8:30 AM and 10:00 PM
- Saturdays between 9:00 AM and 4:00 PM
- Sundays and holidays between 10:00 AM and 3:30 PM with command approval

All operations, which will or can produce noise off-base, are conducted at least 100 meters inside the installation boundary in an attempt to mitigate impacts to neighboring communities.

During normal workdays, a noise model calibration shot will be conducted between 7:30 AM and 8:00 AM. The type and extent of operations conducted during a normal work day will depend on this noise model calibration shot and if it shows adverse noise effects on surrounding communities.

The APG Noise Management Plan illustrates CDNL blast noise contours and peak blast noise contours. CDNL blast noise contours are classified as Zone III (70 CDNL), Zone II (62 CDNL), and LUP Z (57 CDNL). Though ordnance testing at APG can frequently be heard off-base, the CDNL contours extend off-base into the counties of Harford, Kent and Cecil as seen in Figure 3.

Peak blast noise contours are classified by 115 PK15(met) and 130 PK15(met). Moderate risks of noise complaints are associated with 115 PK15(met) and high risks of noise complaints are associated with 130 PK15(met). Blast noise from APG causes noise complaints in Cecil, Harford, and Kent Counties.

Depending on the amount and intensity of development that occurs over the fenceline, any source of noise may begin to conflict with local residents. This could put mission critical activities at APG at risk.

Source: Aberdeen Proving Ground Noise Management Plan, 2006.

Quantity Distance Arcs

Quantity distance (QD) arcs are the area where risk has been assessed based on the impacts of the types of munitions being stored. Quantity distance arcs extend off-base at two locations: into the Chesapeake Bay off Spesutie Island and on the Bush River. These arcs do not encroach on dry land. Additional impact areas are also clustered within the territorial waters of APG off the shore of the EA along the Bush River.

Conowingo and Harford Loops

The Conowingo and Harford Loops are meant to test fuel consumption on various in-service vehicles. Conowingo Loop is a paved, closed loop course that is made up of local and federal public highways. The course is designed to assess medium to heavy duty vehicles. The Harford Loop includes various terrain and grades where test vehicles operate at the posted speed limit. The loops are located north of the Churchville Test Area.

Aberdeen Proving Ground Special Use Airspace

Special Use Airspace (SUA) is airspace where military activity or unusual flight conditions may occur. The designation of SUA serves to alert nonparticipating aircraft (civilian or military) to the possible presence of these activities. There are six types of SUA: Alert Areas, Prohibited Areas, Controlled Firing Areas, Military Operating Areas (MOAs), Restricted Areas, and Warning Areas. Only Restricted Areas are designated within the APG.

A restricted area contains airspace that is subject to restrictions of use due to unusual, often invisible, hazards to aircraft. RDT&E uses at APG create restrictions on outside aircraft operations because of the potential to interfere with myriad testing that occurs at APG.

Restricted airspace encompasses 133 sq. nm in the immediate vicinity of the base which is divided into three areas, R-4001 A, B, and C. R-4001 A and B surround APG and R-4001C is a restricted airspace around the JLENS aerostats. Figure 4 displays APG SUAs.

Source: https://www.federalregister.gov/articles/2013/10/01/2013-23951/proposed-modification-and-establishment-of-restricted-areas-aberdeen-proving-ground-md#h-18

Microwave Line-of-Sight

The Microwave Line-of-Sight footprint is defined as the area in which electromagnetic waves or acoustic waves are transmitted or spread to various communication sites by simple unobstructed horizontal planes. This horizontal plane is at a certain height and allows for a clear, unobstructed pathway for the transmission of electromagnetic waves for electronic scoring of bombing and target practice.

Depending on a structure's height and distance from APG, obstructions built within the radio frequency line-of-sight may have a significant impact to RDT&E activities at APG.

Microwave Line of Site requirements at APG generally extend northwest of the installation to other properties within Harford County. No Line of Site extends to the Eastern Shore. A BRAC Spectrum Study comparing APG to Fort Monmouth, New Jersey showed that Line of Site conditions at APG did not reveal any unexplained or unexpected results. It was determined that no change would be needed for APG to accommodate Line-of-Site spectrum capacity.

However, as Harford County continues to grow, there may be the possibility for taller structures to be built within the APG line-of-sight areas.

Introduction

This chapter provides an overview of compatibility tools currently used or applied in evaluating and addressing compatibility issues in the Aberdeen Proving Ground (APG) Joint Land Use Study (JLUS) study area. Relative to compatibility planning, there are a number of existing plans and programs that are either designed to address compatibility directly or indirectly through the topics they cover.

This summary provides an overview of key plans and programs that impact compatibility planning organized by level of government. There are three types of planning tools evaluated relative to their applicability: permanent, semi-permanent, and conditional. Permanent planning tools include acquisition programs, either fee simple purchase of property or the purchase of development rights. Semi-permanent tools include regulations such as zoning or adopted legislation. Examples of conditional tools would include memorandums of understanding (MOU), intergovernmental agreements (IGA), and other policy documents such as comprehensive plans (CP) that can be periodically modified.

The overview of key plans and programs is organized in the following order:

- Federal
- Aberdeen Proving Ground
- State of Maryland
- Harford County
- Cecil County
- Kent County
- City of Aberdeen
- City of Havre de Grace
- Other tools and references

Federal

Federal policy, laws and programs have evolved to influence almost every aspect of land use. This is especially true in coastal environments that host major military facilities, like APG. A broad range of federal plans, programs and actions apply to APG both directly and indirectly. In some cases federal authority may exercise exclusive control over state and local authorities, while in other cases (such as coastal zone management), federal agencies may delegate primary "operational" responsibility to state agencies, favoring to establish policy, certify state programs, and fund and monitor their activities.

The following is not an exhaustive accounting of all relevant federal laws or programs, but rather an identification of those considered to be most relevant for assessing compatibility issues and potential strategies stakeholders might employ to avoid or mitigate conflicts.

Clean Air Act

The Clean Air Act (CAA) is the comprehensive federal law that regulates air emissions from stationary and mobile sources in order to control air pollution. Under the CAA, the EPA establishes limits on six criteria pollutants through the National Ambient Air Quality Standards. Standards are set to protect public health and public welfare. The CAA also gives the EPA the authority to limit emissions of air pollutants generated from sources such as chemical plants, utilities, and steel mills. Individual states may have stronger air pollution laws, but they may not have weaker pollution limits than those set by the EPA. Under the law, states have to develop State Implementation Plans that outline how each state will control air pollution under the CAA.

Clean Water Act

The Clean Water Act (CWA) establishes the regulation of water resources and water pollution. The CWA establishes the goals of eliminating the release of toxic substances and other sources of water pollution to ensure that surface waters meet high quality standards. The CWA prevents the contamination of near shore, underground and surface water sources.

Federal Aviation Act

An important outcome of the Act is FAA Regulation Title 14 Part 77, commonly known as Part 77, which provides the basis for evaluation of vertical obstruction compatibility. This regulation determines compatibility based on the height of proposed structures or natural features in relation to their distance from the ends of a runway. Using a distance formula from this regulation, local jurisdictions can easily assess the height restrictions near airfields.

The FAA has identified certain imaginary surfaces around runways that are used to determine how structures and facilities are evaluated to identify if they pose a vertical obstruction in relation to the airspace around a runway. The levels of imaginary surfaces build upon one another and are designed to eliminate obstructions to air navigation and operations, either natural or man-made. The dimension or size of an imaginary surface depends on the runway classification.

Federal Coastal Zone Management Act of 1972

The Coastal Zone Management Act (CZMA) was created in 1972 and is administered by NOAA's Office of Coastal Resource Management (OCRM). In 1978, to manage its extensive coastline (more than 7,000 miles), estuarine embayment's, tidal flats, tidal wetlands, creeks and other coastal assets, Maryland developed its Coastal Program.

In general, the program emphasizes protection of coastal resources, water dependent uses, and "facilities in the national interest" located in coastal areas (including military bases). Public access to the shore is also a primary CZMA objective. The CZMA is administered at the state level through Maryland's Coastal Program.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) of 1969 is a federal regulation that established a United States (US) national policy promoting the protection and enhancement of the environment and requires federal agencies to analyze and consider the potential environmental impact of their actions. The purpose of NEPA is to promote informed decision-making by federal agencies by making detailed information concerning significant environmental impacts available to both agency leaders and the public.

All projects receiving federal funding require NEPA compliance and documentation. NEPA is applicable to all federal agencies, including the military. NEPA mandates that the military analyze the impact of its actions and operations on the environment, including surrounding civilian communities. Inherent in this analysis is an exploration of methods to reduce any adverse environmental impact.

Aberdeen Proving Ground (APG)

APG Base Realignment and Closure Impact Study

The 2007 Base Realignment and Closure (BRAC) Impact Study analysis estimates the economic, fiscal and public policy implications of BRAC–related growth at APG through 2017 for a seven–jurisdiction area, which includes Harford, Cecil, Baltimore, New Castle, Lancaster and York counties and the City of Baltimore.

The analysis makes heavy use of publicly–sourced data and uses standard econometric methodologies. The study team considers analysis under three separate scenarios: low-case, mid-case and high. By calculating employment, income, population and other impacts, the study team identified by jurisdiction the most problematic elements from the perspective of ongoing BRAC accommodation, including prospective shortfalls in housing, school capacity, water/sewer capacity and wastewater treatment capacity though 2017, the final year forecasted.

Source: Aberdeen Proving Ground BRAC Impact Study, 2007.

Aberdeen Proving Ground (APG) Master Plan

All US Army installations are required to maintain a Real Property Master Plan (RPMP), in accordance with Army Regulation 210-20 and UFC 2-100-01. The Aberdeen Proving Ground Master Plan comprises three major planning component documents all of which address specific planning concerns and strategies for the future of APG.

Long Range Component (LRC). The LRC outlines APG's long-term strategies for growth with consideration of regional, local, installation, and site-specific planning issues. It contains focused, detailed planning strategies that guide the long-range use of land and facilities throughout APG. It is a broad-based area analysis of the entire installation projected over a period of 20 to 50 years. It describes the existing conditions and baseline data used to develop the plans contained in this component, as well as the remaining components of the RPMP.

Short Range Component (SRC). The SRC defines real property projects scheduled in the near term. It is tied to the long-term strategies of the Capital Investment Strategy and the Long Range Development Plans of the LRC. The SRC reflects installation facility actions and capital investments over the current Future Years Defense Plan window (2010-2017) and marks the transition from planning to programming.

Capital Improvement Strategy (CIS). The CIS contains the holistic set of actions needed to create the Real Property Vision and links long-term planning (general strategies) to plan implementation. The CIS supports the vision of the LRC and forms the basis of programming actions. It focuses on strategies to integrate current demands with long-term facility needs, based on assessments of excesses and deficits. It also leads to the prioritization of programming actions found in the SRC.

Other Planning Initiatives Noted in the Master Plan

APG Enhanced Use Leasing (EUL) Program. EUL legislation (10 USC 2667) provides additional tools for managing installation assets. The purpose of the EUL is to achieve business efficiencies and maximize returns on investment by using lease proceeds for a variety of operational needs. Currently, APG has a EUL under development on Maryland Boulevard with St. John Properties.

Community Development and Management Plan. Corvias Military Living was contracted to develop the Community Development and Management Plan for APG, as part of the Army's Residential Communities Initiative (RCI) Program.

The RCI program is intended to improve the quality of life for Soldiers and families assigned to APG. Over the anticipated 50-year term all family housing will be rehabilitated or replaced and additional new housing will be provided. In addition, RCI will bring new community centers, other ancillary facilities and amenities to meet family housing needs at APG.

Source: Aberdeen Proving Ground Real Property Master Plan Update, 2012.

Army Compatible Use Buffer Program

The most recent ACUB plan for APG was finalized in 2011 as the “Chesapeake BAY-CUB.” The plan addresses growing encroachment concerns as they relate to realistic training opportunities and the continued viability of APG as a significant training and research center for the US Army and the Maryland Army National Guard.

The 2011 revisions address multiple levels of compatibility, including environmental and safety concerns. Environmental considerations include the bald eagle and wetlands, and other local and regional species and habitats of concern in the Chesapeake Bay Critical Area. The plan outlines other anticipated training and testing restrictions such as safety and human welfare. The BAY-CUB provides a proposed action and a preliminary list of alternatives to deal with compatibility issues. These programs seek to maximize the amount of land available for research and development and training and testing operations while responsibly addressing conservation and potential nuisance concerns. The implementation of these plans and policies assist in coordinating local and regional compatibility measures around APG and the Chesapeake Bay.

Source: Aberdeen Proving Ground Army Compatible Use Buffer Program, 2011.

Integrated Cultural Resources Management Plan

The ICRMP is a planning tool employed by APG to make informed decisions regarding the cultural resources under their control in compliance with public laws, in support of military mission, and consistent with sound principles of cultural resources management.

The ICRMP includes an overview of laws, statutes, regulations, and executive orders that relate to the management of cultural resources at APG. Internal and external coordination procedures are specified through standard operating procedures to ensure compliance with cultural resources laws during the execution of

APG mission activities. The document also sets goals for APG's Cultural Resources Program (CRP) over a five- year planning horizon.

APG has reviewed and updated their ICRMP to reflect the current status of the identification and evaluation of cultural resources at APG, as well as changes in its administrative structure. The APG ICRMP is based upon information assembled from historical, archeological, ethnographic, architectural, and planning documents prepared for APG since 1996.

Source: Aberdeen Proving Ground Integrated Cultural Resources Management Plan, 2008.

Integrated Natural Resources Management Plan

APG has prepared an INRMP to address the management of the natural resources at APG and the interrelationships of the natural resources with the military mission. The INRMP reflects the commitment set forth by the Army to conserve, protect, and enhance the natural resources. The primary purpose and objective of the INRMP is to present an implementable management plan that guides APG in achieving natural resource management goals, supporting the military mission, and complying with environmental policies and regulations. In addition, the INRMP ensures that natural resources conservation measures and Army activities on APG land are integrated and consistent with federal stewardship requirements

Source: Aberdeen Proving Ground Integrated Natural Resources Management Plan, 2009.

Operational Noise Management Plan

The ONMP serves as a primer on operational noise for installation personnel and the community. Prepared by the US Army Public Health Command at APG in 2005, the ONMP identifies the specific noise environment for APG, the impacts of the noise environment and provides recommendations to manage this environment as a responsible neighbor. The objectives of the ONMP are to:

- Provide a document which can educate both the military and the public about the noise generated from APG operations.
- Manage noise complaints to reduce the potential for conflict between APG and the surrounding communities.
- Assess the compatibility of the noise environment with the existing and proposed land uses.
- Mitigate the noise and vibration environments, where feasible, to increase land use compatibility.

Source: Aberdeen Proving Ground Operational Noise Management Plan, 2006.

Readiness and Environmental Protection Initiative Projects

Coordination between the Aberdeen Test Center staff and the Harford Land Trust/Harford County helped alleviate threats to the nearby Churchville Test Area through a Readiness and Environmental Protection Initiative (REPI) project. As of September 30, 2010, the one REPI conservation project that has taken place at APG has resulted in 163 acres of preserved land, partially alleviating the threat of nearby regional growth which was causing noise, dust and other issues.

Source: US DOD Readiness and Environmental Protection Initiative (REPI) Project Fact Sheet, Aberdeen Proving Ground.

State of Maryland

Chesapeake Bay & Atlantic Coastal Critical Areas Act & Protection Program

The Critical Area Act establishes the Chesapeake Bay Critical Area and Atlantic Coastal Bays Critical Area Protection Program and the Critical Area Commission to enable the State and local governments to jointly address the impacts of land development on habitat and aquatic resources.

The law governing the Program requires that development projects within 1,000 feet of the tidal influence of the Chesapeake Bay meet standards designed to mitigate adverse effects on water quality, and fish, plant and animal habitat. Local governments can also prohibit uses that they believe would adversely affect habitat or water quality within the Critical Area. Each jurisdiction within a critical area develops and implements a plan to achieve the objectives of the Program, which is subject to review and approval by the Commission.

Sources: Harford County Chesapeake Bay Critical Area Management Program, 2011; http://www.dnr.state.md.us/criticalarea/reg_act.asp.

Coastal Zone Management Act & Program

The Coastal Zone Management Act (CZMA) of 1972 provides for the management of the nation's coastal resources and helps balance economic development with environmental conservation. Maryland's Coastal Zone Management Program was approved in 1978 in response to the CZMA. With Coastal Zone boundaries that include 17 of the state's 23 counties bordering the Atlantic Ocean and the Chesapeake Bay, the program coordinates multi-agency initiatives that provide a framework for statewide water quality, hazard mitigation, public access and habitat restoration.

Sources: Coastal Zone Management Act of 1972; http://dnr.maryland.gov/ccs/pdfs/MD309AS2001.pdf.

Maryland's Military Installation Council

The Maryland Military Installation Council (MMIC) identifies what public infrastructure and community support is needed for the development and expansion of Maryland military installations and studies potential impacts of tentative development and expansion on local communities. The Council also researches best management practices regarding how other jurisdictions cope with increased development around military installations, and reviews State policies in order to best support the mission of the military installations and maximize economic benefits to local communities.

Source:http://msa.maryland.gov/msa/mdmanual/26excom/html/23military.htm

"PlanMaryland"

Maryland has implemented comprehensive state level and statewide planning and growth management policies and practices to promote "Smart Growth" (SG) principles. Smart Growth protects natural resources and promotes community character by leveraging investments in existing developed areas and limiting low density, single use "sprawl" development patterns and their associated public costs. Since 2009 local government Comprehensive Planning requirements have been expanded to include sustainable growth. PlanMaryland resulted in a sustainable growth plan for the 21st century focusing on trends and land use, visioning, state coordination and implementation, management and best management practices.

Source: http://plan.maryland.gov/plan/plan.shtml.

Transportation Plan, 2035

The 2035 Maryland Transportation Plan (MTP) looks to the future and identifies the state's most critical transportation challenges and needs, and provides a structure for how to address them through statewide visions, strategies and goals. The MTP incorporates related state goals for the economy, sustainable growth and the environment. It furthermore incorporates other agency transportation plans and public input and serves as the states guiding policy on transit. The MTP also establishes priorities and principles for implementation to be used in decision making regarding Maryland's transportation investments.

Source: Maryland Transportation Plan, 2035.

Local Jurisdictions

In Maryland authority to regulate land use is delegated by the state to counties and municipalities. The nature of a jurisdiction's authority to regulate local land use depends on that jurisdiction's form of local government. For instance, the "Land Use Article" of the Annotated Code of Maryland provides the legal basis for planning at the municipality and county level throughout most of Maryland. In such cases, the Article grants the authority to prepare a comprehensive or master plan, a zoning ordinance, and subdivision regulations for many of the state's municipalities.

Two of the Maryland counties within the APG JLUS study area, Cecil and Kent Counties, are "non-charter" counties and therefore derive their authority to regulate land use from the Land Use Article. Harford County is a charter county granted planning and zoning authority under the "Express Powers Act" in lieu of the Land Use Article.

