11-2007

# Coastal Maritime Forests in Virginia – Delineation and Distribution

Marcia Berman
*Virginia Institute of Marine Science*

Harry Berquist
*Virginia Institute of Marine Science*

## Recommended Citation

# Coastal Maritime Forests in Virginia – Delineation and Distribution

## Final report submitted to

## Virginia Coastal Zone Management Program
## Virginia Department of Environmental Quality

### Prepared by

**Marcia Berman and Harry Berquist**
**Center for Coastal Resources Management**
**Virginia Institute of Marine Science**
**College of William and Mary**
**Gloucester Point, Virginia  23062**

**November, 2007**

## Introduction and Definitions

Coastal maritime forests are important coastal habitats that receive little attention despite their declining presence along the coast. What constitutes a coastal maritime forest can vary depending on how broadly one wants to define the community structure. This study defines coastal maritime forests in part by the ecological community classification developed by the Virginia Department of Conservation and Recreation (VADCR). However, the definition used here includes only maritime dune woodlands and maritime uplands. Arguably, one could also consider forested swamps as a maritime habitat. This study makes an important distinction, consistent with the definition used by the Massachusetts Division of Fisheries and Wildlife (2006), that maritime forests or coastal forests do not tolerate standing salt water. They are, however, adaptive to salt spray on their leaves. This is a major variation from the wetter forested wetlands not considered in this study.

In Virginia, maritime dune and maritime upland forests are significantly rarer habitats than their marsh counterparts, with a restricted distribution that is largely explained by habitat loss. Maritime dune woodlands are composed of deciduous, coniferous, and broadleaf evergreens. Maritime upland forests contain "… species-poor evergreen and mixed coastal forests" (Fleming et al., 2006). They are often pine-dominated, with an under story of deciduous trees. While species may grow in a broader class of soil types, the maritime dune woodlands and upland forests grow in well to rapidly drained nutrient poor sandy soils.

## Project Objectives

This project had two major goals. The first builds on an earlier effort by the Virginia Department of Forestry, who delineated maritime forests using remote sensing techniques. Their project integrated land use and soils data to generate a map that defines potential boundaries of maritime forest. This study follows an identical approach with two major exceptions. The first is the soils data used in this study is mapped at a much finer scale. The second is this study has a field validation component that reviewed random sites around selected locations to ground-truth the remote sensing output. The Virginia Department of Forestry provided staff support from various regional offices to perform all field work. Ancillary data such as soils and aerial imagery were also used where wetland and dune habitat could be distinguished.

The second major goal of this project was to compute, on a county-by-county basis, the amount of maritime forest cover present in each coastal locality, and the extent of maritime forests located within conservation lands. Boundaries for conserved lands data from VA DCR were used.

The results of the study are documented here. A website hosted by the Center for Coastal Resources Management (CCRM) includes report, maps, and GIS data (http://ccrm.vims.edu/maritimeforest/maritimeforest.html).

## Acknowledgements

## Methods

Land use and land cover data were derived from a 2000 Landsat 7 thematic image classification generated by the Regional Earth Science Application Center (RESAC) at the University of Maryland. RESAC uses a modified Anderson Level II classification (Anderson et al., 1976), and a decision tree algorithm developed by their program and described in Varlyguin et al. (2001). Figure 1 illustrates the classification.

A baseline forest coverage was generated by extracting deciduous forests, evergreen forests, and mix (deciduous-evergreen) forest communities from the RESAC dataset. All other classes were masked out of the analysis. Esri's ArcMap® software was used.

Digital soils data were derived from the National Soil Survey Geographic (SSURGO) database. These data are surveyed and mapped nationwide at scales ranging from 1:12,000 to 1:63,360. They represent the most accurate region-wide soils data available (Soil Survey Staff, no reference date). From this dataset, soils with properties typical of maritime forest habitat were extracted for coastal Virginia. Using guidance from the VADCR all non-hydric well drained, excessively drained, sandy or sandy loam soil types were extracted for the coastal plain of Virginia. This constitutes many different named soil classes. The soil classes derived in the final delineation are listed in Appendix 1.

| | |
|---|---|
| no data | ⬛ |
| low intensity developed | 🟥 |
| medium intensity developed | 🟥 |
| high intensity developed | 🟥 |
| commercial / industrial | |
| | ⬛ |
| transportation | 🟫 |
| croplands | 🟧 |
| pasture | 🟨 |
| fallow | ⬜ |
| | ⬛ |
| natural grass | 🟩 |
| recreational non-golf grass | 🟩 |
| intensely managed grass | 🟩 |
| deciduous shrublands | 🟦 |
| evergreen shrublands | 🟦 |
| mixed (deciduous-evergreen) shrublands | 🟦 |
| mixed (tree-grass or shrub-grass) rangeland | 🟦 |
| deciduous forests | 🟩 |
| evergreen forests | 🟩 |
| mixed (deciduous-evergreen) forests | 🟩 |
| deciduous wooded wetlands | 🟪 |
| evergreen wooded wetlands | 🟪 |
| emergent herb-sedge wetlands | 🟪 |
| mixed wetlands | 🟪 |
| beaches and other sandy areas | ⬜ |
| bare rock, strip mines, quarries, gravel pits | ⬜ |
| bare soil, bare ground | ⬜ |
| water | 🟦 |

Figure 1. Modified Anderson Level II Land Use classification developed by RESAC (from http://www.geog.umd.edu/resac/lc2.html)

Using ArcMap® a baseline delineation of maritime forest was generated by combining the land cover and the soils data. This delineation indicated maritime forest habitat in seven different jurisdictions: Accomack, Hampton, Mathews, Norfolk, Northampton, Poquoson, and Virginia Beach.

As expected, these two basic properties of maritime forests can be shared with other vegetative communities. Therefore, ancillary data combined with the expertise of local foresters, and landscape ecologists was used to refine the boundaries. Imagery and field maps were scrutinized in committee and logical exclusions were made based on topographic elevation, inundation potential, location of dunes, location of ridge and swale topography, proximity to wetlands, and proximity to the coast. By our accepted project definition, maritime forests do not grow in wet, swampy environments. Therefore vegetation that appeared to be in low lying marshes and had direct connectivity to streams was excluded. Similarly, maritime forests are coastal landscapes and despite the fact that one could detect appropriate vegetation and soils properties inland, these areas were excluded. Figure 2 is an example from Mathews County where polygons meet vegetation and soil properties but do not meet other logical habitat parameters, such as landscape position relative to the coast. Imagery proved to be an important resource for

defining ridge and swale topography and dune environments; landscape properties conducive with our maritime forest definition.

A revised set of baseline field maps were generated and superimposed on 2002 high resolution natural color imagery (VBMP, 2002). For each general area, a GPS location was generated at random and plotted on field images. Foresters were given the coordinates, maps and a checklist of things to review. The checklist was provided as guidance only, and was not always returned completed (Appendix 2). Foresters conducted general ground surveys at random locations in and around the plotted site. Site locations, while random, were reviewed prior to field work to insure there was a representative sample within each delineated boundary; inclusive of edges. Appendix 3 shows the final sites reviewed in the field. Due to access problems no field reviews were conducted on the privately owned barrier islands off the eastern shore of Virginia.

Following the field assessments, a revised delineation was generated for each county or city evaluated by digitizing and editing boundaries according to field recommendations while using maritime forest soils and 2002 VBMP high resolution imagery (2 ft resolution) for guidance. ArcMap® was used and shape files were generated. A separate review by the VADCR Division of Natural Heritage indicated an absence of coverage on the eastern shore barrier islands. These were added to the final map compositions using comparable image processing techniques, but no field validation. Referenced survey data provided by Natural Heritage Program provided a comfortable level of ground-truthing. All map compositions are presented in Appendix 4, 5, and 6.

Figure 2. Polygons in blue highlight areas that have correct soils and forest cover, but are logically not maritime habitat based on landscape position.

## General Community Risk Analysis

Two factors contribute to the future potential loss of maritime forests. The first is climate change and the potential for increased storm severity that could accelerate coastal erosion. Sea level rise associated with climate change impacts also poses a risk if the natural dune environment that supports maritime forests cannot be sustained.

Sustainability of dune forests in particular is largely controlled by development pressure that restricts the availability and transport of aeolian sands that maintain coastal dunes. To determine the immediate risk of development on maritime forests, GIS data delineating conserved areas (from the VA Dept. Conservation and Recreation) were superimposed on the final maritime forest habitat maps. This analysis would quantify the remaining habitat currently in conservation areas. The results are reported in Table 1.

### Table 1. Maritime Forest within Conservation Lands

| County | Acres within Conservation | Acres out of Conservation | Total (acres) |
|---|---|---|---|
| Accomack | 820 | 35 | 855 |
| Northampton | 406 | 128 | 534 |
| Virginia Beach | 2704 | 0 | 2704 |
| | _____ | _____ | _____ |
| | 3930 | 163 | 4093 |