These distinctions have relevance to the particular scope of the delegated authority, to procedural requirements affecting land use planning and regulation. In addition to their comprehensive plans and zoning ordinances, counties and municipalities may also elect to use other tools to address specific compatibility issues. For example, Maryland state regulations require a general notification of potential noise from military installations, but local jurisdictions may further specify that this notification be accomplished through the land development process or supplementary noise abatement techniques.

There are five incorporated jurisdictions (three counties and two cities) within the APG Study Area that are acting as "partners" in the JLUS; Harford County, Cecil County, Kent County, and the Cities of Aberdeen and Havre de Grace, with numerous smaller census designated places (CDP's) within unincorporated county lands. This JLUS focuses on areas most affected by APG activities and conversely, the areas that have the most potential to pose compatibility and mission protection issues for APG.

Harford County

Harford County extends over 526 square miles (over 15percent is water), with a 2012 population of 248,257, the people represent a sizable population that have the potential to be affected by APG missions. The County has utilized a variety of planning tools to achieve its goals for organized development and a safe environment for its residents.

Harford County Master Plan & Land Use Element Plan

The Harford County Master Plan is a policy document that assists in guiding the long range development plans of the County. The Master Plan, along with the Land Use Element Plan, establish goals and guiding principles upon which city officials' base decisions regarding development and growth. The 2012 update of the Master Plan contains elements outlining the County profile, the public engagement process, inter-jurisdictional coordination, and strategic framework of the County. The strategic framework section within the Master Plan details all of the other 'Element Plans' that were created by the various departments of the county. The visions, goals and guiding principles outlined in the various elements of the Master Plan and the Land Use Element Plan are important because they direct the implementation of specific regulations which influence the area around APG, which is located within Harford County.

Harford County Zoning Code

The Harford County Code contains the codified zoning ordinance which was adopted in 2008 and has been amended through January 2014. The ordinance categorizes the land within the County into seventeen districts, with several overlay districts, and provides development regulations for each district. Lot size requirements, lot area, parking, and height regulations are detailed under supplementary regulations, and a permitted use matrix is provided for each district. The County of Harford does not include overlay districts for airport or military zoning, although it does contain an overlay district for the Chesapeake Bay Critical Area. Article VII: District Regulations details each of the seventeen districts, their density allocations, and their height maximums. The R4 Urban Residential district allows for mid-rise and high-rise apartments up to five or six stories in height, and the B3 General Business District allows for four story row duplexes, but only within the Chesapeake Science and Security Corridor. The remainder of the residential, commercial and industrial districts restrict heights to three stories (aside from Industrial Districts which allow for 40 feet for industrial buildings). The Mixed Use Office district (MO) allows for retail and trade service buildings up to 65 feet in height, while transient housing is allowed up to a maximum height of 85 feet.

Article XI of the ordinance details regulations for telecommunication facilities. Articles V, VII and IX of the ordinance details regulations for outdoor lighting.

Airport Land Use Compatibility

Harford County does not currently regulate zoning for airport purposes, such as employing an Airport Overlay Zone, nor does it use an Airport Land Use Compatibility Plan (ALUCP). Airport Land Use Compatibility Plans establish planning boundaries and land use compatibility standards for airports that do not employ their own Airport Plan. Harford County does have authority to implement airport zoning regulations that would contribute to military compatibility in unincorporated areas proximate to APG. Article IX: Special Exceptions of the Harford County Code gives detail regarding transportation, communications and utilities exceptions in relation to air facilities, although it is in regards to public and private airports only and not military air facilities. The regulations, taken from the Code of Maryland Regulations (COMAR), state that the height of obstacles near each end of the runway must be compatible with takeoff and landing performance.

Other Harford County Tools

Real Estate Disclosure

Section 10-702 of the Real Property Article, Annotated Code of Maryland, requires the owner of certain residential real property to furnish to the purchaser either (a) a RESIDENTIAL PROPERTY DISCLAIMER STATEMENT stating that the owner is selling the property "as is" and makes no representations or warranties as to the condition of the property or any improvements on the real property, except as otherwise provided in the contract of sale, or in a listing of latent defects; or (b) a RESIDENTIAL PROPERTY DISCLOSURE STATEMENT disclosing defects or other information about the condition of the real property actually known by the owner. Certain transfers of residential property are excluded from this requirement.

Army Alliance

The Army Alliance, Inc. is a chartered nonprofit organization created to work with local, state and federal officials to promote continuous economic viability of APG. Army Alliance works with senior Army and DOD officials and local and State officials in making sure that APG remains a major component in the Army's long-term strategy.

Army Alliance periodically updates a strategic plan that outlines a number of proactive initiatives designed to attract additional Army activities as well as other federal research and development activities across the nation.

Source: http://armyalliance.org/

MOU between APG and Harford County

A Memorandum of Understanding (MOU) was adopted in 2009 titled 'Mutual Support for Emergency or Disaster Assistance between Aberdeen Proving Ground and Harford County, Maryland.' The MOU states that due to the common relationship between APG and Harford County, effective planning and support between the two entities is necessary. It mentions that mutual areas of interest as part of the MOU are comprehensive, including support and coordination of resources such as medical, police, fire, logistical, and technical or hazardous material (HAZMAT) assistance.

Cecil County

Cecil County comprises over 415 square miles (over 15 percent is water), with a 2010 population of 101,108 people. The County has utilized a variety of planning tools to achieve its goals for organized development and a safe environment for its residents.

Cecil County Comprehensive Plan

The Cecil County Comprehensive Plan, adopted in 2010, includes Elements for: land use, water resources (including potable water, wastewater, and stormwater), transportation, public facilities (including police, emergency services, schools, parks, and libraries), economic development, housing, environmentally sensitive areas, mineral resources, and other natural resources.

Cecil County Zoning Ordinance

The Cecil County Zoning Ordinance, originally adopted in 1993 and amended through 2010, categorizes the land within Cecil County into eighteen districts, providing development regulations for each. For each respective district the Code details maximum residential density provisions, building heights and outdoor lighting requirements. The majority of Cecil County lands proximate to APG military missions or located within APG noise contours include the Open Space (OS) district, the Northern and Southern Agricultural-Residential (NAR and SAR) districts, and the Rural Residential (RR) districts. Other Cecil County zoning districts encompassed by the APG 115 PK15 peak blast noise contour include the Manufactured Home (MH) district, the Maritime-Business (MB) district, the Development Residential (DR) district, both Light and Heavy Industrial (M1 and M2) districts, the

Village Residential (VR) district, the Multifamily Residential (RM) district, the Mineral Extraction A (MEA) district, the Suburban Residential (SR) district, and the Business General (BG) district.

Article V, Part VIII discusses utilities, specifically telecommunication structures and communication towers. Section 115 states that communication towers may be permitted in the BG, M1 and M2 zones, and as a special exception in the NAR, SAR, MH and RM districts providing they have setbacks three times the height of the tower from the nearest roadway. It furthermore states new towers shall be built at the lowest height possible, but pursuant to Section 168 communication towers are not subject to district height regulations.

Article VI Schedule of Zone regulations details yard requirements, as well as building height limitations per district. The OS district purpose is preservation, recreation and protection of resources, and therefore does not allow for residential land uses and most development. The RR, NAR, SAR, SR, VR, DR, RM, MH, MB and MEA districts all have maximum height limitations of 35 feet, while the BG district has a height maximum of 55 feet for commercial/ business oriented buildings, and the M1 and M2 industrial districts have height maximums of 75 feet. Additionally, Article V details several regulations for lighting, while Article VII details density by zoning district.

Airport Land Use Compatibility

Cecil County does not currently regulate zoning for airport purposes, nor does it use an Airport Land Use Compatibility Plan (ALUCP). The county does however employ an Airport Approach Zone, defined within Section 168 of Article VII. This Airport Approach Zone is defined by the FAA, but is aimed at civilian and commercial public airports. Given that the majority of the area surrounding APG and its two air fields is incorporated, Cecil County's authority to implement airport zoning regulations is limited, nor would it apply to APG, which resides in Harford County.

Special Area Plan- Urban Growth Boundary Plan

The purpose of this Urban Growth Boundary Study is to create areas around each of the Towns, whereby the provision of water and sewer infrastructure would be closely coordinated between the County and the respective Towns. The primary focus of this Study has been to seek input from the Towns on their existing ability to serve areas currently outside incorporated boundaries, and to evaluate ways to effectuate that service. In the US Route 40 corridor, the Urban Growth Boundaries (UGB's) are subareas of the larger Development and Suburban Districts. In the outlying areas, around the Towns of Rising Sun, Chesapeake City and Cecilton, the UGB's correspond to those areas designated as Town-Residential (TR) Zoning.

This plan also details future Annexation Areas of the Towns, which are derived from each town's comprehensive plan.

Other Cecil County Tools

Real Estate Disclosure

Property disclosure is mentioned in the Zoning Ordinance for Cecil County under the Right to Farm Ordinance, as well as under Section 293 Property Disclosure and Hold Harmless Statement, the latter of which details disclosure regarding property frontage on a publicly maintained road and access to public water and sewer lines.

Cecil County Strategic Plan

The Cecil County 2014-2019 Strategic Plan is the first comprehensive plan developed, approved, and adopted under the new system of charter government and specifically responds to the regulations described in Article 6, Section 601 (a). The process for developing the plan included the work of the Strategic Planning Advisory Network, public feedback, and a review by County employees and affiliate agencies.

Priorities of the plan including advancing lifelong educational opportunities for citizens of all ages, providing fiscal stability, implementing improvements in infrastructure, creating an environment that encourages economic growth through job creation, business development, and community revitalization, and improving the quality of life for citizens by enhancing safety and health in all communities.

Eastern Shore Land Conservancy

The Eastern Shore Land Conservancy (ESLC) is a non-profit corporation in good standing with the charitable division of the office of the Secretary of State of Maryland. They assist in the conservation of natural habitats and resources along the eastern shore of Maryland. To date, ESLC has:

- Protected nearly 47,000 acres of the Eastern Shore's important natural habitat areas and prime farmland through easements on 268 properties and the creation of three preserves;
- Assisted in the protection of another 7,400 on 16 properties.
- Established a record of preservation that far exceeds any other local land conservancy in Maryland and is one of the most successful in the country;
- Received conservation easement and other property interests on which more than $40 million worth of development rights have been extinguished;
- Rescued six highly threatened priority properties on 1,146 acres and worth more than $12 million using their Land Rescue Revolving Fund. In two cases, the properties are key links in trail systems and will allow public access and serve as permanent urban growth boundaries.

Source: http://www.eslc.org/

Kent County

Kent County is comprised of approximately 415 square miles (over 30 percent is water), with a 2010 population of 20,197 people and approximately 210 miles of shoreline. The County has utilized a variety of planning tools to achieve its goals for organized development and a safe environment for its residents.

Kent County Comprehensive Plan

The Kent County Comprehensive Plan presents a series of goals and strategies to guide the preparation of County regulations and the application of County programs. These goals and policies are organized in eight functional categories dealing with the economy, towns and villages, the countryside, the environment, housing, transportation, community facilities and public services, and historic and cultural preservation. Each section contains a summary of important issues and trends, a statement of goals which should guide the County's administrative programs, and a list of strategies that the County will take to reach these goals.

Kent County Zoning Code

Chapter 222 of the Kent County Code details the Land Use Ordinance, adopted in 2002 and amended through 2013. The Kent County Land Use Ordinance divides the land within the county into seventeen major districts in which the Code provides development regulations for these districts. Kent County does not include a stand-alone district provision or sub districts for military or Airport zoning, yet they do provide a unique section on Marine district regulations, although they do not apply to APG. Districts that fall within the APG 115 peak blast noise contour include the Agricultural Zoning (AZD) District, the Resource Conservation District (RCD), the Rural Character district (RC), the Rural Residential (RR) district, the Critical Area Residential (CAR) district, the Community Residential (CR) district, the Village (V) district, the Crossroads Commercial (CC) district, the Marine (M) district, the Employment Center (EC) district, and the Industrial (I) district.

Maximum height restrictions are delegated by district, in which many of them are specific (down to the heights per residential or commercial buildings use). The CC district allows for height maximums of 45 feet for commercial buildings and 38 feet for residential buildings, while the EC and I districts allow for height maximums of 45 feet for industrial buildings and 35 feet for residential buildings. All other districts within the noise contour boundaries (AZD, RCD, RC, RR, CAR, CR, V, and M districts) restrict building heights to 38 feet.

Collocation of personal wireless facilities on existing facilities is permitted in most zoning districts. Communication towers are permitted only as a special exception in the AZD, RCD, RC, CC, C, CCA, EC and I zoning districts. New communication towers are limited to 199 feet unless a variance is granted. Article V details regulations for outdoor lighting and maximum density by district.

Airport Land Use Compatibility

Kent County does not currently regulate zoning for airport purposes, nor does it have an Airport Land Use Compatibility Plan (ALUCP) although the Land Use code does establish an Airport Safety Zone within the Land Use Overlay for a proposed public airport. Because the area surrounding APG is within Harford County, airport-specific land use controls for Kent County would not be relevant to APG.

Other Kent County Tools

Real Estate Disclosure

Chapter 85: Farming, of the Kent County Code details a section on Real Estate transfer disclosure and a right to farm notice. The real estate transfer disclosure statement is written as follows:

> *"Upon any transfer of real property by any means, the transferor shall provide the purchaser or lessee a statement specifically advising the purchaser or lessee of the existence of this chapter that shall be substantially in the form approved by the Kent County Zoning Administrator and by resolution of the Board of County Commissioners. The transferor shall require that the purchaser or lessee sign the statement and have it recorded by the Kent County Clerk of Court."*

Kent County does not require additional disclosures specific to impacts from APG.

Eastern Shore Land Conservancy

The ESLC is a nonprofit charitable organization in Maryland that helps in conservation and easement acquisition of land. More information on ESLC is detailed in the previous section, under 'Other Cecil County Tools'.

City of Aberdeen

The City of Aberdeen encompasses roughly 6.8 square miles, had a 2010 population of 14,959 people, and has long supported mission protection for APG due to the location of the installation in the City of Aberdeen.

City of Aberdeen Comprehensive Plan

The City's Comprehensive plan was most recently updated in 2011, and includes the following elements: land use, municipal growth, transportation, community facilities, mineral resources, sensitive areas, housing, and water resources. The plan concludes with an Implementation chapter which details authority, smart growth measures, the development code and the capital improvement program. The guidelines outlined in the various elements of the Comprehensive Plan are important because of their potential impacts on operations at APG, which is located in Aberdeen.

City of Aberdeen Development Code

City of Aberdeen Municipal Code Chapter 235 contains the approved development code, or zoning ordinance, which was adopted in 1990 and has been amended through 2014. The code divides the land within the county into fifteen districts, and provides development regulations for these districts. Lot size requirements, lot area, parking, and height regulations are detailed under Article IV: Provisions Applicable to All Districts and a map is provided for each district. The City of Aberdeen does not include a stand-alone district provision or sub districts for airport or military zoning.

Section 235-24 of the Aberdeen Development Code details General Height requirements for residential, commercial and industrial districts, as well as exceptions and modifications.

While communication towers are allowed in the B-3, M-1, M-2, ORE, AG and TOD districts with special exception approval, no other height provisions that reference communication or transmission towers are specified within the Aberdeen Development Code. Additionally, several sections in the Code detail regulations for outdoor lighting.

Special Area Plans

The Aberdeen TOD Master Plan was completed in 2012 and details importance of the MARC commuter rail, the local and state highways, as well as possible future transportation amenities.

The TOD Master Plan helps give a tangible vision to a future that realized the potential growth at Aberdeen Proving Ground. Some strategies include better and/or additional shuttle bus service to connect APG with the train station and downtown Aberdeen, more frequent and mid-day shuttle service between downtown, the station, and APG employment zones, and even car-sharing at and around the station area and at APG.

Other Tools

Flood Control Ordinance

The City of Aberdeen has the responsibility under the Flood Control and Watershed Management Act, §5-801 - 809 et seq., Environmental Article of the Annotated Code of Maryland, to control floodplain development in order to protect persons and property from danger and destruction and to preserve the biological values and the environmental quality of the watersheds or portions thereof under its jurisdiction.

Chapter 275 of the City of Aberdeen Code is titled Floodplain Management and it details the establishment of a Floodplain District, development regulations for that district, as well as administration and enforcement for those floodplain regulations.

Real Estate Disclosure

While the City of Aberdeen has several sections in their Ethics chapter of their Code that refer to financial disclosure, it is not clear whether the City does or does not impose further affirmative disclosure requirements on a real estate vendor.

City of Havre de Grace

The City of Havre de Grace, located approximately five miles to the northeast of Aberdeen, encompasses roughly 6.9 square miles, including small areas of water, with a 2010 population of 12,952 people.

City of Havre de Grace Comprehensive Plan

The City of Havre de Grace has a Comprehensive Plan that was written in 2004, with amendments made to the Municipal Growth and Water Resources Elements in 2010. The Comprehensive Plan includes the following elements: municipal growth, historic preservation, economic development, transportation, community facilities, mineral resources, sensitive areas, housing, and water resources. The Plan also includes an Implementation chapter which details authority, recommendations, the development code and the capital improvement program. The guidelines outlined in the various elements of the Comprehensive Plan are important because of their potential impacts on operations at APG, which is located near Havre de Grace.

City of Havre de Grace Zoning Code

City of Havre de Grace Municipal Code Chapter 205 contains the approved development code, or zoning ordinance, which was adopted in 2000 and amended through 2009. The code divides the land within the city into seven districts, which are Residential (R, R-1, and R-2), Residential Office (RO), Residential Business (RB), Mixed Office/ Employment Center (MOE), and Commercial (C). Lot size requirements, lot area, and height regulations are detailed by district, and a map is provided for the districts. The City of Havre de Grace does not include a stand-alone district provision or overlay district for airport or military zoning.

Height regulations are sporadically detailed in the zoning ordinance by district. Height regulations are detailed in Table 1 of the Zoning Code, and while heights are usually delegated by district, the code goes in depth, giving height maximums by use. Most residential uses in the R-1 and R-2 districts are limited to 40 feet, while conditional use residential uses, duplexes, townhouses and semi-detached residential buildings in the RO and RB districts are allowed up to 60 feet in height, as long as yard setbacks increase by one foot for every two feet in excess of the 40 foot building maximum. Multi-family residential buildings in the R-2, RO and RB districts, as well as hotels permitted in the C and RB districts are allowed up to 80 feet. Most Commercial uses such as community facilities, parking facilities, schools and clubs are allowed up to 60 feet in height, while churches (permitted in R, R-1, R-2, and RO, RB and C districts) and hospitals are allowed up to 100 feet in height.

Utility structures are allowed up to 60 feet in height, and are permitted in the C district and conditionally permitted in the R, R-1 and R-2 districts provided their height equals their setback from adjacent residential properties. Utility structures are also conditionally permitted in the RO and RB districts, and are a special exception in the MOE district. Telecommunication towers are allowed in the MOE district provided several terms are met. No other height provisions that reference communication or transmission towers are specified within the Havre de Grace zoning code.

The zoning code provides additional regulations for density, found in Table 1 of the code. Several district regulations, such as the MOE district regulations, including provisions for outdoor lighting. Additionally, Chapter 116 of the Havre de Grace Code details noise prohibitions and exemptions.

Other Tools

Flood Control Ordinance

Chapter 78 of the City of Havre de Grace Code is titled Floodplain Management and it details the establishment of a Floodplain Zones and boundaries, development regulations for these zones, as well as variances and permit enforcement for those floodplain regulations.

Real Estate Disclosure

While the City of Havre de Grace has several sections in their Ethics chapter of their code that refer to financial disclosure, it is not clear whether the city does or does not impose further affirmative disclosure requirements on a real estate vendor.

Other Tools and References

Office of Economic Adjustment and NACo

In the interest of land use compatibility between the military and the local community, the DOD Office of Economic Adjustment (OEA) and other public interest groups, such as the National Association of Counties (NACo), have prepared educational documents and videos that educate and inform the public about encroachment issues and methods that can be used to address existing or future compatibility concerns. The following five resources have been published to inform the public on land use compatibility.

Guides

The Practical Guide to Compatible Civilian Development near Military Installations (July 2007), OEA

This guide offers general information on community development and civilian encroachment issues. The guide can be found at: http://www.oea.gov/.

Joint Land Use Study Program Guidance Manual (November 2006)

This manual provides guidance on the JLUS program, process, and efforts to support compatible development. This manual can be obtained on the OEA website at the following address: http://www.oea.gov/.

Encouraging Compatible Land Use between Local Governments and Military Installations: A Best Practices Guide (April 2007), NACo

This guidebook presents case studies of best practices between the military and communities through communication, regulatory approaches, and Joint Land Use Studies. The guide can be accessed on the NACo website at the following address: http://www.naco.org/.

Videos

The Base Next Door: Community Planning and the Joint Land Use Study Program, OEA

This informative video discusses the issue of encroachment near military installations as urban development occurs within the vicinity. This video can be accessed on the official OEA YouTube channel at: http://www.youtube.com/watch?v=6UiyWDgLeJM

Managing Growth, Communities Respond, OEA

This video highlights the lessons learned from three communities (Kitsap Naval Base in Bangor, Washington; Fort Drum in Jefferson County, New York; and Fort Leonard Wood in Pulaski County, Missouri) that have successful programs for managing growth near their respective military installations. This video can be accessed on the official OEA YouTube channel at: http://www.youtube.com/watch?v=rea6d3bDp3c

Professional Associations Network

The Professional Associations Network is an informal group composed of the Presidents (or their designated representative) of the APG Professional Associations. The APG PAN originated to assist in the coordination of the growing number of professional associations supporting the APG community and to accommodate the needs of our brethren and their associations that may be transitioning from other locations due to BRAC.

Identification of Compatibility Issues

Compatibility, in relation to military readiness, can be defined as the balance or compromise between community needs and interests and military needs and interests. The goal of compatibility planning is to promote an environment where both community and military entities communicate, coordinate, and implement mutually supportive actions that allow both to achieve their respective objectives.

A number of factors assist in determining whether community and military plans, programs, and activities are compatible or in conflict. For this Joint Land Use Study (JLUS), 24 compatibility factors were reviewed to identify, determine, and establish a prioritized set of key study area issues. These compatibility factors are listed below.

Compatibility Factors	
1 Air Quality	13 Legislative Initiatives
2 Anti-Terrorism / Force Protection	14 Light and Glare
3 Coordination / Communication	15 Marine Environments / Climate Change
4 Cultural Resources	16 Noise
5 Dust / Smoke / Steam	17 Public Trespassing
6 Energy Development	18 Roadway Capacity
7 Frequency Spectrum Capacity	19 Safety Zones
8 Frequency Spectrum Impedance / Interference	20 Scarce Natural Resources
9 Housing Availability	21 Sensitive Biological Resources
10 Infrastructure Extensions	22 Vertical Obstructions
11 Land / Air / Sea Spaces	23 Vibration
12 Land Use	24 Water Quality / Quantity

Of the 24 compatibility factors considered, several were determined to be inapplicable to this JLUS: Air Quality, Anti-Terrorism / Force Protection, Cultural Resources, Energy Development, Light and Glare, and Public Trespassing.

Similar issues were consolidated into single compatibility factors. For example, the Marine Environments and Climate Adaption issues were consolidated into one factor since the impacts associated with each of these are very similar.

Issues

At the initial committee workshops and subsequent public forums, groups were asked to identify the location and type of compatibility issues they thought existed today, or could occur in the future, using the 24 factors as a guide. A number of individual issues were identified for each factor. Additional technical issues were analyzed and added based on available information and similarity with other community JLUS experiences around the country.

Setting Priorities

The public and committees provided input on establishing priorities for the compatibility factors and issues. Priorities were used to determine the type and timing of associated actions for each issue. Three criteria were utilized to prioritize the compatibility factors:

- Is it a Current Impact? Each issue was considered based on its current impact to the compatibility of either APG or the surrounding areas. Issues posing the most extensive operational constraints or community concerns constitute the highest priority.
- Location. This criterion assesses the proximity of each issue in relation to activities occurring on APG and surrounding areas. Issues occurring near the installation are often more critical than those occurring remotely.
- Potential Impact. Although an issue may not have a current impact on the installation or the community, it may possess the ability to become an issue in the future. Should conditions change, adjacent or proximate development increase, or other issues become apparent, new conflicts with existing or future missions and operational activities at APG could arise. Issues were considered based on their future potential using the same criteria that were established for current impact.

With a comprehensive list of issues to address in the JLUS, the public and Advisory Committee (AC) identified the relative priority of each compatibility factor. The Executive Committee finalized the prioritization of issues based on public and AC input, categorizing the factors into four categories:

- High-Priority. Due to the nature of these issues, an immediate response is warranted. Issues identified as High Priority are to be initiated within 1-2 years following completion of the JLUS.
- Medium-Priority. To be initiated within 3-4 years following completion of the JLUS.
- Low Priority. To be initiated in 5 or more years following completion of the JLUS.
- Awareness Factors. Awareness factors are those issues that pose a minimal impact to APG and/or the surrounding jurisdictions and are documented in this JLUS for the purpose of maintaining operational awareness. These items do not require action at the current time, but should be monitored in the long term.

APG Compatibility Issues by Factor

Coordination / Communication refers to the programs and plans that promote interagency coordination. Interagency communication serves the general welfare by promoting a more comprehensive planning process inclusive of all affected stakeholders. Interagency coordination also seeks to develop and include mutually beneficial policies for both communities and the military in local planning documents such as general plans. The following Coordination / Communication issues were identified:

- Coordination between APG and Jurisdictions. Coordination between APG and local jurisdictions on area planning and land use issues is informal and inconsistent leading to a lack of information sharing and coordinated evaluation of development impacts. Jurisdictions do not understand APG requirements that affect long-range development plans.
- Communication of Remediation Activities. Installation's Water quality improvement efforts are not adequately conveyed to the public.
- Formal Coordination Process. No formal process to notify APG of development actions outside the fenceline.
- Base Community Relations Outreach. APG community relations outreach extends to Harford and Cecil County but does not include Kent County which is informed only through media alerts.
- Communication of APG Activities. Public's nominal mission understanding affects community support for APG.
- Communication from APG with Outside Community. Because communications are not formalized, the level of APG communication with outside jurisdictions is perceived as dependent on leadership interest which can fluctuate with changes in leadership.
- Coordination on Multi-Jurisdictional Infrastructure Improvements. Coordinate multijurisdictional infrastructure improvements to ensure all jurisdictions are notified and can plan appropriately for impacts in affected areas. This will help avoid previous scenarios where intersection improvements were not fully coordinated across jurisdictions and resulted in relocation of water lines and regulatory takings of homes in roadway widening areas.
- Engagement from APG on Area Planning Issues. Installation planners attend local jurisdiction planning meetings but lack of active participation is perceived as indifference.
- Security Issues Not Communicated. Harford County Sheriff is not regularly informed about events that happen on the installation that affect the outside community.
- Complaint Documentation Process. Notifying APG and documenting noise and vibration complaints, particularly when there is private property damage, is perceived as onerous to homeowners.
- Energy Conservation Efforts. Need for coordinated effort on regional energy conservation efforts to ensure that solutions from all parties are considered. Providing an inclusive process that considers solutions from multiple sources will ensure the best outcomes for all regional stakeholders. This will alleviate organizations potentially working at cross-purposes such as with the waste-to-energy plant

where the decision to potentially reuse or demolish the facility was made after significant investment and without the transparent exploration of alternatives.

- Coordination on Public-Private Partnerships. Need for coordination between APG and surrounding jurisdictions on Public-Private Partnerships, such as housing and Enhanced Use Leasing that may impact areas outside APG to balance the viability of communities while addressing the ongoing needs of APG.
- Wildlife Hazards. Communication and coordination between various agencies is required to manage bird populations and control the size of the deer herd in the Aberdeen Area and Edgewood Areas to reduce the potential for negatively affecting military activities including aircraft strikes.

Dust, Smoke, and Steam is a by-product generated by both military and civilian activities. The primary dust, smoke, and steam-related issues in this JLUS are associated with military vehicle testing. Dust, smoke, and steam are compatibility issues if sufficient in quantity to impact military and / or flight operations, such as reduced visibility or cause equipment damage, or if military activities cause dust, smoke, or steam to interfere with civilian uses or quality of life. The following Dust, Smoke, and Steam issues were identified:

- Dust Generation from Testing Activities at APG and Dust, Smoke, and Steam from Activities outside APG. Military activities at APG automotive test areas can create fugitive dust impacts outside APG and dust, smoke, and steam from activities outside APG can migrate onto APG.

Frequency Spectrum Impedance/Interference is the interruption of electronic signals due to the existence of a structure or object between the source of the signal and its destination (receptor). Such obstructions can include wind turbines, cell towers, and tall buildings depending on the ground-level elevation at the site and the numbers of structures within a confined area. The following Frequency Spectrum Interference / Impedance issues were identified:

- No Coordinated Assessment of Hazards Associated with Frequency. Though there is informal coordination between CERDEC, other tenants, and APG to deconflict frequency use during CERDEC ground-to-satellite tests, there is no plan to coordinate and assess near-zone and far-zone hazards associated with ground-to-satellite tests.
- Potential for Ground-Based Interference. Line-of-sight signal transmission between Aberdeen Area and Churchville Test Site can be impacted from potential signal interference.
- Potential to Disrupt Aircraft Navigational Systems. Coordination of signal transmission frequency testing and angle of transmission with area aircraft is required to ensure that potential disruption to aircraft navigational systems does not occur.
- Potential for Harford Metropolitan Area Network to Impact APG. Harford County is pursuing the Harford Metropolitan Area Network (HMAN) project for high speed fiber optic transmission for the County, the municipalities of Havre de Grace, Bel Air and Aberdeen, and businesses throughout the county. Though current phases include only hardwiring, any proposed Wi-Fi in the future may create a radiating signal bloom that could potentially impact APG frequency testing.
- Radio Frequency Interference Affects Emergency Services Communications. Jurisdictions on both sides of Chesapeake Bay have experienced EMS radio system outages from unknown sources speculated to come from APG.
- APG Electronic Warfare Footprint. Concern that electronic warfare footprint associated with APG research and testing activities can spill-over into adjacent jurisdictions. Land uses that occur outside of APG that rely on wireless signals could have the potential to impact activities at APG.
- Coordination with Broadband Providers. Lack of coordination between broadband providers and APG can result in signal interference from use of bi-directional amplifiers outside the fenceline.

- Marine Frequency on Range. Potential for signal interference with waterfront lanes / marine frequencies on range.

Frequency Spectrum Capacity is the entire range and capacity of electromagnetic frequencies used for communications and other transmissions, which includes communication channels used for radio, cellular phones, and television. In the performance of typical operations, the military relies on a range of frequencies with reliable capacities for communications and support systems. Similarly, public and private users rely on a range of frequencies in the use of cellular telephones and other wireless devices used on a daily basis. The following Frequency Spectrum issues were identified:

- Comprehensive Frequency Management Program. Need for a comprehensive Frequency Management Program to assess current and future frequency needs of all APG tenants inside and outside the fenceline to deconflict frequency requirements.

Housing Availability addresses the supply and demand for housing in the region, the competition for housing that may result from changes in the number of military personnel, and the supply of military family housing provided by the installation. The following Housing Availability issues were identified:

- Urban Environments. Urban city environments such as Baltimore City provide amenities and lifestyle attractive to young professionals. These urban environments are unavailable proximate to APG. APG personnel choosing to reside in an urban environment will have a longer commute adding to regional roadway congestion. The lack of urban environments proximate to APG may put the installation at a disadvantage for attracting younger job seekers.

Infrastructure Extensions covers the extension or provision of infrastructure (i.e., roads, sewer, water, etc.). The extension or expansion of community infrastructure to a military installation or areas proximate to an installation have the potential to induce growth, potentially leading to incompatible uses and conflicts between military missions and civilian communities. Through careful planning, the extension of infrastructure can serve as a mechanism to guide development into appropriate areas, protect sensitive land uses, and improve compatibility of land uses and military missions. The following Infrastructure Extensions issues were identified:

- Water provision to APG Edgewood Area. The current service agreement with Harford County for water provision to the Edgewood Area is a non-binding short-term temporary solution for Winters Run Creek production deficiencies. Long-term solutions for Edgewood water will require new infrastructure.
- Coordination of Easements on APG Property. There is utility infrastructure traversing APG property without a formal agreement with APG at the Churchville Test Site. Formal easements are necessary to know which agency requires maintenance access, to coordinate access when needed, and to prevent potential liability issues.

Land, Air and Sea Space Competition is the management or use of land and air space to accomplish testing, training, and operational missions. These resources must be available and of a sufficient size, cohesiveness, and quality to accommodate effective training and testing. Military and civilian air operations can compete for limited air space, especially when the airfields are in close proximity to each other. Use of this shared resource can impact future growth in operations for all users. The following Competition for Land and Air Spaces issues were identified:

- JLENS Program. Public perception that the JLENS program could impact rights to privacy.

Land Use planning and regulation relates to the government's role in protecting the public's health, safety, and welfare. Local jurisdictions' general plans and zoning ordinances can be the most effective tools for avoiding or resolving land use compatibility issues. These tools balance land use compatibility with safety and noise zones and imaginary surfaces to promote development patterns appropriate for the airfield vicinity while protecting public property rights. Land use separation also applies to properties where the use of one property may adversely impact the use of another. For instance, industrial uses are often separated from residential uses to avoid impacts related to noise, odors, lighting, and so forth. The following Land Use issues were identified:

- Incompatible Land Development. More intense land development throughout the Study Area has the potential to inhibit mission-critical activities at APG.
- Real Estate Disclosures Inconsistent Across Jurisdictions. Inconsistent application of real estate disclosures results in patchwork of new home buyer knowledge of installation impacts on properties.
- Potential for New Mission Footprints Constrained by Environmental Constraints. Buffers for wetlands, wildlife, and eagle nesting potentially reduce developable land for additional missions at Aberdeen Area.
- Eastern Shore Properties Present Possible Encroachments. Real estate easement instruments for properties with noise monitoring equipment on Eastern Shore do not contain legal descriptions resulting in access that may be outside the easements.
- Identification of Encroachment Buffers. Encroachment buffers around APG are not identified on City and County planning documents.

Legislative Initiatives are proposed changes in relevant policies, laws, regulations or programs which could potentially have a significant impact on one or more substantive areas of concern to both the facility and to the stakeholder communities. The focus of this compatibility issue is on initiatives with general and broad implications. The following Legislative Initiative issues were identified:

- Environmental Regulatory Impacts. Federal and state environmental regulations reduce the APG buildable footprint and ability to accommodate new missions.

Marine Environments / Climate Adaptation is attempting to mitigate the potential impacts caused by climate change, which is the gradual shift of global weather patterns and temperature resulting from natural factors and human activities (e.g. burning of fossil fuels) that produce long-term impacts on atmospheric conditions. The effects of climate change vary and may include fluctuations in sea levels, alterations of ecosystems, variations in weather patterns, and natural resource availability issues. The results of climate change, i.e. ozone depletion and inefficiencies in land use, can present operational and planning challenges for the military and communities as resources are depleted and environments altered. The following Marine Environments / Climate Adaptation issues were identified:

- Dredging Requests to Aberdeen Proving Ground. The Port of Baltimore has engaged APG over the last couple of decades about receiving dredging spoils. Though APG is not currently a designated receiver site in the Army Corps of Engineers Dredged Material Management Plan, the upland placement of dredging spoils could be used to combat potential sea-level rise.
- Long-Term Plan for Environmental Impacts from Climate Change. Sea level rise studies indicate that portions of APG may be underwater as early as 2050 necessitating a long-term mitigation plan for APG.
- Conowingo Dam Impacts Aberdeen Proving Ground. When Conowingo Dam floodgates are open, debris, sediment, and flooding occur along Spesutie Island.
- Disposal of Dredged Material Destined for Cecil County and Associated Risk from Unexploded Ordnance. Concern that dredging spoil disposed of in Cecil County may carry risks of unexploded ordnance. Consideration that these spoils could be used for shoreline stabilization at APG to combat sea-level rise.

Noise is the result of both military mission exercises and construction and development activities. This factor can be incompatible with sensitive land uses. Noise that is loud and extending into night hours can disrupt the lives of the public. The following Noise issues were identified:

- Noise from Installation Activity. Noise from activities at APG has the potential to affect sensitive noise receptors in surrounding communities.
- Regional Noise Sources. There are other sources of blasting than APG within the region which can be misattributed to APG testing.
- Overflight of the City of Havre de Grace. APG overflight of the City of Havre de Grace creates general noise nuisance.

Roadway Capacity relates to the ability of existing freeways, highways, arterials, and other local roads to provide adequate mobility and access between military installations and their surrounding communities. The following Roadway Capacity issues were identified:

- Peak Hour Traffic (Traffic Loads at Gates). Peak hour traffic including a mid-day peak causes congestion and traffic delays outside the installation which have a quality of life impact for those working at APG and those traveling the area.
- Public Transportation Connections. Amtrak and MARC commuter trains stop near the boundary of both APG and Edgewood, but there is no direct transit connection from the stations into the installation.
- Increased APG Commuter Traffic Affects Local Roads and Level of Service. APG commuter traffic affects local roads and contributes to level of service impacts:
    - Westbound commuter traffic to APG cuts through local subdivisions via I-95 to reach the installation
    - Traffic switching between Route 40 and I-95 to avoid higher I-95 eastbound toll creates failing LOS at US Route 40 and State Hwy. 222 interchange
    - Congestion on Harford County cross arteries such as MD 543 and 152
- Traffic congestion creates safety hazard at MD 543 at I-95 interchange.