## Results

In the final iteration, maritime forest habitat was present in only three jurisdictions: Accomack County, Northampton County and the City of Virginia Beach. The general locations are shown in Figure 3. A total of 4,093 acres was computed. The largest community exists in the City of Virginia Beach with 2,704 acres (1,094 hectares) (Appendix 4). Northampton County has 534 acres (216 hectares) (Appendix 5). Accomack County has 855 acres (346 hectares) (Appendix 6). This study revealed significantly less maritime forest habitat than an earlier estimate conducted by the Department of Forestry (DOF). We attribute major discrepancies to the coarser resolution soils (STATSGO) data used in the DOF delineation and to a lesser degree, the

absence of ground-truthing in that study.  A comparison of results is illustrated in Figure 3.  The VA Dept. of Conservation and Recreation's Division of Natural Heritage also provided locational information for sites where they have surveyed for maritime forest habitat.   These sites are shown on the delineation maps in Appendix 4-6.   Only six of the sixteen field sites they surveyed did not fall within boundaries delineated using remote sensing techniques.   These generally fell out of the delineation due to soil properties and could represent a slightly different acceptance of parameters that define maritime forest.

Using the conservation lands dataset compiled by VADCR we determined all but 163 acres of maritime forest habitat resides within existing conservation lands.  These areas are located in Northampton County and Accomack County.  According to the conservation lands boundary data provided by VADCR, maritime forest community is present north of  Kiptopeke State Park and largely outside of any publicly owned property.  This area may be currently undergoing development or development pressure may be evident in the vicinity of this community, but this has not been verified.  Communities found on Great Neck and Savage Neck in Northampton County are also outside of protected lands.

In Accomack County, only 35 of the total 855 acres are outside of publicly owned conservation lands.  These areas are located in low lying uplands of the back barrier system.

Given that the majority of the remaining maritime forest in Virginia in located in protected lands, one could conclude that the short-term risk to the remaining forest habitat is low.  However, long-term risks associated with development pressure along the perimeter of conservation lands may impede the community from performing habitat functions in the future.  An analysis of development pressure in the adjacent lands as well as an existing functional assessment of the individual communities would be required to make this determination.   Also, the long-term effects associated with sea level rise and storm climate cannot be overlooked.

## Recommendations

While short-term preservation of most remaining maritime forest habitat is sustainable by existing conservation boundaries, at least two of these sites are located outside major centers of urban and residential development.  At this time, there is no assessment that determines if and how existing development impacts the ability of these habitats to perform ecosystem services.  Furthermore, as development in the surrounding community of Virginia Beach and Northampton County continues, future declines in habitat function could occur.   If at all possible, efforts to secure the lands in Northampton County would be recommended since the county has zoned significant undeveloped tracks for future development.   A closer look at the risk associated with development along the bayside maritime forest communities would be prudent.

Further study would be needed to 1) assess the current ecosystem services existing maritime forest provide, and 2) assess the potential that future development would have on available ecosystem services. Both of these initiatives would require protocols for the evaluation of services and stressors in this environment. We would recommend a focus on habitat and flood control services to start and a review of the existing work conducted by the VADCR-NH program which could provide a base line functional assessment.

Elements of different landscape models could be employed to determine potential for disruption of these services due to development. Models like the Chesapeake Bay Resource Lands Assessment may be consulted to determine ecological vulnerability resulting from development (http://www.chesapeakebay.net/rla.htm). Based on the findings, a prediction of long-term probability for habitat sustainability may be determined.

## References

Anderson, J.R., E.E. Hardy, J.T. Roach, and R.E. Witmer, 1976. A land use and land cover classification system for use with remote sensor data. US Geol. Surv. Prof. Pap., 964p.