Safety Zones are areas in which development should be more restrictive, in terms of use and concentrations of people, due to the higher risks to public safety. Issues to consider include aircraft accident potential zones, weapons firing range safety zones, and explosive safety zones. The following Safety issues were identified:

- Awareness of Range Fires. During dry months of the year, certain testing procedures can cause brush fires. These fires need to be maintained and proper communication needs to be provided outside of APG regarding their potential effects.
- Unexploded Ordnance. Areas at APG could still contain unexploded ordnance buried underground which potentially pose a safety risk for adjacent development outside the fenceline.
- Incompatible Uses in Accident Potential Zones. Incompatible uses in the Accident Potential Zones extend into Harford County and the City of Aberdeen creates a safety concern.

Sensitive Biological Resources include federal and state listed species (threatened and endangered species) and their habitats. These resources may also include areas such as wetlands and migratory corridors that are critical to the overall health and productivity of an ecosystem. The presence of sensitive biological resources may require special development considerations and should be included early in the planning process. The following Sensitive Biological Resources issues were identified:

- Eagle Nesting Sites. Eagle nesting site buffers impact ability to carry out mission-critical activity and contribute to reduced development areas.

Scarce Natural Resources involves pressure to gain access to valuable natural resources, such as oil, natural gas, and minerals, located on military installations, within military training areas, or on public lands historically used for military operations, can impact land utilization and military operations. The following Scarce Natural Resources issues were identified:

- Water Quantity / Quality at Edgewood. Harford County water supply to Edgewood is temporary because of Harford County's own service demand.

Vertical Obstructions are structures that impede navigable airspace for both military and civilian aircraft operations. Structures that pose a threat to the airspace for military and civilian aviation include tall wind turbines and wireless communication towers. It is important to ensure the communities adjacent to APG plan accordingly to safeguard against unintended safety concerns relative to structures that obstruct navigable airspace. The following Vertical Obstructions issues were identified:

- Vertical Obstructions Understanding. Lack of awareness of vertical obstruction requirements within jurisdictions surrounding APG can lead to incompatible development.

Vibration is an oscillation or motion that alternates in opposite directions and may occur as a result of an impact, explosion, noise, mechanical operation, or other change in the environment. Vibration may be caused by military and / or civilian activities. Some studies have shown that homeowners become concerned about the structural rattling and potential damage when the peak decibels exceed 120 dBP (peak sound level), but actual damage isn't likely to occur at decibels lower than 150 dBP. The following Vibration issues were identified:

- Vibration Damage in Study Area Communities. Vibration from APG ordnance testing has the ability to cause physical property damage in areas throughout the study area on both sides of the Chesapeake Bay.

Water Quality and Quantity is the factor that assesses the quantity and quality of water resources in the APG JLUS Study Area. This factor evaluates the amount of water that is utilized by the installation relative to the available supply of water and then compares that with the demand and supply that is utilized by the surrounding communities to provide for the necessary public services. In addition to evaluating the water supply, this factor also reviews the overall quality of public water use in the JLUS Study Area. Water quality can be affected by military operations, public recreation use and stormwater drainage. The following Water Quality and Quantity issue has been identified:

- Havre de Grace Marina Siltation. The Spesutie Island Causeway is a potential source of sediment buildup near the Havre de Grace Marina which is reported to affect local boating and the Chesapeake Bay ecosystem.
- Edgewood Area Lacks an Uninterruptable Water Supply. The Edgewood Area water source is subject to periodic production shortages. Supplemental water to the Edgewood Area from Harford County is temporary. A reliable source of water to serve the Edgewood Area is needed to meet current and future needs.
- Aberdeen Area Lacks an Uninterruptable Water Supply. The source of water for the Aberdeen Area suffers from periodic production shortages due to flows that cannot be maintained during moderate drought periods. Back-up water supplies are provided from Harford County by way of the City of Aberdeen through a collective MOU which expires in 2017.
- EUL Site On Top of Aquifer Recharge Infiltration Field. The EUL site is located within the Source Water Protection Area that encompasses the water wells for Harford County and the City of Aberdeen. There is a concern that future EUL development can impact the aquifer recharge associated with the wells.
- Stewardship of Chesapeake Bay Waters. Perception that counties are providing a disproportionate amount of funding versus APG to clean the Chesapeake Bay.

Please see the next page.

Implementation Plan

This section identifies and organizes the recommended courses of action (strategies) that have been developed through a collaborative effort between representatives of Harford County and its JLUS partners: local jurisdictions, APG, state and federal agencies, local organizations, the general public, and other stakeholders that own or manage land or resources in the region. Because the APG JLUS is the result of a collaborative planning process, the strategies in this section represent a true consensus plan; a realistic and coordinated approach to compatibility planning developed with the support of stakeholders involved throughout the process.

The JLUS strategies incorporate a variety of actions that can be taken to promote compatible land use and resource planning. Existing and potential compatibility issues arising from the civilian / military interface can be removed or mitigated through implementation. The recommended strategies function as the heart of the JLUS document and are the culmination of the process.

The key to the implementation of strategies is the establishment of the JLUS Implementation Coordination Committee (see Strategy COM-1A) to oversee the execution of the JLUS. Through this committee, local jurisdictions, APG, and other selected partners can continue their collaboration to establish procedures, recommend, or refine specific actions, and adjust strategies over time to promote the resolution of key compatibility issues through realistic strategies and implementation.

Implementation Plan Guidelines

The key to a successful plan is balancing the different needs of all involved stakeholders. In working towards a balanced plan, several guidelines became the basis upon which the strategies were developed. These guidelines included:

- In concert with the Maryland state laws, the Implementation Plan was developed with the understanding that the recommended strategies must not result in a taking of property value. In some cases, it may be determined that recommended strategies can only be implemented with new enabling legislation.
- In order to minimize regulation, where appropriate, strategies were recommended only for specific geographic areas to resolve the compatibility issues identified.
- Similar to other planning processes that include numerous stakeholders, the challenge is to create a solution or strategy that meets the needs of all parties. In lieu of eliminating strategies that do not have 100% buy-in by all stakeholders, it was determined that the solution / strategy may result in the creation of multiple strategies that address the same issue but would be tailored to individual jurisdictions or agencies.

APG Military Compatibility Areas

In compatibility planning, the generic term "Military Compatibility Area" (MCA) is the term used to formally designate a geographic area where military operations may impact local communities, and conversely, where local activities may affect the military's ability to carry out its mission. The MCAs are geographic areas where the majority of the recommended strategies apply. The proposed APG Military Compatibility Area Overlay District (MCAOD) is an area that incorporates all of the MCAs.

The use of MCAs and the MCAOD ensures that strategies are applied to the appropriate areas, and that locations not affected by a specific compatibility issue are not impacted by regulations or policies that are not appropriate for their location or circumstance.

The MCAs are proposed to accomplish the following purposes:

- Promote an orderly transition between community and military land uses so that land uses remain compatible.
- Protect public health, safety, and welfare.
- Maintain operational capabilities of military installations and areas.
- Promote the awareness of the size and scope of military mission areas to protect areas separate from the actual military installation (i.e., critical air space) used for mission purposes.
- Establish compatibility requirements within the designated area, such as requirements for sound attenuation, real estate disclosure, and air navigation easements.

There are four proposed MCAs for the area around APG that comprise the MCAOD. These MCAs (described in the following paragraphs) are:

- Noise MCA
- Safety MCA
- Vertical Obstruction MCA
- BASH MCA

Figure 5 shows the combined MCAOD and Figures 6 through 9 provide maps of the respective MCAs.

Noise Military Compatibility Area

The Noise MCA includes all land located outside APG within the noise contours for 115 PK15 (met) peak blast or 57 decibels averaged C-weighted (CDNL) noise levels (Land Use Planning Zone) associated with ordnance testing and other military activities at APG. This MCA encompasses land areas which are identified by APG as posing the potential for noise complaints from ordnance testing. The APG Noise MCA is illustrated on Figure 6.

Noise is often a concern to the public surrounding military installations that have flying or ordnance testing missions. The siting of residential and other land uses such as schools and hospitals which are particularly sensitive to noise, are not recommended within areas identified in this MCA.

Coordination among local jurisdictions, developers, and organizations and agencies responsible for the siting of noise sensitive uses is recommended within the Noise MCA. Including the Noise MCA in local planning documents will provide public awareness, and where possible, land use controls may be used to reduce the potential for the proliferation of noise sensitive uses where they are most impacted by APG operations.

Additional information and technical background explaining the various noise measurement units [i.e. CDNL vs. PK15 (met)] and specific noise contours associated with ordnance testing is provided in the Military Profile found within the Chapter 3 of the Background Report.

Safety Military Compatibility Area

The Safety MCA comprises the existing Phillips Army Airfield Clear Zone (CZ), Accident Potential Zones I and II (APZ I and APZ II), and the Weide Army Heliport CZ and APZ I. The APG Safety MCA is illustrated on Figure 7.

The proposed Safety MCA identifies areas where measures would be applied to regulate compatible land use types and densities / intensities of development outside APG. Since the safety zones at Weide Army Heliport and the Phillips Army Airfield CZs do not extend off the installation, the MCA contains only portions of APZ I and APZ II associated with Phillips Army Airfield that extend into Harford County and the City of Aberdeen. The current location of the safety MCA is based on the Phillips Army Airfield layout and air operations identified in the APG Master Plan and dimensions identified in DOD's United Facilities Criteria (UFC) 3-260-01, Airfield and Heliport Planning and Design.

Each of the safety zones has recommended guidelines of the type of development that should not occur within them. These guidelines are found in the DID Instruction 4165.57. Compatibility guidelines preclude land uses that concentrate large numbers of people, such as residences, apartments, churches, and schools, from being sited within APZs. While the likelihood of an accident is remote, the DOD recommends low density

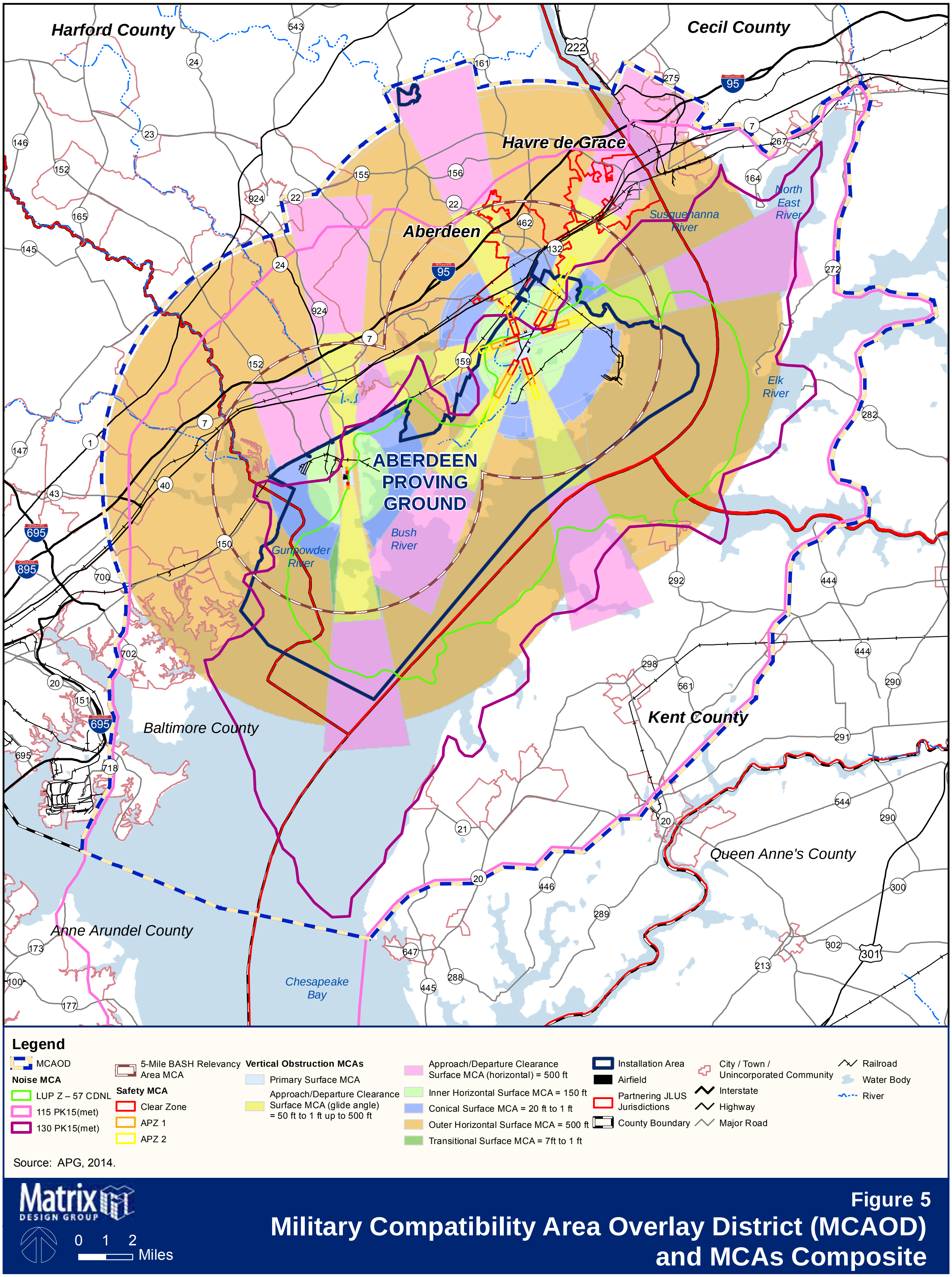


Figure 5
Military Compatibility Area Overlay District (MCAOD) and MCAs Composite

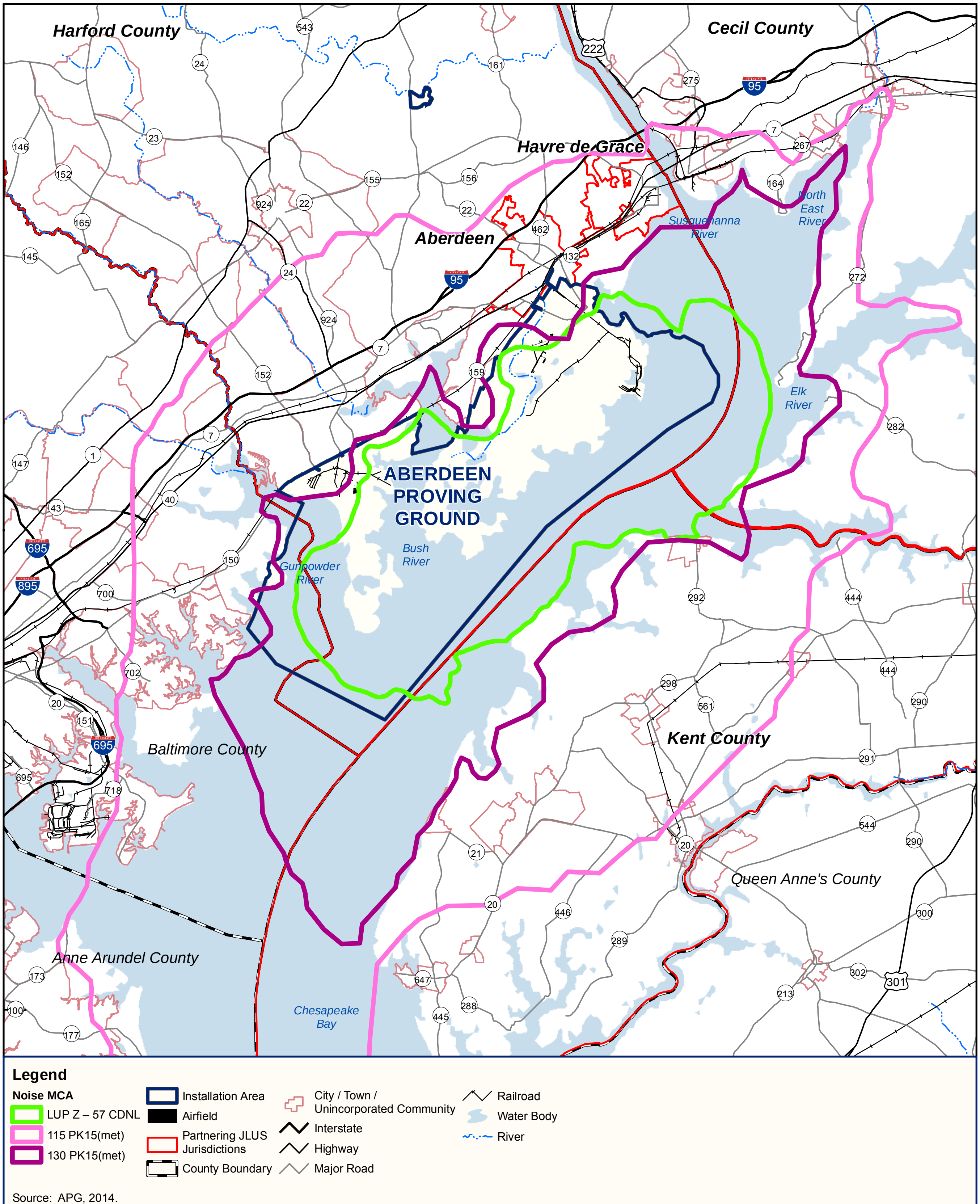


Figure 6
Noise MCA

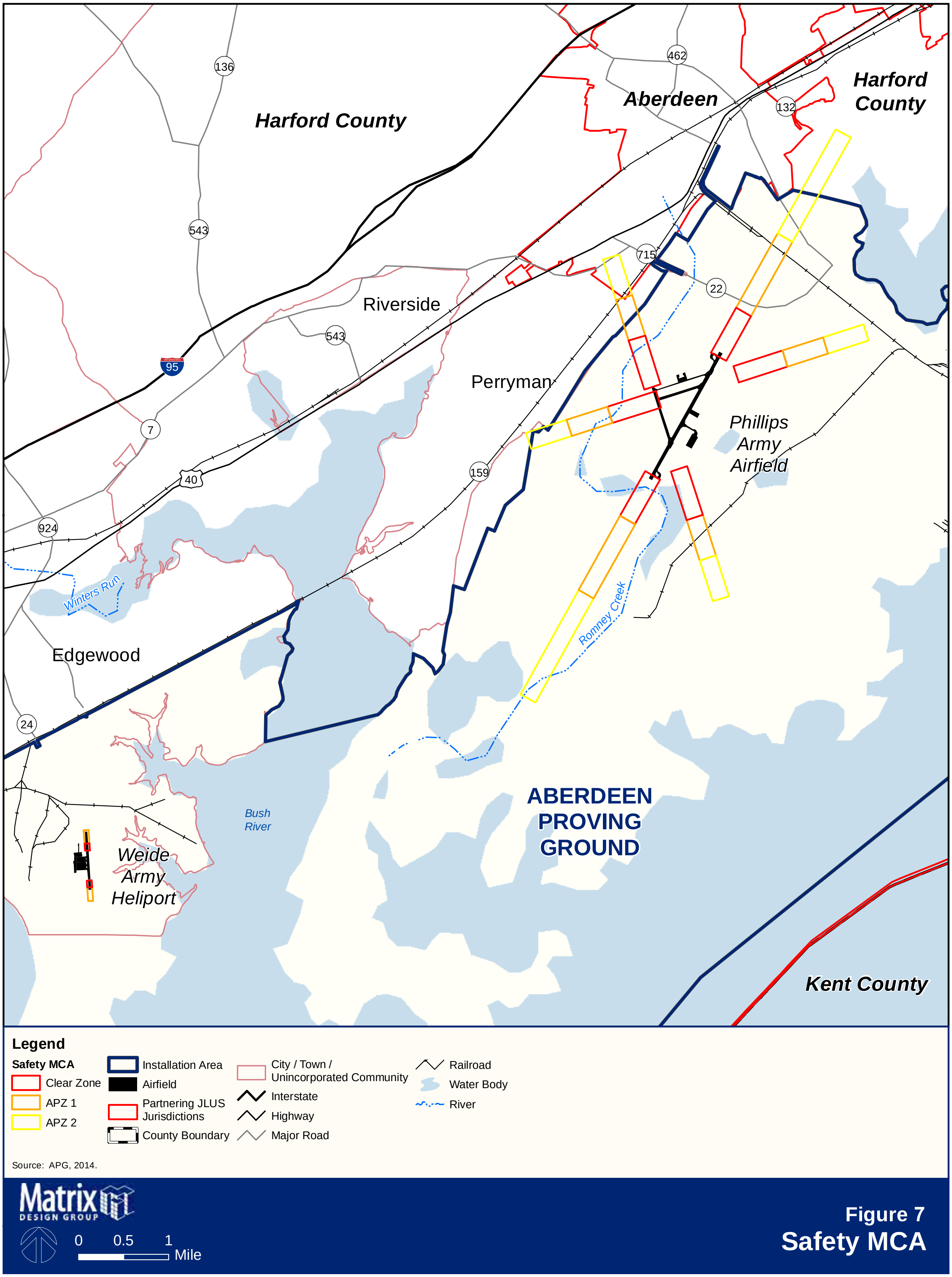


Figure 7
Safety MCA

land uses within the APZs to ensure the maximum protection of public health and property.