Commonwealth of Massachusetts Division of Fisheries and Wildlife, 2006, Natural Community Fact Sheet – Coastal Forests, Maritime Forests, and Maritime Shrublands, Natural Heritage and Endangered Species Program, Westborough, MA, pp. 4.
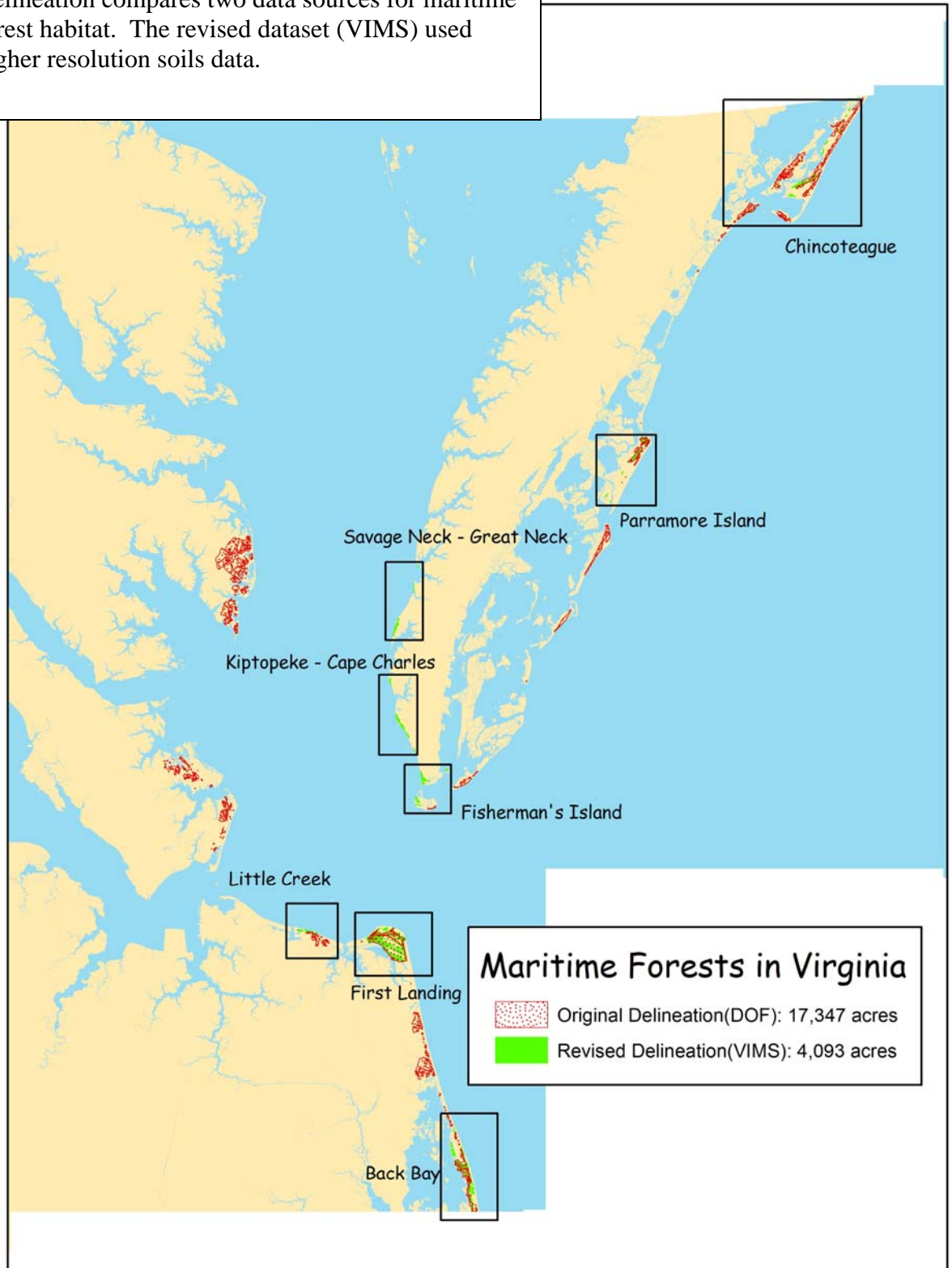
Fleming, G.P., P.P. Coulling, K.D. Patterson, and K. Taverna. 2006. The natural communities of Virginia: classification of ecological community groups. Second approximation. Version 2.2. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic (SSURGO) Database for *Survey Area, State* [Online WWW]

Varlyguin, D., R K Wright, S J Goetz, S D Prince (2001). Advances in land cover classification from applications research: a case study from the mid-Atlantic RESAC. Available at www.geog.umd.edu/resac and on ASPRS CD-ROM in American Society for Photogrammetry and Remote Sensing (ASPRS) Conference Proceedings, Washington DC.


Virginia Department of Conservation and Recreation, 2005, Va Conservation Lands Database.

Figure 3.  Location of maritime forests in Virginia.
Delineation compares two data sources for maritime
forest habitat.  The revised dataset (VIMS) used
higher resolution soils data.



Chincoteague

Parramore Island

Savage Neck - Great Neck

Kiptopeke - Cape Charles

Fisherman's Island

Little Creek

First Landing

Back Bay

Maritime Forests in Virginia

Original Delineation(DOF): 17,347 acres

Revised Delineation(VIMS): 4,093 acres

APPENDIX 1.

Soil Classes: City of Virginia Beach, Northampton County, and Accomack County

SSURGO Soils Classes used in the Maritime Forest Delineation[**]

**Virginia Beach**

10  Corolla fine sand,  Moderately well drained,  Partially hydric (10 percent)

16E  Fripp sand-2 to 30 percent slopes,  Excessively drained,  Partially hydric (5 percent)

18  Lakehurst variant sand,  Moderately well drained,  Partially hydric (5 percent)

22E  Newhan fine sand-2 to 30 percent slopes,  Excessively drained,  Partially hydric (13 percent)

23C  Newhan-Corolla fine sands-0 to 15 percent slopes,  Excessively drained,  Partially hydric (5 percent)

**Northampton**

AsE  Assateague sand-2 to 50 percent slopes,  Excessively drained,  Partially hydric (5 percent)