Within APZ I, residential uses are not recommended and only limited low intensity non-residential uses are recommended. Detached single family residential uses – up to 2 units per acre are recommended within APZ II. Other compatible uses in APZ II include agriculture, limited intensity office / retail, and light industrial. Development within the areas proximate to these safety zones should be reviewed for compatibility with both current military mission and future missions.

Vertical Obstruction Military Compatibility Area

The Vertical Safety MCA is based on the DOD Imaginary Surfaces – a set of surfaces in 3-dimensional space designated to prevent the risk of structures becoming vertical obstruction hazards to aircraft. These surfaces include both sloping surfaces radiating outward from the runway and surfaces with maximum heights that extend along the horizontal plane. Some of the more critical surfaces include the Inner Horizontal Surface, which restricts development of structures up to 150 feet above airfield elevation and the Approach-Departure Clearance Surface which includes a 500-foot slope from the end of the runway out to a distance of approximately 4.7 miles. The Vertical Obstruction MCA is intended to follow the DOD imaginary surfaces with regard to structure height and is not intended to reduce or change DOD guidance with regard to maximum height of structures.

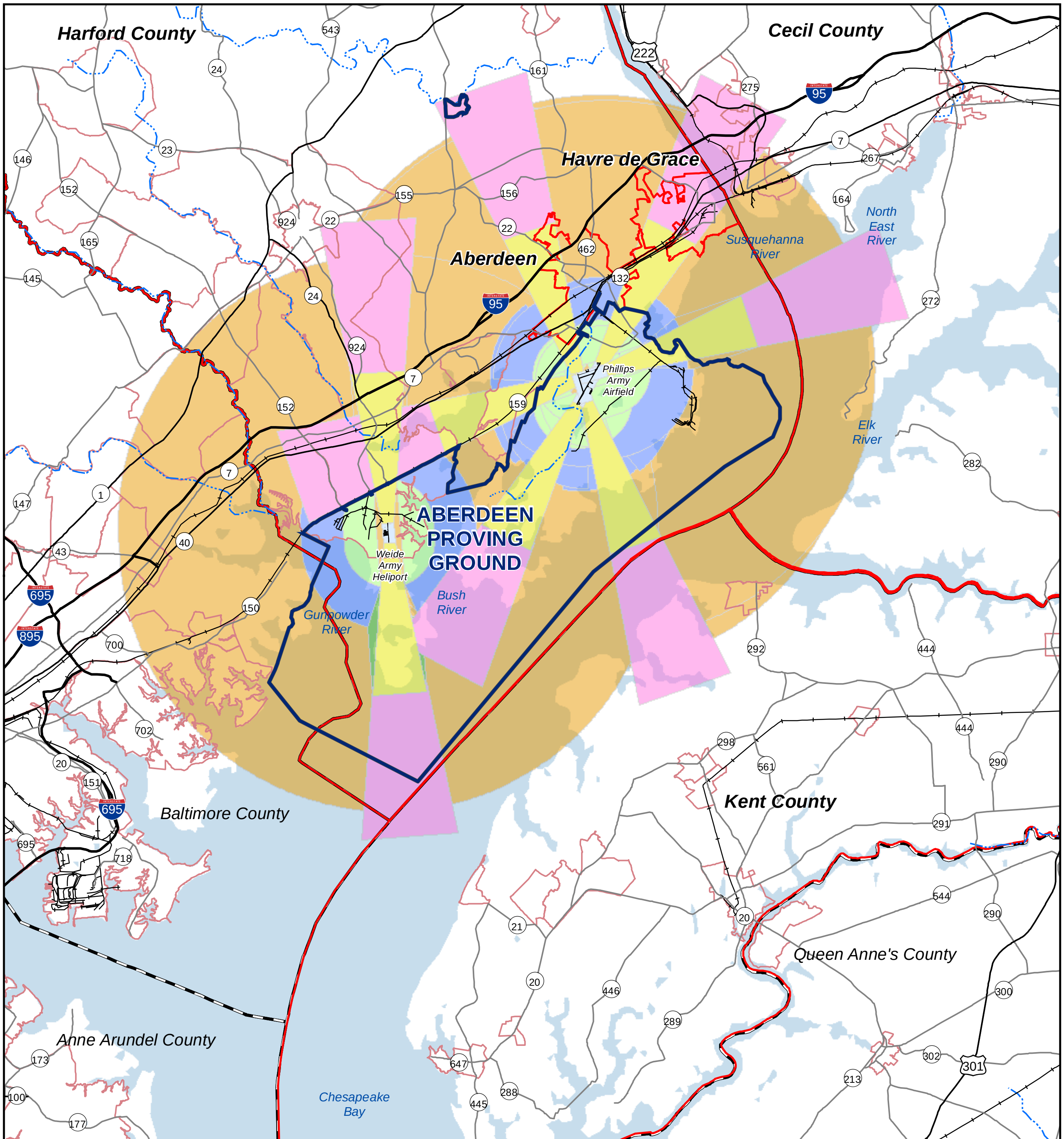
A potential source for aircraft accidents to occur is related to the presence of vertical obstructions in areas that are frequently used by low flying aircraft. Vertical obstruction issues are a major concern to flight operations and training due to the potential for a building or structure to extend into navigable airspace and impede the safety of flight operations. Vertical obstructions can affect flight safety, line of sight, and even frequency. Examples of potential vertical obstructions include communications towers (radio, television, cellular, microwave, etc.), silos, electric transmission towers and lines, and similar manmade structures.

While the presence of vertical obstructions can sometimes be mitigated by altering flight tracks, increasing minimum allowable flight altitudes or similar risk reduction measures, the proliferation of vertical obstructions or their placement along key flight routes can cause long term changes in the viability of navigable airspace, ultimately affecting the sustainability of military missions. The APG Vertical Obstruction MCA is illustrated on Figure 8.

BASH Military Compatibility Area

The APG Bird and Wildlife Strike Hazard (BASH) MCA extends out from nearest air operations area of both the Phillips Army Airfield and the Weide Army Heliport a distance of five statute miles. This MCA is meant to include areas around the airfield with the highest safety concerns if concentrations of birds or bird-attracting uses were located there. Bird strikes with aircraft can have serious safety concerns, including the potential for loss of life and / or aircraft. Even minor bird strikes can cause costly repairs to aircraft and interfere with flight missions. However, helicopters are less likely than most fixed-wing aircraft to suffer major damage from BASH incidents.

The five-mile distance associated with the BASH MCA is an FAA recommended standard for managing bird attractants around runways. Developments like landfills, landfill transfer stations, developments with major water features are just some examples of uses that may attract birds within the approach and departure flight corridors in an around APG. The APG BASH relevancy area MCA is illustrated on Figure 9.



Legend

Vertical Obstruction MCA

- Primary Surface MCA
- Approach/Departure Clearance Surface MCA (glide angle) = 50 ft to 1 ft up to 500 ft
- Approach/Departure Clearance Surface MCA (horizontal) = 500 ft
- Inner Horizontal Surface MCA = 150 ft
- Conical Surface MCA = 20 ft to 1 ft
- Outer Horizontal Surface MCA = 500 ft
- Transitional Surface MCA = 7ft to 1 ft
- Installation Area
- Airfield
- Partnering JLUS Jurisdictions
- County Boundary
- City / Town / Unincorporated Community
- Interstate
- Highway
- Major Road
- Railroad
- Water Body
- River

Source: APG, 2014.

Matrix DESIGN GROUP

0 1 2 Miles

Figure 8
Vertical Obstruction MCA

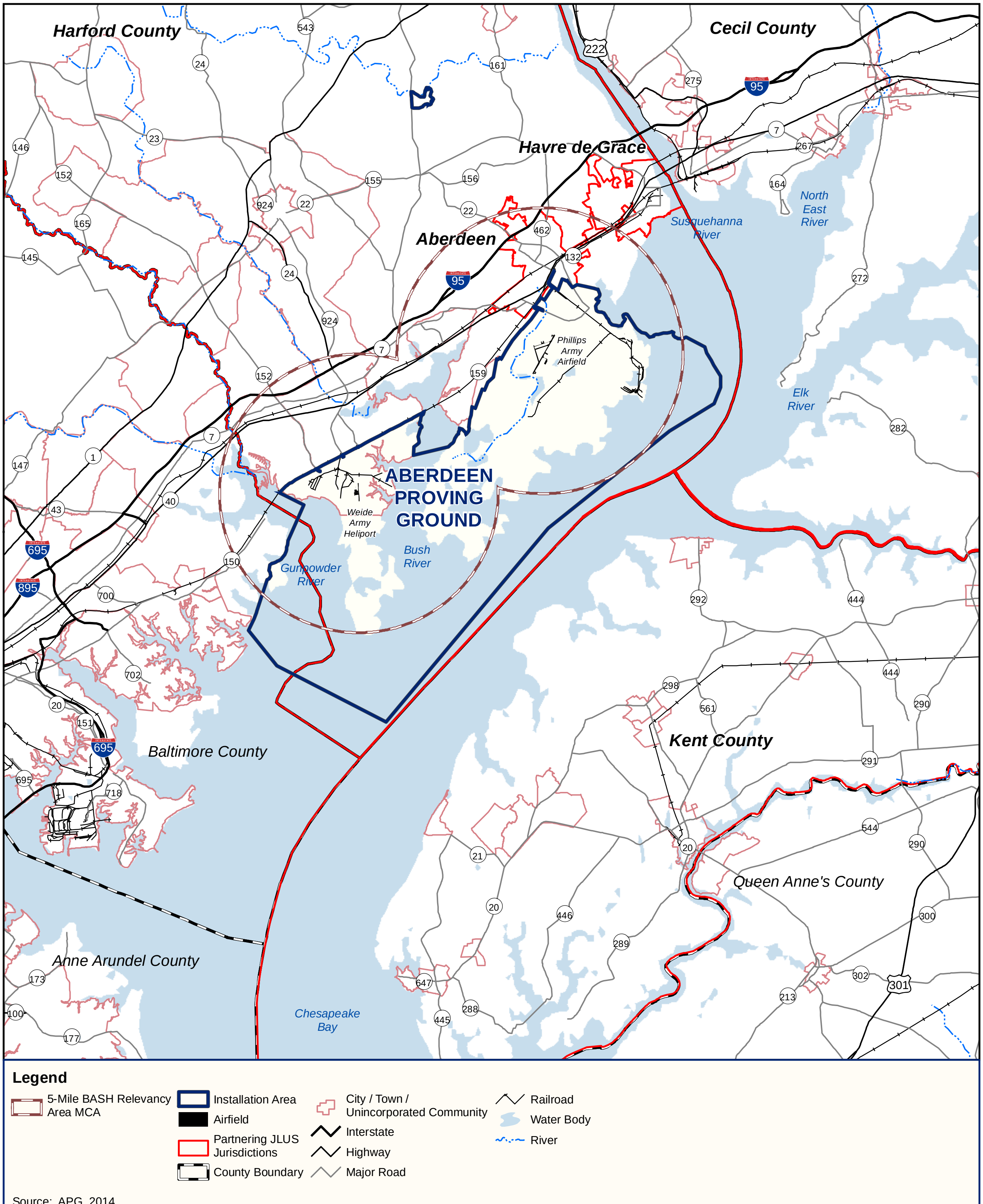


Figure 9
BASH MCA

How to Read the Implementation Plan

The strategies developed are designed to address the issues identified during preparation of the JLUS. The purpose of each strategy is to:

- avoid future actions, operations, or approvals that would cause a compatibility issue,
- eliminate an existing compatibility issue,
- reduce the adversity of an existing issue, and / or
- provide for on-going communications and collaboration.

In an effort to list and describe the strategies in an efficient manner, they have been arranged in a table to correspond with their compatibility factor. The issue within each factor topic is presented first to provide a linkage between the strategy and the condition it is to resolve or minimize. The following paragraphs provide an overview of how to read the information presented for each strategy in the JLUS.

Strategy ID Number. Each strategy is assigned a unique identifier (i.e., COM-1A, COM-1B, COM-1C, etc.) to provide an easy reference. A Strategy ID is composed of the Compatibility Issue to which it applies, i.e. "COM" for Communications / Coordination strategies and a sequential number.

Military Compatibility Area (MCA) / Location. The MCA / location identifies the geographic area applicable to the strategy (i.e., Safety MCA, Noise MCA, etc.). The MCA geographies for the APG strategies are described and illustrated on the previous pages of this JLUS. Some of the strategies are designated as "General" if they do not have a specific associated geography; some are designated as "MCAOD" if they apply to the entire MCAOD for the JLUS Study Area, while others may apply only to APG or a specific jurisdiction.

Strategy. In bold type is a title that describes the strategy. This is followed by the complete strategy description of a recommended action.

Timeframe / Priority. The timeframe or priority is an estimate of when a strategy is anticipated to be initiated – High [2016]; Medium [2017-2018] and Low [2019 and beyond]). Awareness refers to strategies that will be needed on a continuous, intermittent, or as-needed basis.

Responsible Partner. At the right end of the strategy table are a set of columns, one for each jurisdiction, military entity, agency, and organization with responsibilities relevant to implementation of the JLUS strategies. A column is also assigned as "Other" where parties are only required for select strategies. These parties are identified at the end of the strategy description if they apply.

If an entity has responsibility relative to implementing a strategy, a mark is shown under their name. This mark is one of two symbols that represent their role. A solid square (■) designates that the entity has a primary responsibility for implementing the strategy. A hollow square (□) designates that the entity plays a key supporting role, but is not directly responsible for implementation. The responsible parties are identified by their name or assigned acronym in the heading at the top of the page.

Figure 10 illustrates how to read the Implementation Strategies. The JLUS strategies are presented on the following pages organized alphabetically by compatibility factor.

Figure 10. Strategy Key

Issue or Strategy ID	Geographic Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
Safety Zones											
SA-3		**Incompatible Uses in Accident Potential Zones** Incompatible uses in the Accident Potential Zones extend into Harford County and the City of Aberdeen creating a safety concern. Development is a concern in these areas because this is where statistically aircraft accidents are most likely to occur.									
SA-3B	Safety MCA	**Amend Zoning Codes for Incompatible Uses within Accident Potential Zones** Consider amending zoning codes to preclude incompatible land uses and establish Floor Area Restrictions for property within Accident Potential Zones I and II consistent with recommendations in Department of Defense Instruction 4165.57.	2019		■		■				

Issue / Strategy Number: Alpha-numeric identifier used for reference.

Geographic Area: Where each strategy applies. For example, if only MCA is indicated, then that strategy only applies to areas within the MCA.

Strategy: Description of the strategy.

Timeline: The expected initiation date for strategy implementation.

Responsible Party: The primary and partner responsible agencies. For example, the ■ denotes the primary agency who will take the lead in implementation. The □ denotes partner agency who will assist the primary agency in implementation.