AtD  Assateague fine sand-2 to 35 percent slopes-rarely flooded,  Excessively drained, Partially hydric (12 percent)

FhB  Fisherman fine sand-0 to 6 percent slopes-occasionally flooded,  Moderately well drained,  Partially hydric (15 percent)

FmD  Fisherman-Assateague complex-0 to 35 percent slopes-rarely flooded, Moderately well drained,  Partially hydric (15 percent)

**Accomack County**

AtD   Assateague fine sand- 2 to 35 percent slopes- rarely flooded, Excessively drained, Partially hydric (4 percent)

FhB  Fisherman fine sand- 0 to 6 percent slopes- occasionally flooded,  Moderately well drained,  Partially hydric (2 percent)

FmD Fisherman-Assateague complex- 0 to 35 percent slopes- rarely flooded,  Moderately well drained,  Partially hydric (5 percent)

---

[**]   Similar soil classes were found in localities which did not meet other criteria for maritime forest habitat.

APPENDIX 2.

General Site Review Checklist for Maritime Forest Delineation

Site name (or number)

Is there standing water at the site?

Is there wetlands vegetation at the site?

Is this site characteristic of an abandoned agricultural field?

Are the boundaries of the site within view of an open water body?

Is the site located in or near a beach environment?

General soil description:

General on site topography (e.g. high cliff, dune ridge, swale, tidal flat)

Are you in agreement with the delineation by DOF for this site?*

Are you in agreement with the delineation by VIMS for this site?*

Does the site meet the minimum criteria for maritime forest based on the Natural Heritage Program Definition (vegetation and soils)?

Do you think the site is a maritime forest?

* if DOF or VIMS does not delineate the area as a maritime forest and you agree say yes.

APPENDIX 3.

Field Site Review Locations*

Mathews County
Northampton County
City of Virginia Beach

* These localities in addition to the City of Poquoson and Accomack County were reviewed using remote sensing techniques as well.

Lat: 37.4524
Lon. -76.2760

VIMS deliniation (Based on RESAC2000 and SSURGO data)
VA DOF deliniation

**Maritime Forest**
**Mathews County**
**Map 1 - Site 1**
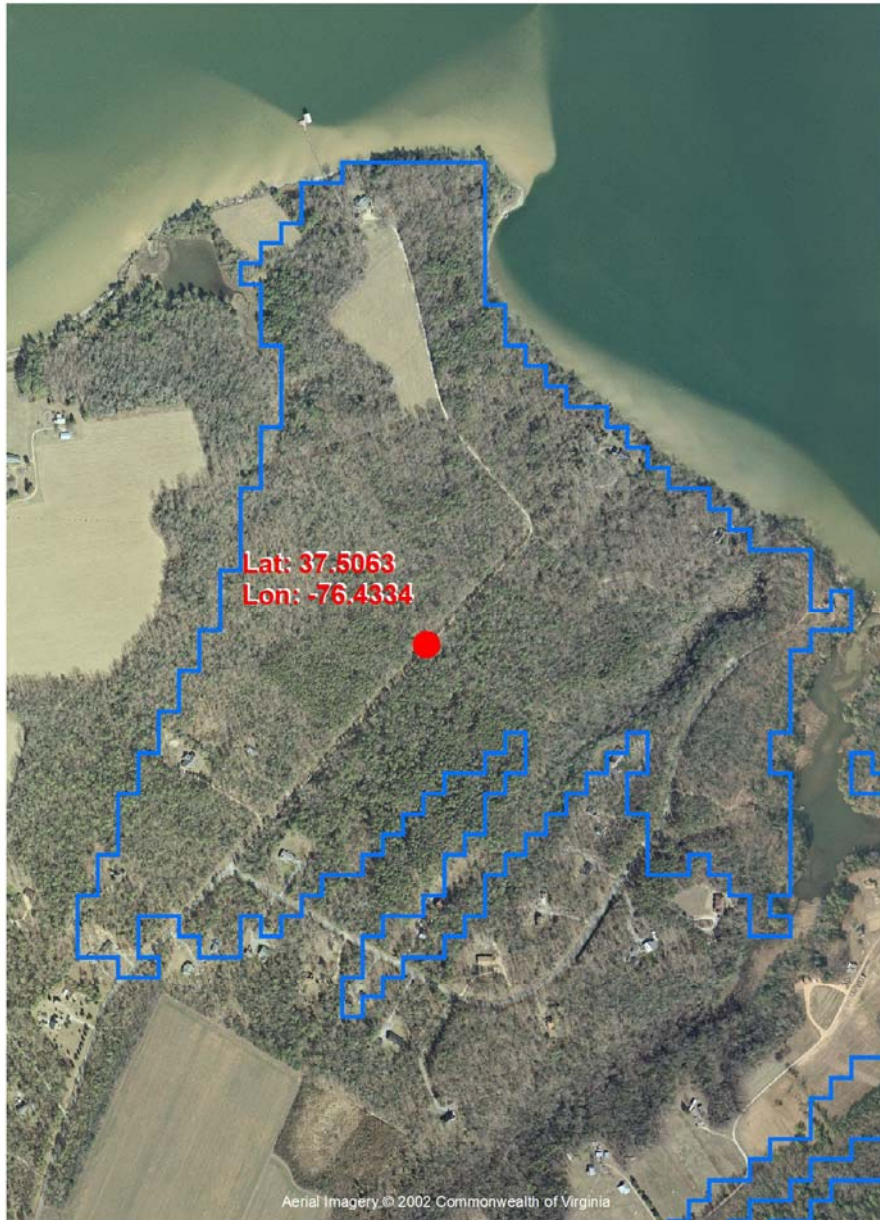
Lat: 37.5063
Lon: -76.4334