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		Coordination / Communication									
COM-1		**Coordination Between APG and Jurisdictions** Coordination between APG and local jurisdictions on area planning and land use issues is informal and inconsistent leading to a lack of information sharing and coordinated evaluation of development impacts. Jurisdictions do not understand APG requirements that affect long-range development plans.									
COM-1A	Study Area	**Establish a JLUS Coordination Committee** Establish a JLUS Coordination Committee to maintain efficient and effective coordination among the JLUS partners and to oversee the implementation of JLUS recommendations. The JLUS Coordination Committee should meet on a regular basis as agreed upon by the Committee and be responsible for establishing effective and timely means of communication for the purpose of coordinating and addressing compatibility concerns and issues. Consider committee membership from the JLUS Executive Committee as well as other community partners as deemed appropriate to maintain continuity and institutional project knowledge. Consider the formation of a technical subcommittee comprising Advisory Committee members to address technical aspects of the JLUS implementation. *Other Partners: Town of Perryville, other members as deemed required*	2016	■	■	■	■	■	■	■	■
COM-1B	Study Area	**Provide Mutual Briefings** To perpetually enhance support and cooperation, and reinforce the partnership between APG and local jurisdictions, APG should annually present a “state of the installation” briefing including strategic goals, operational changes, and proposed construction projects that may impact the greater community to the Study Area county commissions and city councils. The counties and cities should provide annual briefings to APG of changes within the communities that may impact the installation including comprehensive plans, master plans, transportation plans, zoning, development	2016	■	■	■	■	■	■		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		projects, and capital improvement plans. *Other Partner: Town of Perryville*									
COM-1C	Study Area	**Conduct Quarterly Planning Coordination Meetings** APG Department of Public Works Planning Division and the planning department heads from Study Area jurisdictions should conduct quarterly meetings to share short and long-term visions and goals including changes in federal agency, DOD and APG policy / guidelines as they apply to development outside the fenceline, real property development at APG, and changes to jurisdiction comprehensive plans, master plans, transportation plans, zoning, development projects, and capital improvement plans. *Other Partner: Town of Perryville*	2016	■	■	■	■	■	■		■
COM-1D	Study Area	**Develop and Maintain a Repository of Requirements Documentation to Inform the Community Planning Decision-Making Process** APG Department of Public Works Planning Division should develop and maintain a repository of non-classified requirements documentation relevant to planning and development outside the fenceline. Requirements documentation may include information related to vertical obstructions, frequency spectrum, energy development, bird and wildlife attractants, etc. The repository should be available to Study Area jurisdictions for consultation to ensure development is compatible with APG mission operations.	2016	■							
COM-2		**Communication of Remediation and Water Improvement Activities** Installation's remediation and water quality improvement efforts are not adequately conveyed to the public.									
COM-2A	General	**Reinstate the Restoration Advisory Board Website** Reinstate and maintain the APG Restoration Advisory Board (RAB) website. Include updates on restoration activities as part of	2016	■							

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		outreach activities to educate the community outside the fenceline and foster community support. Consider leveraging APG social media to disseminate information to the public. Consider leveraging APG social media to maximize communication to the public of RAB activities and remediation status.									
COM-2B	General	**Public Communication of Water Quality Improvements** Identify public outreach methods to convey status of water quality improvements at APG. Leverage existing APG resources and outreach methods. Consider incorporating water improvement activities as part of the outreach efforts recommended in Strategies COM-5A, COM-5B, and COM-5C.	2016	■							
COM-3		**Formal coordination process for Development Notification** No formal process to notify APG of development actions outside the fence line.									
COM-3A	Study Area	**Include APG in an Advisory Capacity to Local Planning Commissions and Development Advisory Committees** Establish a formal agreement between all Study Area jurisdictions and APG to formalize a process that provides copies of certain types of development proposals, rezoning, and other land use or regulation changes for lands located within the APG influence area for review and comment. The agreement should address an effective method that promotes a productive communication and coordination process that can be maintained and reproduced in the future. This supports a proactive approach for identifying potential conflicts early in the proposed development application. Review periods shall conform to existing community processes for providing comment. The process of formalizing Army review and comment should include: ▪ Definition of project types that require review ▪ Definition of project types that require military attendance at pre-application meetings, if applicable Identification of	2016	□	■	■	■	■	■		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		the points of contact for all coordination Formal procedures for requesting and receiving comments ▪ Standard timelines for responses consistent with State law and local/county procedures. The Army representative will provide technical information on items being considered, but shall not directly vote to approve, conditionally approve, or deny a project or development application. Procedures should be reviewed annually and updated as appropriate by the JLUS Coordination Committee. *Other Partner: Town of Perryville*									
COM-3B	Study Area	Formalize Development Review Coordination Consider formalizing coordination processes to ensure long-term consistency in information sharing and communication between local jurisdictions and agencies with APG that will also supplement existing coordination requirements in overlay district regulations. Establish a Memorandum of Agreement (MOA) to formalize processes for APG review and comment on development proposals, rezoning applications, other land use or regulation changes or master plans that may pose operational impacts on APG. The MOA should outline an effective process that promotes productive communication and coordination that can be maintained and replicated in the future. The MOA should provide a proactive approach for identifying potential conflicts with the military as early in the development review process as possible. The MOA with APG should include: ▪ Definition of project types that require review ▪ Definition of project types that warrant military participation at development review meetings ▪ Identification of points of contact for all coordination	2016	■	■	■	■	■	■		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		▪ Notification procedures for requesting and receiving comments ▪ Timeframes for responses consistent with state law and similar jurisdiction procedures. ▪ Provide notice to APG on all public hearings regarding projects identified for coordination. Procedures should be reviewed annually and updated as appropriate by the JLUS Coordination Committee. *Other Partner: Town of Perryville*									
COM-3C	Study Area	Consider Web-Based Tool for Coordinated Development Reviews Consider implementing a web-based tracking tool for coordinating development reviews with APG using automation through e-mail notifications. The tool could provide a clearinghouse to discuss various project types and a forum for discussion on broader long-term project review, such as comprehensive plan updates, zoning ordinance language, and capital improvement plans for public facilities. Ensure that project uploads include contact information, project location information, a project description, and a deadline for comments.	2016	■	■	■	■	■	■		
COM-4		Base Community Relations Outreach within Study Area APG community relations outreach extends to Harford and Cecil County but does not include Kent County which is informed only through media alerts.									
COM-4A	Cecil County / Kent County	Strengthen Outreach to Eastern Shore Communities APG should develop and implement a plan to strengthen outreach efforts and coordination with the Eastern Shore communities in Cecil and Kent counties to educate the public and garner support for APG. Outreach should include press releases, notification of events, education, and operational changes and anomalies outside of normal procedures that may impact the Eastern Shore communities. Outreach should employ community meetings, area newspapers, television, radio,	2019	■				□	□		

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		jurisdiction websites, social media, and other outreach methods as employed with Harford County.									
COM-5		**Communication of Aberdeen Proving Ground Activities with Outside Communities** Public's nominal mission understanding affects community support for APG.									
COM-5A	Study Area	**Develop an Outreach Campaign Plan** Develop an Outreach Campaign Plan to identify public outreach goals and action items, metrics and milestones for activities, and responsible parties for conducting outreach activities. Goals should support a range of activities including public appearances, speaking engagements, educational seminars, open houses, media engagements, exhibits, press and news release and publication development/distribution that reinforces the community understanding of APG, enhances its strategic value within the community, and strengthens the community support base. The Public Outreach Campaign Plan should address current issues, concerns, and potential changes at APG. Consideration should be given to a broad mix of outreach channels including in person, print, video, and digital tools such as websites, social media, and podcasts and support from area jurisdictions and organizations. *Other Partner: CSSC*	2019	■	☐	☐	☐	☐	☐		☐
COM-5B	Study Area	**Establish an APG Public Outreach Program** APG should create an outreach plan to share information with the community. The public outreach program should describe outreach activities to include possible installation tours / open houses, development of informational brochures to be mailed to neighbors and posted on the APG website, a single location identifying public relations points of contact for APG, and making contact information widely available. It should also include a military and community communication protocol directory that identifies the different	2019	■							

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		level of communication channels between the appointed and elected officials, to staff, to the general public and APG.									
COM-5C	Study Area	Conduct a Good Neighbor Program APG should conduct, on a bi-annual basis, a Good Neighbor Program where they send out letters to property owners within the region inviting them to an APG Open Forum. The purpose of the meeting will be to allow for an open exchange of information to maintain transparent communication and provide a platform for APG to inform neighbors and interested citizens of any upcoming mission changes or operations and maintenance events that may have an impact on the neighbors and whereby the adjacent property owners can provide input and pose questions to Army representatives. The open houses would be held in rotating locations on or near APG and within the region on a semi-annual basis and require participation by each local jurisdiction. *Other Partner: CSSC*	2019	■	□	□	□	□	□		□
COM-5D	Study Area	Make APG Points of Contact More Widely Known Advertise and increase awareness of APG Public Affairs Office and other contact numbers for all community complaints and inquiries. Communication procedures, including methods for providing input, posing inquiries, and expected response time should be made publicly available through the APG and local jurisdiction websites, social media sources, and posted in public facilities such as community centers, municipal buildings, and local newsletters. *Other Partner: CSSC*	2019	■	□	□	□	□	□		□

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
COM-6		Communication from APG with Outside Community Because communications are not formalized, the level of APG communication with outside jurisdictions is perceived as dependent on leadership interest which can fluctuate with changes in leadership.									
COM-6A	Study Area	**Expand Communication Efforts with All Jurisdictions within the Study Area** Update jurisdictions' and regional planning organizations websites to recognize APG, its mission, location, links to the APG webpage, contact information for key organizations, and relevant installation activities potentially affecting the communities. *Other Partner: CSSC*	2019	■	□	□	□	□	□		□
COM-6B	Study Area	**Increase Awareness through APG News Publication** Increase circulation of the APG News at public locations throughout the Study Area and publish distribution locations on the APG website.	2019	■							
		For other strategies that address this issue see Strategies COM-1B, COM-1C, and COM-3A.									
COM-7		Coordination on Multi-Jurisdictional Infrastructure Improvements Coordinate multijurisdictional infrastructure improvements to ensure all jurisdictions are notified and can plan appropriately for impacts in affected areas. This will help avoid previous scenarios where intersection improvements were not fully coordinated across jurisdictions and resulted in relocation of water lines and regulatory takings of homes in roadway widening areas.									
COM-7A	Study Area	**Regional Infrastructure Technical Working Group** Consider the formation of a regional Infrastructure Technical Working Group comprising subject matter experts to collaborate, share information, and coordinate during the planning, programming, design, and construction of multi-jurisdictional infrastructure projects. *Other Partners: Town of Perryville, Maryland DOT, CSSC, BMC, WILMAPCO*	2019	■	■	■	■		■	■	■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
COM-7B	Cities of Aberdeen and Havre de Grace	**Participation on Baltimore Regional Transportation Board** Request participation on the Baltimore Regional Transportation Board, which functions as the Metropolitan Planning Organization serving Harford County, to ensure that MPO mission of providing comprehensive, coordinated and continuous (“3C”) transportation planning is inclusive of the cities of Aberdeen, Havre de Grace during all project phases to provide the cities with a shared awareness of planned and programmed improvements surrounding APG and to appropriately coordinate and budget for impacts. *Other Partner: Baltimore Regional Transportation Board (BRTB)*	2019		■	■			■		□
COM-8		**Engagement from Aberdeen Proving Ground on Area Planning Issues** Installation planners attend local jurisdiction planning meetings but lack of active participation is perceived as indifference.									
		For strategies that address this issue see Strategies COM-1C and COM-3A.									
COM-9		**Security Issues Not Communicated to Outside Law Enforcement** Harford County Sherriff is not regularly informed about events that happen on the installation that affect the outside community.									
COM-9A	Study Area	**Establish and Formalize Coordination Procedures and Protocols** Establish an MOA to formalize procedures, protocols, and points of contact for the coordinated and timely dissemination of security and safety information reciprocally between APG and Study Area law enforcement offices and departments that affect areas outside and inside the fenceline. Ensure that all MOA’s are current and updated. *Other Partner: CSSC*	2019	■	■	■	■	■	■		□

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
COM-10		**Complaint Documentation Process to Aberdeen Proving Ground** Notifying APG and documenting noise and vibration complaints, particularly when there is private property damage, is perceived as onerous to homeowners.									
COM-10A	Study Area	Consolidate Information on Damage Claims Process Preparation and development of a fact sheet on the damage claims process can be provided upon request to homeowners if they believe damage from vibration caused by mission activities has occurred. The fact sheet should include where to locate and submit claim forms, points of contact for the process, and what to expect during the claims review process.	2019	■							
COM-11		**Coordination on Regional Energy Conservation Efforts** Need for coordinated effort on regional energy conservation efforts to ensure that solutions from all parties are considered. Providing an inclusive process that considers solutions from multiple sources will ensure the best outcomes for all regional stakeholders. This will alleviate organizations potentially working at cross-purposes such as with the waste-to-energy plant where the decision to potentially reuse or demolish the facility was made after significant investment and without the transparent exploration of alternatives.									
		For a strategy that addresses this issue see Strategy COM-7A.									
COM-12		**Coordination on Public-Private Partnerships** Need for coordination between APG and surrounding jurisdictions on Public-Private Partnerships, such as housing and Enhanced Use Leasing that may impact areas outside APG to balance the viability of communities while addressing the ongoing needs of APG.									
		For a strategy that addresses this issue see Strategy COM-1C.									
COM-13		**Communication and Coordination to reduce Wildlife Hazards** Communication and coordination between various agencies is required to manage bird populations and control the size of the deer herd in the Aberdeen Area and Edgewood Areas to reduce the potential for negatively affecting military activities including aircraft strikes.									
COM-13A	Study Area	Educate the Public Surrounding APG about Wildlife Hazards Provide enhanced public awareness and educational programs and brochures to improve the public awareness and understanding of the hazards of bird attractants and wildlife habitats on the activities at APG including aviation operations to enhance interagency management. Coordinate the education process with area	2021	□	□	□	□	□	□		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		agencies to incorporate as part of their outreach. Include this information on agency, jurisdiction and APG websites, and include as part of the Public Outreach Program in COM-5B. *Other Partners: Maryland Department of Planning and Maryland Department of Natural Resources*									
Dust / Smoke / Steam											
DSS-1		**Dust Generation from Testing Activities** Military activities at the Automotive Test Areas and Churchville Test Area can create fugitive dust impacts outside the test sites.									
DSS-1A	Harford County / City of Aberdeen	**Pursue Acquisition and Easements through ACUB Program** Identify priority property outside APG subject to the potential for fugitive dust impacts from test facilities and incorporate in ACUB program for either fee simple acquisition or the acquisition of easements. *Other Partners: Harford Land Trust*	2021	■	■		■				□
DSS-1B	City of Aberdeen / Harford County	**Ensure Community Activities such as Construction, Prescribed Burns and Industrial Processes Employ Best Management Practices** Ensure regulations require best management practices and enforcement mechanisms to control fugitive dust, smoke, and steam impacts that may migrate onto APG and impact operations.	2021		■		■				

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
Frequency Spectrum Capacity											
FSC-1		**Comprehensive Frequency Management Program** Need for a comprehensive Frequency Management Program to assess current and future frequency needs of all APG tenants inside and outside the fence line to deconflict frequency requirements.									
FSC-1A	APG	**Develop a Comprehensive Frequency Management Program** Develop and implement a Comprehensive Frequency Management Program for all tenants at APG to establish a spectrum planning process that ensures the current and future availability of spectrum and procedures for deconflicting future spectrum needs.	2019	■							
Frequency Spectrum Impedance / Interference											
FSI-1		**No Coordinated Assessment of Hazards Associated with Frequency Use** Though there is informal coordination between CERDEC, other tenants, and APG to deconflict frequency use during CERDEC ground-to-satellite tests, there is no plan to coordinate and assess near-zone and far-zone hazards associated with ground-to-satellite tests.									
FSI-1A	APG	**Develop a Plan to Formalize Assessment and Mitigation of Frequency Hazards** Develop and implement a Frequency Hazard Mitigation Plan to coordinate, assess, and establish mitigation procedures for potential near-zone and far-zone hazards associated with ground-to-satellite tests that may impact other APG tenant operations, APG personnel, and activities outside the fenceline.	2019	■							
FSI-2		**Potential for Ground-Based Interference** Line-of-sight signal transmission between Aberdeen Area and Churchville Test Area can be impacted from potential signal interference.									
FSI-2A	City of Aberdeen / Harford County	**Establish Procedures to Avoid Frequency Conflicts** The City of Aberdeen and Harford County should coordinate with APG on review of projects with frequency requirements that could impact communications off-installation. The criteria that triggers coordination includes: ▪ proximity to APG ▪ tower height	2019	■	□		□				

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		▪ power emission from tower sources ▪ high output transmission devices									
FSI-2B	City of Aberdeen / Harford County	Pursue Acquisition and Easements through ACUB Program Identify priority property outside APG within the line-of-sight requirement and incorporate in ACUB program for either fee simple acquisition or the acquisition of easements. *Other Partners: Harford Land Trust*	2019	■	■		■				□
FSI-3		Potential to Disrupt Aircraft Navigational Systems Coordination of signal transmission frequency testing and angle of transmission with area aircraft is required to ensure that potential disruption to aircraft navigational systems does not occur.									
		For a strategy that addresses this issue see Strategy FSI-1A.									
FSI-4		Potential for Harford Metropolitan Area Network to Impact APG Harford County is pursuing the Harford Metropolitan Area Network (HMAN) project for high speed fiber optic transmission for the County, the municipalities of Havre de Grace, Bel Air and Aberdeen, and businesses throughout the county. Though current phases include only hardwiring, any proposed Wi-Fi in the future may create a radiating signal bloom that could potentially impact APG frequency testing.									
FSI-4A	City of Aberdeen / City of Havre de Grace / Harford County	Coordinate on Harford County Long-Term IT Infrastructure Planning Include the ongoing coordination for the HMAN long-term IT infrastructure project including any pre-planning for future wireless requirements throughout the service area as part of the coordination in Strategies COM-1B, COM-1C, and COM-3A.	2019	■	□	□	■				
FSI-5		Radio Frequency Interference Affects Emergency Services Communications Jurisdictions on both sides of Chesapeake Bay have experienced EMS radio system outages from unknown sources speculated to come from APG.									
FSI-5A	Study Area	Formalize Communication Procedures Identify and convene a coalition of spectrum stakeholders to discuss use of frequencies and notification procedures for mitigating and troubleshooting possible service interruptions. *Other Partner: CSSC*	2019	■	□	□	□	□	□		□

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
FSI-6		**APG Electronic Warfare Footprint** Concern that electronic warfare footprint associated with APG research and testing activities can spill-over into adjacent jurisdictions. Land uses that occur outside of APG that rely on wireless signals could have the potential to impact activities at APG.									
FSI-6A	Study Area	**Ensure Compatible Frequencies** The Federal Communications Commission is the government entity responsible for managing frequency usage. The military is assigned certain frequencies to use that generally do not interfere with civilian uses. The continued usage of only assigned frequencies should ensure no interference between military and civilian uses. *Other Partner: Federal Communications Commission*	2019	■	□	□	□	□	□		□
FSI-6B	City of Aberdeen / City of Havre de Grace / Harford County	**Employ RF Spectrum Analysis Technology** Employ "RF spectrum analyzer" technologies used to detect interference between frequency bands. Identify interference from on- and off-installation sources including military and public/commercial users.	2019	■							
FSI-7		**Coordination with Broadband Providers** Lack of coordination between broadband providers and APG can result in signal interference from use of bi-directional amplifiers outside the fenceline.									
FSI-7A	City of Aberdeen / City of Havre de Grace / Harford County	**Develop an Educational Outreach Program with Broadband Providers to Ensure They are Aware of APG Frequency Requirements** APG should work with broadband providers to ensure that providers are aware of the installation frequency requirements when planning wireless broadband transmission facilities to deconflict and prevent future interference with required installation frequencies. *Other Partner: Local Broadband providers*	2019	■							□
FSI-7B	General	**Develop Outreach Materials** Work with affected jurisdictions to develop public outreach materials including website updates and public service announcements to	2019	■	□	□	□	□	□		□

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		inform the public about the potential for interruption of cellular service and GPS devices within areas associated with APG testing. *Other Partner: CSSC*									
FSI-7C	City of Aberdeen / City of Havre de Grace / Harford County	Establish Procedures to Avoid Frequency Conflicts / Issues Identify telecommunications projects that should be referred to the military for review and communicate this information to jurisdictions. The criteria that triggers coordination includes tower height, proximity to APG, power emission from tower sources, and high output transmission devices. Coordinate with jurisdictions on RF projects that could impact off-installation communications. *Other Partners: Federal Communications Commission*	2019	□	■	■	■				□
FSI-7D	APG	Adjust Frequency Usage Evaluate the feasibility of adjusting frequency usage to utilize different frequencies that would not interfere with, or be impacted by, bi-directional amplifiers.	2019	■							
FSI-8		Marine Frequency on Range Potential for signal interference with waterfront lanes / marine frequencies on range.									
		For strategies that addresses this issue see Strategies FSI-5A and FSI-6A.									
Housing Availability											
HA-1		Urban Environments Urban city environments such as Baltimore City provide amenities and lifestyle attractive to young professionals. These urban environments are unavailable proximate to APG. APG personnel choosing to reside in an urban environment will have a longer commute adding to regional roadway congestion. The lack of urban environments proximate to APG may put the installation at a disadvantage for attracting younger job seekers.									
HA-1A	City of Aberdeen	Implement Transit Oriented Development Master Plan Continue implementation of Master Plan for the Transit Oriented (TOD) development in downtown Aberdeen including strategies and coordinated funding.	2016/On-going		■						

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
HA-1B	City of Aberdeen	**Coordinate Aberdeen TOD Development with APG** Coordinate the development of the TOD with APG to leverage opportunities and synergies to support the APG workforce.	2016	□	■						
HA-1C	Harford County	**Master Plan for Transit Oriented Development in Edgewood** Develop a Master Plan for Edgewood that creates a pedestrian-oriented live / work / play community leveraging local and regional transportation connections incorporating the MARC Station. Conduct a market analysis to determine the optimum mix of housing types, commercial opportunities and amenities to attract a diverse workforce and support area growth into the future. *Other Partner: Harford County Office of Economic Development*	2016	■			■				□
HA-1D	Harford County	**Edgewood Community Area Plan** Amend the Harford County Land Use Element Plan and Edgewood Community Area Plan to recognize the development of TOD for Edgewood. Develop specific regulations that support and incentivize its development. Identify and evaluate partnership opportunities with APG for (P4) Private-Public Public-Public development to catalyze investment and buildout.	2019	□			■				
HA-1E	Harford County	**Incorporate Infrastructure Improvements in Harford County Capital Improvements Plan to facilitate Edgewood Transit Oriented Development** Identify and program necessary infrastructure projects in the Harford County Capital Improvements Plan to facilitate the creation and development of Edgewood TOD.	2019				■				

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		Infrastructure Extensions									
IE-1		**Water provision to APG Edgewood Area** The current service agreement with Harford County for water provision to the Edgewood Area is a non-binding short-term temporary solution for Winters Run Creek production deficiencies. Long-term solutions for Edgewood water will require new infrastructure.									
IE-1A	APG	**Master Plan for Long-Term Infrastructure Improvements for Potable Water Provision to Edgewood Area** Develop a Master Plan including assessment of existing conditions; quantified supply and future demand based on anticipated need; defined courses of action for supply including a reliable source of water and any conservation and reuse measures; and funding for infrastructure improvements to achieve the safe and reliable provision of water to the Edgewood Area without relying on temporary sources. Consider as options: ▪ A long-term service agreement with Harford County ▪ Provision from the Aberdeen Area by way of Harford County infrastructure (connection fees which support capital construction of the County system to provide the water and capital construction by the Army to enhance the connection to the county system would be required) ▪ Provision form the Aberdeen Area entirely within the jurisdiction of APG to reduce all reliance on external infrastructure and safeguard the potable water supply. *Other Partners: Army Corps of Engineers, US Environmental Protection Agency, Maryland Department of the Environment, Maryland Department of Natural Resources, Harford County*	2016	■			□				□

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
IE-1B	APG	**Plan and Coordinate for the Implementation of Infrastructure Improvements to Achieve a Safe and Reliable Potable Water Supply to the Edgewood Area** Develop a coordinated Implementation Plan to execute the Water Provision Master Plan in Strategy IE-1A. Include measurable milestones, Capital Improvement Plan projects, dedicated funding sources, and multijurisdictional / multiagency coordination. *Other Partners: Army Corps of Engineers, US Environmental Protection Agency, Maryland Department of the Environment, Maryland Department of Natural Resources*	2017	■							□
IE-1C	APG	**Implement Water Reduction Projects** Implement programmed projects to reduce potable water usage in the Edgewood Area through the beneficial reuse of treated groundwater for non-potable uses.	2016	■							
IE-2		**Coordination of Easements on APG Property** There is utility infrastructure traversing APG property without a formal agreement with APG at the Churchville Test Area. Formal easements are necessary to know which agency requires maintenance access, to coordinate access when needed, and to prevent potential liability issues.									
IE-2A	Churchville Test Area	**Research Undocumented Utilities and Execute any Necessary Access Easements with Respective Utility Companies** Confirm with APG DPW Master Planning Real Estate Branch whether active easement instruments are located at the Churchville Test Area. Research historical real property instruments to identify whether utilities are present. Consider employing Miss Utility to identify subsurface utilities onsite. Execute easement instruments with any utility than runs through the property not having an easement agreement with APG. *Other Partners: Miss Utility, utility providers*	2019	■							□

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		Land / Air / Sea Space									
LAS-1		**JLENS Program** Public perception that the JLENS program could impact rights to privacy.									
LAS-1A	Study Area	**Develop a JLENS Educational Program** Create an informational brochure and/ or packet to distribute to the public in surrounding communities about the nature of the JLENS program, reinforcing the public safety benefit. Incorporate the brochure into public outreach efforts in Strategies COM-5B and COM-6A.	Aware-ness	■							
		Land Use									
LU-1		**Incompatible Land Development** More intense land development throughout the Study Area has the potential to inhibit mission-critical activities at APG.									
LU-1A	MCAOD	**Define and Establish Military Compatibility Areas (MCAs)** Create a Military Compatibility Area Overlay District (MCAOD) containing Military Compatibility Areas (MCAs) that reflect the types and intensity of compatible uses. The MCAOD is the collective geographic area of all of the MCAs combined. The MCAs established should be used by local jurisdictions to identify areas where specific compatibility issues are more likely to occur and address ways to avoid compatibility issues. The MCA's should include: Safety MCA - Includes the Accident Potential Zones (APZs) I and II. Noise MCA - Includes areas within the averaged 57 dB CDNL noise zone and 115 dB PK15 (met) and 130 dB PK15 (met) impulse noise zones. Vertical Obstruction MCA – Based on the DOD imaginary surfaces map, horizontal area which limits development of buildings and structures. BASH MCA – 5-mile radius from the center of the airfield at Phillips Army Airfield and the	2017	□	■	■	■	■	■		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		Weide Army Heliport. Where appropriate, the jurisdictions should incorporate the MCAOD and MCA boundaries on their zoning map and future land use maps and include the zones on their websites for easy access and understanding by the public. *Other Partner: Town of Perryville*									
LU-1B	Noise MCA	**Continue to Pursue Properties for ACUB Program and Seek Partnership Opportunities** Continue to pursue property in Priority Areas identified in the ACUB Program for fee simple acquisition and conservation easements to meet multipurpose goals including noise compatibility and environmental stewardship. *Other Partners: Harford Land Trust, Cecil Land Trust, The Eastern Shore Land Conservancy, Maryland Agricultural Land Preservation Foundation*	2016	■							■
LU-1C	MCAOD	**Incorporate Compatibility Planning Concepts into CIPs / Infrastructure Master Plans.** Incorporate compatibility planning concepts into CIPs / Infrastructure Master Plans for infrastructure extensions and improvements. Avoid extension of infrastructure service within APG area of influence for rezoning applications, except to serve approved community / area plans or commercial and industrial development which provides a compatible land use pattern.	2019		■	■	■	■	■	□	
LU-2		**Real Estate Disclosures Inconsistent Across Jurisdictions** Inconsistent application of real estate disclosures results in patchwork of new home buyer knowledge of installation impacts on properties.									
		For strategies that address this issue see Strategies NOI-1F and NOI-1G.									
LU-3		**Potential for New Mission Footprints Constrained by Environmental Conditions** Buffers for wetlands, wildlife, eagle nesting and other natural resources potentially reduce developable land for additional missions at Aberdeen Area.									
LU-3A	APG	**Developable Areas Plan** Produce a Developable Areas Plan that provides an overview of all constraints - bird /	2021	■							

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		wildlife habitat areas, environmental, wetlands and shoreline buffers, an assessment of changes / trends in those areas, and mitigation measures to manage birds / wildlife including ongoing adaptive management. The Plan should identify remaining developable areas unencumbered by all constraints at APG and include facility demolitions to provide a comprehensive examination of areas to support additional future missions and mission growth. Enhance the existing "Red, Yellow, Green" Map for areas suitable for development, suitable for development with mitigation (on- or off-site), and areas where development is inappropriate. Actively seek input from APG tenants in the Plan development to incorporate programmed facilities, future mission changes, and geographic areas where tenant synergies can be leveraged towards future facilities.									
LU-4		Properties Present Possible Encroachments Real estate easement instruments for properties with noise monitoring equipment on the Western and Eastern Shore do not contain legal descriptions resulting in access that may be outside the easements.									
LU-4A	Study Area	Review and Revise Easements for Noise Monitoring Equipment Review and revise access easements for private properties with noise monitoring equipment where metes and bounds legal descriptions are not delineated on the real estate instruments. Consider conducting field surveys to identify locations of access easements to prevent potential encroachments.	2021	■							
LU-5		Identification of Encroachment Buffers Encroachment buffers around APG are not identified on City and County planning documents									
		For a strategy that address this issue see Strategy LU-1A.									

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
LU-6		**Environmental Regulatory Impacts** Federal and state environmental regulations reduce the APG buildable footprint and ability to accommodate new missions.									
LU-6A	Study Area	**Comprehensive Planning for Development** Develop a comprehensive plan that assesses the impacts of federal and state environmental regulations on the operations at APG and considers mitigation alternatives to address ongoing mission needs. Identify potential on- and off-site mitigation strategies and techniques. *Other Partners: Maryland Department of the Environment, US Environmental Protection Agency, US Army Corps of Engineers*	2019	■			■	■			□
		For another strategy that address this issue see Strategy LU-3A.									
Marine Environments / Climate Change											
MEC-1		**Dredging Requests to Aberdeen Proving Ground** The Port of Baltimore has engaged APG over the last couple of decades about receiving dredging spoils. Though APG is not currently a designated receiver site in the Army Corps of Engineers Dredged Material Management Plan, the placement of clean dredge spoils along the shoreline could be used to combat potential sea-level rise.									
MEC-1A	APG	**Assess the Viability of Receiving Dredging Spoils** Evaluate the viability of receiving clean dredging spoils at APG shoreline areas as part of a long-term strategy for mitigating sea-level rise. If determined favorable, coordinate with state and federal agencies to include APG as a receiver site for clean dredging spoils from the Port of Baltimore as part of the Dredged Material Management Plan, from areas along the Susquehanna River upstream of the Conowingo Dam, and from the Chesapeake and Delaware Canal. *Other Partners: Maryland Department of the Environment, US Environmental Protection Agency, US Army Corps of Engineers*	2021	■			■				□

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
MEC-2		**Long-Term Plan for Environmental Impacts from Climate Change** Sea level rise studies indicate that portions of APG may be underwater as early as 2050 necessitating a long-term mitigation plan for APG.									
MEC-2A	APG	**Develop Long-Range Plan for Sea-Level Rise** Develop a long-range strategic plan for mitigating upland impacts of sea-level rise and shoreline erosion at APG. Incorporate updated analysis and quantifiable impacts of projected real property loss by APG area on mission capability and capacity, and identify strategies to mitigate impacts.	2021	■							
MEC-2B	City of Aberdeen / City of Havre de Grace / Harford County	**Quantify Regional Sea-Level Rise and Consider Adoption of Sea-Level Rise Ordinance** Conduct a study to quantify the regional impacts of development on sea-level rise and consider adoption of a sea-level rise ordinance to address any cumulative regional impacts including those experienced at APG. The ordinance may contain revisions to existing floodplain ordinances to allow tailored regulations for high-risk areas including more resilient development within high-risk areas and directing development away from vulnerable areas to preserve valuable coastal resources and strategic assets. *Other Partners: Army Corps of Engineers, US Environmental Protection Agency, Maryland Department of the Environment, Maryland Department of Natural Resources, Clean Chesapeake Coalition*	2021	□	■	■	■				□
		For another strategy that addresses this issue see Strategy MEC-1A.									
MEC-3		**Conowingo Dam Impacts Aberdeen Proving Ground** When Conowingo Dam floodgates are open, debris, sediment, and flooding occur along Spesutie Island.									
MEC-3A	Harford County / Cecil County	**Reduce Upstream Sediment Load Flowing Into the Susquehanna River** Consider land use regulations that reduce the sediment load from discharging into the Susquehanna River. *Other Partners: Army Corps of Engineers, US Environmental Protection Agency, Maryland*	2019				■		■		□

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		Department of the Environment, Maryland Department of Natural Resources, Clean Chesapeake Coalition									
MEC-3B	APG / Havre de Grace	Work with the Army Corps of Engineers Educate the Army Corps of Engineers on the downstream impacts of opening the Conowingo Dam floodgates on APG operations to ensure that solutions being considered by the Army Corps of Engineers in their ongoing study of sedimentation control minimize impacts on APG operations and shoreline / basin areas near Havre de Grace. *Other Partner: Army Corps of Engineers Baltimore District, Town of Perryville*	2016	■		□					□
		For another strategy that addresses this issue see Strategy MEC-1A.									
MEC-4		Disposal of Dredged Material Destined for Cecil County and Associated Risk from Unexploded Ordnance Concern that dredging spoil disposed of in Cecil County may carry risks of unexploded ordnance. Consideration that these spoils could be used for shoreline stabilization at APG to combat sea-level rise.									
		For a strategy that addresses this issue see Strategy MEC-1A.									
Noise											
NOI-1		Noise from Installation Activity Noise from activities at APG has the potential to affect sensitive noise receptors in surrounding communities.									
NOI-1A	Noise MCA	Increase Public Understanding of Noise Sources Increase community awareness of flight schedules and military testing and evaluation operations throughout the entire APG area of influence through the use of local media sources, newsletters, brochures, and annual outreach functions hosted by APG in cooperation with each Study Area jurisdiction. Include information that there are other noise generating uses such as quarries within the Study Area.	2021	■	□	□	□	□	□		

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
NOI-1B	Noise MCA	**Seek Assistance from APG to Incorporate Maps and Updates to Planning Documents to Minimize Noise Concerns Among Residents** Based on additional noise data and input from APG, consider revisions to communities' comprehensive plans to define areas that may be suitable for future real estate disclosure, sound attenuation or other measures to mitigate impacts from military operations. *Other Partners: Town of Perryville*	2019	□	■	■	■	■	■		■
NOI-1C	Noise MCA	**Educational Materials on Sound Attenuation Methods** Use DOD or FAA sound attenuation educational materials as a supplemental educational document, describing techniques to reduce indoor vibration associated with impulse noise. Local jurisdictions should make use of already available technical support materials from the Federal Aviation Administration and Department of Defense.	2021		■	■	■	■	■		
NOI-1D	Noise MCA	**Require Noise Easements** Require noise easements for properties within the Noise MCA that notify property owners of the nearby noise and vibration associated with APG operations. These easements allow for these impacts with no liability on the jurisdictions where the noise impacts occur or on the organization generating the noise impacts.	2021		■	■	■	■	■		
NOI-1E	Noise MCA	**Adopt Real Estate Disclosure Amendment that Notifies Potential Buyers of Property within Noise Zones that Property is Located in a Host Community of APG and Subject to Operational Impacts including Noise from Overflight and Range Activities** Develop a Military Compatibility Real Estate Disclosure to provide appropriate information about missions and operations at APG. The disclosure should be provided at the earliest possible point in the interaction between realtor / real estate agent and / or owner and	2019	■	□	□	□	□	□		□

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		buyer or renter and required during title transfers. The disclosure should specify that a property is located near an active military installation and may be subject to aircraft overflight and range activities generating noise, vibration and other related impacts associated with military testing, training and readiness. ▪ Work with Maryland Association of Realtors and local real estate representatives to develop and implement adequate language for inclusion in disclosure notices ▪ Include language in the real estate disclosure that property located in Accident Potential Zone (APZ) I are not eligible for government-backed loans ▪ Introduce legislation requiring military compatibility real estate disclosures for jurisdictions. ▪ Work with the Maryland Real Estate Commission, Maryland Association of Realtors, and local realtors to ensure compliance with notification requirements. *Other Partners: Town of Perryville, Maryland Real Estate Commission, Maryland Association of Realtors*									
NOI-1F	Noise MCA	Develop Information to Facilitate Accurate Disclosures Provide current and adequate information to facilitate informed decisions by jurisdictions, developers and interested citizens relative to a property's location proximate to the APG area of influence. Include an information packet that provides information on applicable regulations that govern development within the APG area of influence. *Other Partners: Town of Perryville, Maryland Real Estate Commission, Maryland Association of Realtors*	2019	□	■	■	■	■	■		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
NOI-1G	Noise MCA	**Develop a Memorandum of Understanding (MOU) with School Districts** APG should develop a MOU with the surrounding school districts to coordinate on all future school master plans to prevent schools from being planned in noise sensitive areas. *Other Partners: School Districts*	2019	■	□	□	□	□	□		■
		For other strategies that address this issue see Strategies LU-1B, LU-2A, LU-2B, and LU-5A.									
NOI-2		**Regional Noise Sources** There are other sources of blasting than APG within the region which can be misattributed to APG testing.									
		For other strategies that addresses this issue see Strategies NOI-1A.									
NOI-3		**Overflight of the City of Havre de Grace** APG overflight of the City of Havre de Grace creates general noise nuisance.									
NOI-3A	City of Aberdeen / City of Havre de Grace / Harford County	**Consider Developing an Airfield Awareness Program** Consider developing an Airfield Awareness Program targeted to the landowners and homeowners to educate and increase awareness of the effects of aircraft operations at Phillips Army Airfield and Weide Army Heliport. Distribute as part of public outreach efforts in Strategies COM-5B and COM-5C, and post on the APG website.	2017	■	□	□	□				
		For other strategies that addresses this issue see Strategies NOI-1A, NOI-1B, NOI-1C, and NOI-1D.									
		Roadway Capacity									
RC-1		**Peak Hour Traffic (Traffic Loads at Gates)** Peak hour traffic including a mid-day peak causes congestion and traffic delays outside the installation which have a quality of life impact for those working at APG and those traveling the area.									
RC-1A	City of Aberdeen / City of Havre de Grace / Harford County	**Monitor Capital Improvements for Roadway Capacity** Monitor capital improvement projects to ensure roadway capacity is sufficient and increases traffic flow and mobility without causing unintentional pressures on the	2019	□	■	■	■			■	■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		military or communities to provide for more services. *Other Partners: BRTB*									
RC-1B	City of Aberdeen / Harford County	**Conduct a Traffic Study to Assess Community Impacts on APG and Vice Versa** Conduct a traffic study to quantify demand cycles and address alternatives such as repositioning or improvements to gate access to allow for alternative routes to APG. *Other Partners: BRTB*	2019	■	□	□	□			■	■
RC-1C	APG / City of Aberdeen	**Coordinate and Budget for Gate Improvements that Affect Off-Installation Roadway Capacity and Level of Service** Identify, coordinate and budget for, necessary improvements to achieve more efficient functionality of installation egress / ingress points and improve localized congestion outside entry gates. This strategy should be implemented in conjunction with Strategies RC-1D and RC-2C.	2019	■	■					□	
RC-1D	City of Aberdeen / Harford County	**Consider Implementing Transportation Demand Management** Assess, develop, and implement Transportation Demand Management strategies and policies to reduce travel demand (specifically single-occupancy private vehicles), or to redistribute the trip generation across space (additional entry gates) or time (staggered work hours / telecommuting). *Other Partner: BRTB*	2019	■	■		■				■
RC-2		**Public Transportation Connections** Amtrak and MARC commuter trains stop near the boundary of both APG and Edgewood, but there is no direct transit connection from the stations into the installation.									
RC-2A	City of Aberdeen / Harford County	**Conduct a Feasibility Study to Assess Viability of Public Transit on to APG** Conduct a transportation feasibility study to quantify the possibility of public transit to reduce overall trip generation to APG. The study should evaluate trip generation including origin and destination pairs; driver	2019	■	□	□	□			■	■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		behavior and preference; peak trip periods; and cost, management, funding of a suitable public transit system, and access on to APG. *Other Partners: Baltimore Regional Transportation Board, Maryland Transit Administration*									
RC-2B	City of Aberdeen / Harford County	**Bike Share Programs and BikeLids at MARC Train Stations** Coordinate with the Maryland Transit Administration and Maryland DOT to establish a bike share program at the Edgewood and Aberdeen MARC stations. This strategy should be implemented in conjunction with Strategy RC-2C. *Other Partners: Maryland Transit Administration*	2019		■		■			■	■
RC-2C	City of Aberdeen / Harford County	**Bike Lanes along State Routes 22 and 24** Request that Maryland DOT plan, program, and install bike lanes along Routes 22 and 24. Identify appropriate roadway segments but ensure lanes are provided to the APG entry gates. It should also address bicycle access at the interchange between 24, 924 and I-95. This strategy should be coordinated and implemented in conjunction with Strategy RC-2B. *Other Partners: Baltimore Regional Transportation Board*	2019	■	■		■			□	■
RC-3		**Increased APG Commuter Traffic Affects Local Roads and Level of Service** APG commuter traffic affects local roads and contributes to level of service impacts: ▪ Westbound commuter traffic to APG cuts through local subdivisions via I-95 to reach the installation ▪ Traffic switching between Route 40 and I-95 to avoid higher I-95 eastbound toll creates failing LOS at US Route 40 and State Hwy. 222 interchange ▪ Congestion on Harford County cross arteries such as MD 543 and 152 ▪ Traffic congestion creates safety hazard at MD 543 at I-95 interchange									
RC-3A	City of Havre de Grace	**Consider Traffic Calming Devices to Discourage Cut-Through Traffic in Subdivisions** Consider installing traffic calming devices in subdivisions to discourage cut-through traffic in residential subdivisions. Consider traffic calming devices such as roundabouts,	2019			■					