Aerial Imagery © 2002 Commonwealth of Virginia

VIMS deliniation (Based on RESAC2000 and SSURGO data)

VA DOF deliniation

**Maritime Forest
Mathews County
Map 2 - Site 1**

Lat: 37.3220
Lon: -76.2787
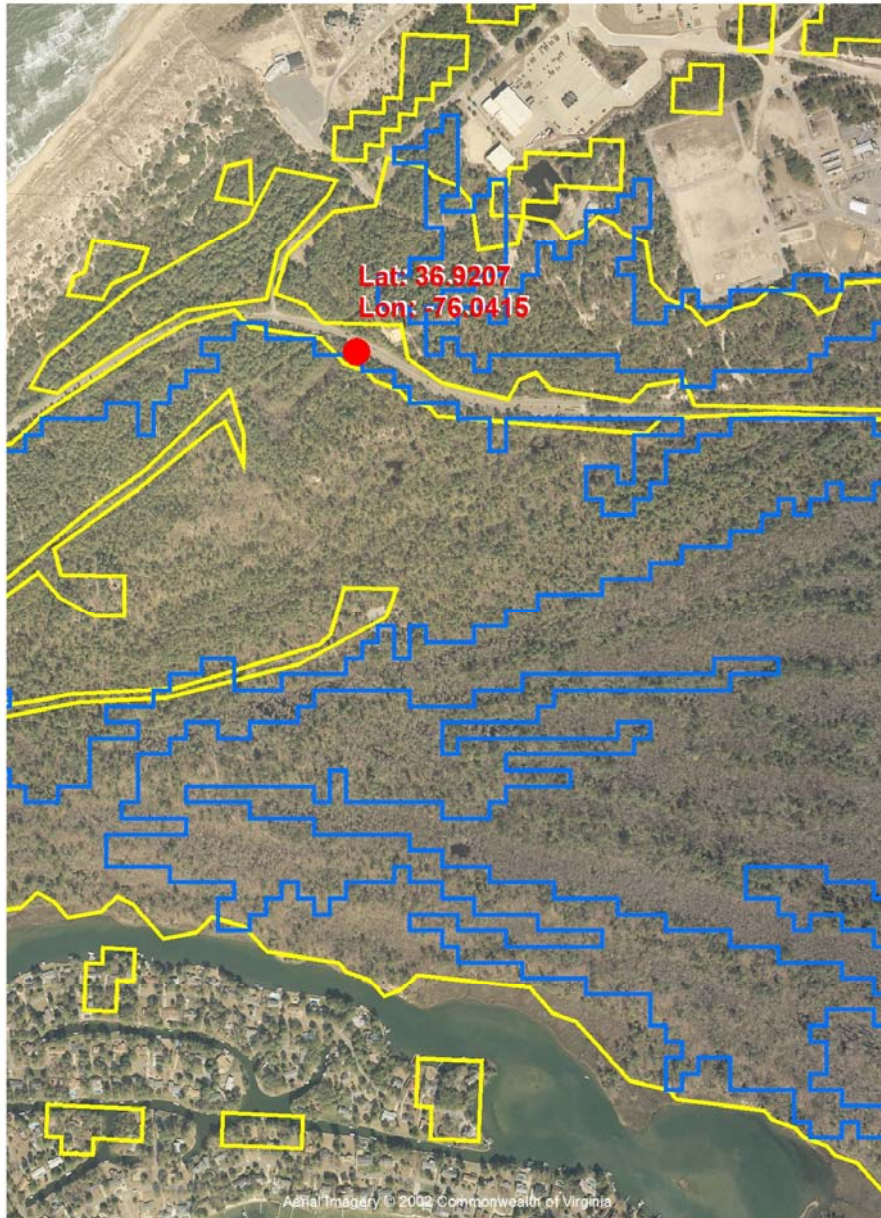
Aerial imagery © 2009 Commonwealth of Virginia

VIMS deliniation (Based on RESAC2000 and SSURGO data)

VA DOF deliniation

**Maritime Forest**
**Mathews County**
**Map 3 - Site 1**

Lat: 37.3220
Lon: -76.2787

Aerial Imagery © 2008 Commonwealth of Virginia

VIMS deliniation (Based on RESAC2000 and SSURGO data)

VA DOF deliniation

**Maritime Forest
Mathews County
Map 3 - Site 1**

Lat: 37.0924
Lon: -75.9733

Aerial Imagery © 2002 Commonwealth of Virginia

VIMS deliniation (Based on RESAC2000 and SSURGO data)

VA DOF deliniation
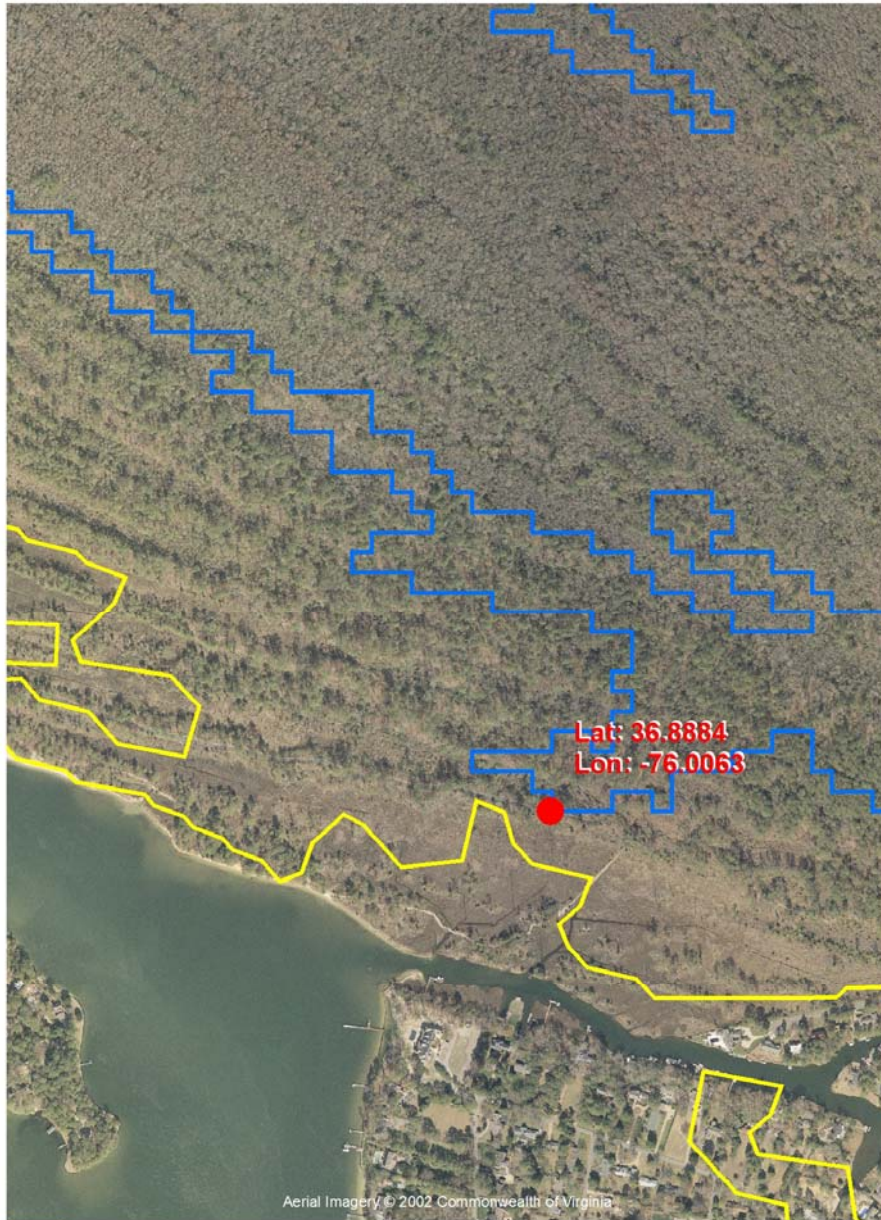
**Maritime Forest
Northampton County
Map 4 - Site 1**

Lat: 37.1649
Lon: -75.9817

Aerial Imagery © 2002 Commonwealth of Virginia

☐ VIMS deliniation (Based on RESAC2000 and SSURGO data)
☐ VA DOF deliniation

**Maritime Forest
Northampton County
Map 4 - Site 2**

18

| | VIMS deliniation (Based on RESAC2000 and SSURGO data) |
| --- | --- |
| | VA DOF deliniation |