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		medians, and speed humps to limit excessive through-traffic on local roads within neighborhoods.									
RC-3B	City of Havre de Grace / Harford County / Cecil County	**Transportation Projects to Reduce Congestion** Identify regional transportation projects that address overall roadway congestion and capacity, regional transportation goals, improvements to current and projected conflict points, and promote a multi-modal transportation system to promote an environment that supports APG mission growth and workforce needs. *Other Partners: Baltimore Regional Transportation Board, Wilmington Area Planning Council, Town of Perryville*	2019		■	■	■		■	☐	☐
RC-3C	City of Aberdeen / City of Havre de Grace / Harford County / Cecil County	**Seek Alternative Funding Sources for Transportation Improvements** Seek additional and alternative sources of funding for transportation improvements at the federal and state level such as the federal Transportation Alternatives Program administered through Maryland MPOs (including the Baltimore Regional Transportation Board and Wilmington Area Planning Council) and (P3) Public-Private Partnerships enacted through House Bill 560 to leverage expertise and efficiencies of the private sector. *Other Partners: Baltimore Regional Transportation Board, Wilmington Area Planning Council*	2019	■	■	■	■		■	☐	☐
Safety Zones											
SA-1		**Awareness of Range Fires** During dry months of the year, certain missions can cause brush fires. These fires need to be maintained and proper communication needs to be provided outside of APG regarding their potential effects.									
		For strategies that address this issue see Strategies COM-6A and COM-9A.									

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
SA-2		Unexploded Ordnance Areas at APG could still contain unexploded ordnance buried underground which potentially pose a safety risk for adjacent development outside the fence line.									
SA-2A	APG	**Efforts to Identify and Clear Unexploded Ordnance from APG** Establish a program and plan to identify and clear unexploded ordnance at APG. Consider expanding the UXO Technology Demonstration Site Program to clear areas near the greatest concentrations of personnel inside the fenceline and within a quarter-mile of the installation perimeter at the Aberdeen Area to provide a buffer outside the fenceline.	2021	■							
SA-3		Incompatible Uses in Accident Potential Zones Incompatible uses in the Accident Potential Zones extend into Harford County and the City of Aberdeen creating a safety concern. Development is a concern in these areas because this is where statistically aircraft accidents are most likely to occur.									
SA-3A	Safety MCA	**Incorporate Safety Military Compatibility Areas into Local Planning Documents** Incorporate the Safety Military Compatibility Area and associated compatible development guidelines from Department of Defense Instruction 4165.57 into local zoning codes and comprehensive plans for the safety of their citizens. Examples of regulations in this area should include conditions associated with types of uses such as restricting new development that attracts large congregations of people and uses that attract concentrations of birds that create a hazard to aircraft.	2019		■		■				
SA-3B	Safety MCA	**Amend Zoning Codes for Incompatible Uses within Accident Potential Zones** Consider amending zoning codes to preclude incompatible land uses and establish Floor Area Restrictions for property within Accident Potential Zones I and II consistent with recommendations in Department of Defense Instruction 4165.57.	2019		■		■				
SA-3C	Safety MCA	**Amend Zoning Codes to Address Accident Potential Zones** Amend zoning codes to require all allowable uses within Accident Potential Zones I and II to undergo a conditional use approval	2019		■		■				

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		process that requires APG review. Uses that would require additional review include, but are not limited to residential uses and those that encourage the congregation of people such as places of worship, daycares, and group care facilities.									
SA-3D	Safety MCA	**Provide Safety zone Maps to Local Realtors and Title Companies** Harford County and the City of Aberdeen should provide maps of the Safety Zones to local realtors and title companies. Maps should include a delineation of areas that are, and may be in the future, subject to safety risks associated with APG flight operations.	2019		■		■				
SA-3E	Safety MCA	**Voluntary Conservation Easements for Property in Accident Potential Zones** Develop a conservation easement program to reduce development potential within the Accident Potential Zones. *Other Partners: Harford Land Trust, The Eastern Shore Land Conservancy*	2019	■	■		■				■
SA-3F	Safety MCA	**Pursue Properties for ACUB Program in Accident Potential Zones and Seek Partnership Opportunities** Pursue property in Priority Areas identified in the ACUB Program within Accident Potential Zones for fee simple acquisition and conservation easements to meet multipurpose goals including safety and environmental stewardship. *Other Partners: Harford Land Trust*	2016	■							■
SA-3G	BASH MCA	**Amend Zoning Ordinances to Include Bird / Wildlife Air Strike Hazard Regulations** Amend zoning ordinances to regulate land uses and guide building standards that will not attract birds and other wildlife in the BASH MCA, specifically within the Approach / Departure Clearance Surface. Such controls should prohibit certain trees and foliage that attract birds in this area.	2019		■	■	■		■		

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		Scarce Natural Resources									
SNR-1		**Water Quantity / Quality at Edgewood** Harford County water supply to Edgewood is temporary because of Harford County's own service demand.									
		For strategies that address this issue see Strategies IE-1A and IE-1B.									
		Sensitive Biological Resources									
SBR-1		**Eagle Nesting Sites** Eagle nesting site buffers impact ability to carry out mission-critical activity and contribute to reduced development areas.									
SBR-1A IN PROCESS	APG	**Continue Monitoring Bald Eagle Nests** Continue to coordinate with US Fish and Wildlife Service to maintain records of Bald Eagle nesting sites and monitor any change in nesting sites to maintain coordinated management strategies that allow continuation of operational activities while providing necessary habitat and species protections. *Other Partner: US Fish and Wildlife Service*	2017	■							□
SBR-1B	APG	**Coordination Among Management Agencies** Work with all management agencies to develop approaches to protect the Bald Eagle and its associated ecosystem and avoid disruption of nesting sites and habitat by providing management strategies that provide adequate habitat protection. *Other partners: US Fish and Wildlife, Maryland Department of Game and Inland Fisheries, Maryland Department of Natural Resources, The Nature Conservancy, The Trust for Public Land*	2017	■							□
		For another strategy that addresses this issue see Strategy LU-1B.									

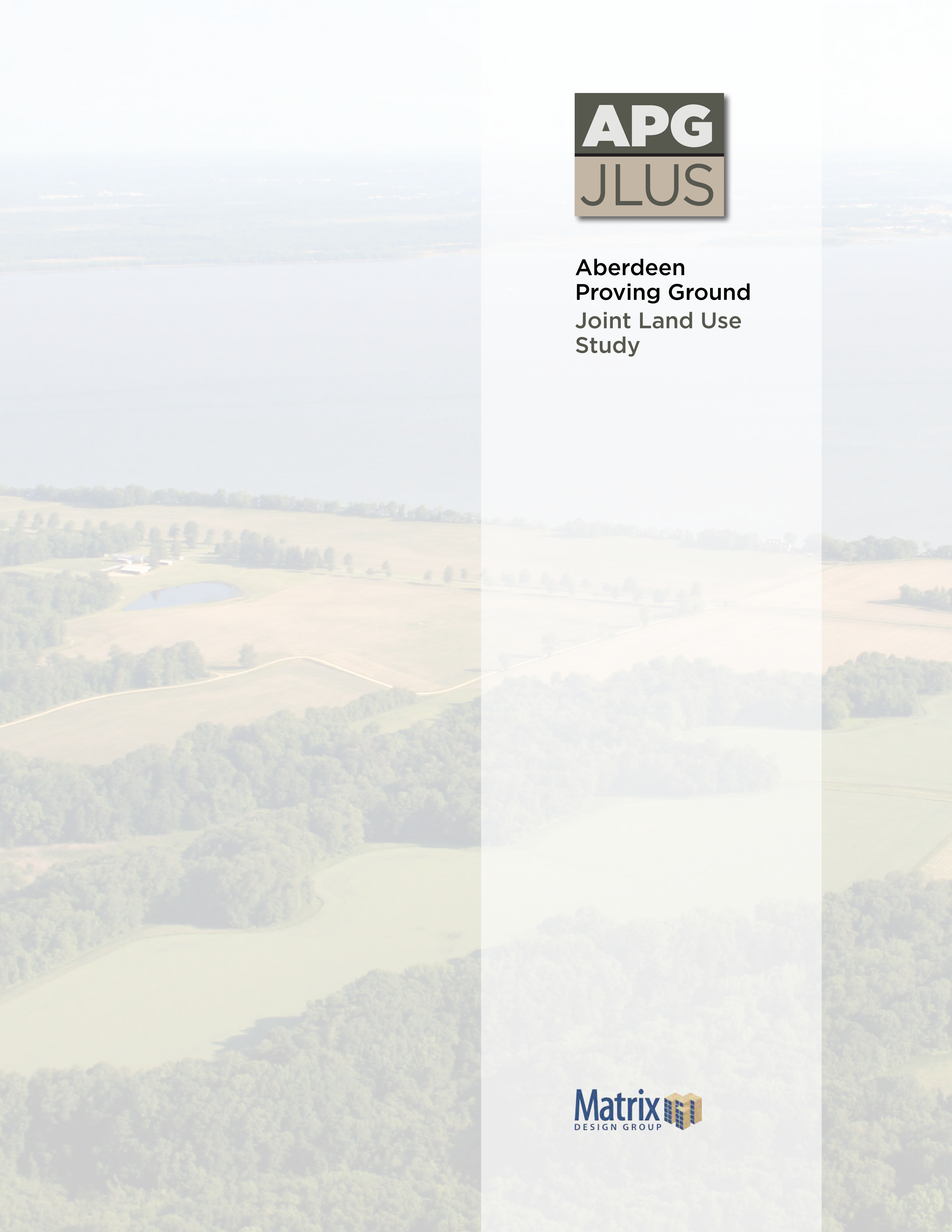
Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
Vertical Obstructions											
VO-1		**Vertical Obstructions Understanding** Lack of awareness of vertical obstruction requirements within jurisdictions surrounding APG can lead to incompatible development.									
VO-1A	Vertical Obstruction MCA	**Identify and Map Specific Areas of Concern Related to Tall Structures** Develop a "Red, Yellow, Green" (RYG) Map, in consultation with APG, that identifies locations throughout the Vertical Obstruction MCA where tall structures (with defined heights) are permissible, permissible with height restrictions, and prohibited to protect public safety and ensure compatibility. *Other Partner: Town of Perryville*	2017	□	■	■	■		■		■
VO-1B	Vertical Obstruction MCA	**Incorporate Vertical Obstruction MCA into Local Planning Documents** Adopt height regulations, incorporating mapping from Strategy VO-1A, for all proposed structures within the Vertical Obstruction MCA to ensure they do not pose a safety hazard to air operations in the region. *Other Partner: Town of Perryville*	2017		■	■	■	■	■		■
VO-1C	Vertical Obstruction MCA	**Optimize Use of Communication Towers** In order to reduce the number of communication towers needed in the future, providers should be encouraged to design new towers, structurally and electrically, to accommodate the applicant / licensee's antennas and comparable antennas for at least two additional users (minimum of three users for each tower structure), unless this design would require the addition of lights or guy wires to an otherwise unlighted and / or unmanned tower.	2017		■	■	■	■	■		
VO-1D	Vertical Obstruction MCA	**Ensure Part 77 Compliance** For all new, redeveloped, or rehabilitated structures (including electrical transmission towers/lines, cellular and radio transmission towers, etc.), ensure compliance with the Federal Aviation Administration (FAA) Part 77 height limit requirements to minimize vertical	2017		■	■	■	■	■		■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
		obstructions. *Other Partner: Town of Perryville*									
VO-1E	Vertical Obstruction MCA	**Develop a 3-Dimensional Imaginary Surfaces Model** The cities of Havre de Grace and Aberdeen and Harford County should collaborate, with the assistance of APG and the FAA, to develop a digital and printed 3D model of existing height regulations compared to allowable heights for the imaginary surfaces. This tool will assist the jurisdictions in considering amendments to their zoning regulations to further enhance military compatibility and for determining whether heights of proposed structures obstruct the navigable airspace during the review of development applications. *Other Partner: FAA*	2017	☐	■	■	■	■	■		☐
VO-1F	Vertical Obstruction MCA	**APG Review of Proposed Structures** Establish partnerships between each jurisdiction and APG to allow for APG review and comment on any proposed new, redeveloped, or rehabilitated structures (including electrical transmission towers/lines, cellular and radio transmission towers, etc.) within the imaginary surfaces.	2017	☐	■	■	■	■	■		
VO-1G	Vertical Obstruction MCA	**Pursue Properties for ACUB Program in Vertical Obstruction Military Compatibility Area and Seek Partnership Opportunities** Pursue property in ACUB Program Priority Areas within the "Red Zone" on Map in Strategy VO-1A for fee simple acquisition and conservation easements to meet multipurpose goals including vertical obstruction safety and environmental stewardship. *Other Partners: Harford Land Trust, The Eastern Shore Land Conservancy*	2016	■							■

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
Vibration											
VIB-1		**Vibration Damage in Study Area Communities** Vibration from APG ordnance testing has the ability to cause physical property damage in areas throughout the Study Area on both sides of the Chesapeake Bay.									
		For strategies that address this issue see Strategies COM-10A and LU-1B.									
Water Quality											
WQQ-1		**Havre de Grace Marina Siltation** The Spesutie Island Causeway is a potential source of sediment buildup near the Havre de Grace Marina which is reported to affect local boating and the Chesapeake Bay ecosystem.									
		For strategies that address this issue see Strategies MEC-3A and MEC-3B.									
WQQ-2		**Edgewood Area Lacks an Uninterruptable Water Supply** The Edgewood Area water source is subject to periodic production shortages. Supplemental water to the Edgewood Area from Harford County is temporary. A reliable source of water to serve the Edgewood Area is needed to meet current and future needs.									
		For strategies that address this issue see Strategies IE-1A, IE-1B, and IE-1C.									
WQQ-3		**Aberdeen Area Lacks an Uninterruptable Water Supply** The source of water for the Aberdeen Area suffers from periodic production shortages due to flows that cannot be maintained during moderate drought periods. Back-up water supplies are provided from Harford County by way of the City of Aberdeen through a collective MOU which expires in 2017.									
WQQ-3A		**Continue to Plan for Onsite Potable Water** Continue to plan for onsite potable water to reduce reliance on Deer Creek and the Chapel Hill Treatment Plant and to provide a secure and reliable source of water. Develop a Master Plan including quantified supply and future demand based on anticipated need, determination of onsite well capacity at APG, modernization plan for onsite facilities, identification of additional / new infrastructure, funding sources, and commitment from the Maryland Department of the Environment of a water permit to draw the necessary quantity to support long-term APG demand. *Other Partner: Maryland Department of the Environment*	2016	■	□						□

Issue/Strategy ID	Geographical Area	Strategy	Timeline	APG	City of Aberdeen	City of Havre de Grace	Harford County	Kent County	Cecil County	Maryland DOT	Other
WQQ-3B	APG	Plan and Coordinate for the Implementation of Infrastructure Improvements to Achieve a Secure and Reliable Potable Water Supply to the Aberdeen Area Develop a coordinated Implementation Plan to execute the Water Provision Master Plan in Strategy WQQ-3A. Include measurable milestones, Capital Improvement Plan projects, dedicated funding sources, and multijurisdictional / multiagency coordination. *Other Partners: Maryland Department of the Environment*	2017	■	□						□
WQQ-4		EUL Site On Top of Aquifer Recharge Infiltration Field The EUL site is located within the Source Water Protection Area that encompasses the water wells for Harford County and the City of Aberdeen. There is a concern that future EUL development can impact the aquifer recharge associated with the wells.									
WQQ-4A	APG	Plan for Cumulative Impacts Develop a plan to ensure that cumulative development impacts of The G.A.T.E. development do not have a detrimental impact on the aquifer recharge for the Source Water Protection Area that would affect the viability of water wells at APG. *Other Partner: St. John Properties*	2019	■	□		□				□
WQQ-5		Stewardship of Chesapeake Bay Waters Perception that counties are providing a disproportionate amount of funding versus APG to clean the Chesapeake Bay.									
WQQ-5A	Study Area	Quantify APG Funding and Include in APG Education Efforts To demonstrate good stewardship of the Chesapeake Bay, quantify the value of, and document ongoing conservation efforts of the Chesapeake Bay ecosystem by APG. Incorporate as part of the public outreach in conjunction with Strategies COM-5B, COM-5C, and COM-6B.	2019	■							

Please see the next page.



APG
JLUS

Aberdeen Proving Ground
Joint Land Use Study

Matrix
DESIGN GROUP

For Additional Information Contact:

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