**Maritime Forest
Virginia Beach
Map 1 - Site 1**

Lat: 36.9207
Lon: -76.0415

Aerial Imagery © 2002 Commonwealth of Virginia

Lat: 36.9073
Lon: -75.9961

Aerial Imagery © 2002 Commonwealth of Virginia

▭ VIMS deliniation (Based on RESAC2000 and SSURGO data)

▭ VA DOF deliniation

**Maritime Forest**
**Virginia Beach**
**Map 1 - Site 2**

Lat: 36.8884
Lon: -76.0063

VIMS deliniation (Based on RESAC2000 and SSURGO data)

VA DOF deliniation
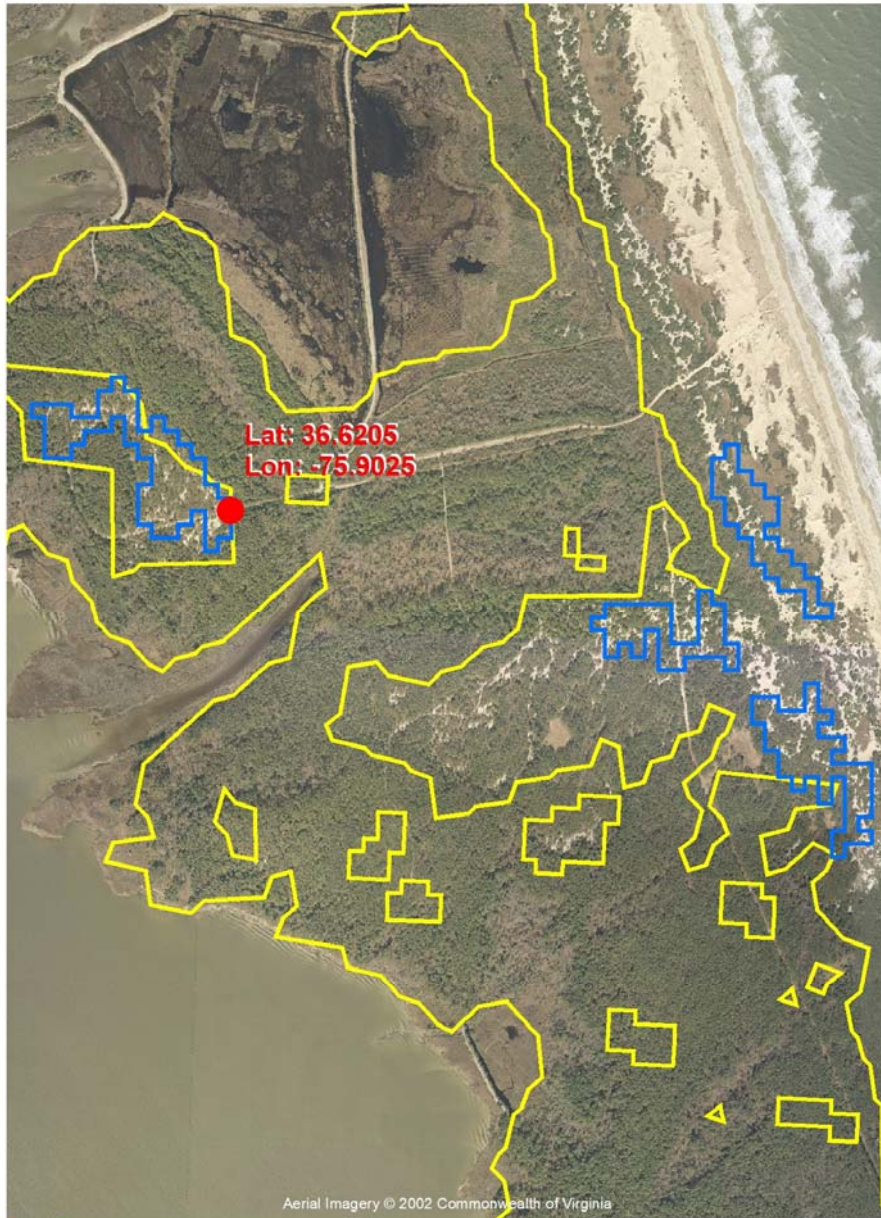
**Maritime Forest
Virginia Beach
Map 1 - Site 3**

Aerial Imagery © 2002 Commonwealth of Virginia

Lat: 36.6205
Lon: -75.9025

Aerial Imagery © 2002 Commonwealth of Virginia

VIMS deliniation (Based on RESAC2000 and SSURGO data)

VA DOF deliniation

**Maritime Forest
Virginia Beach
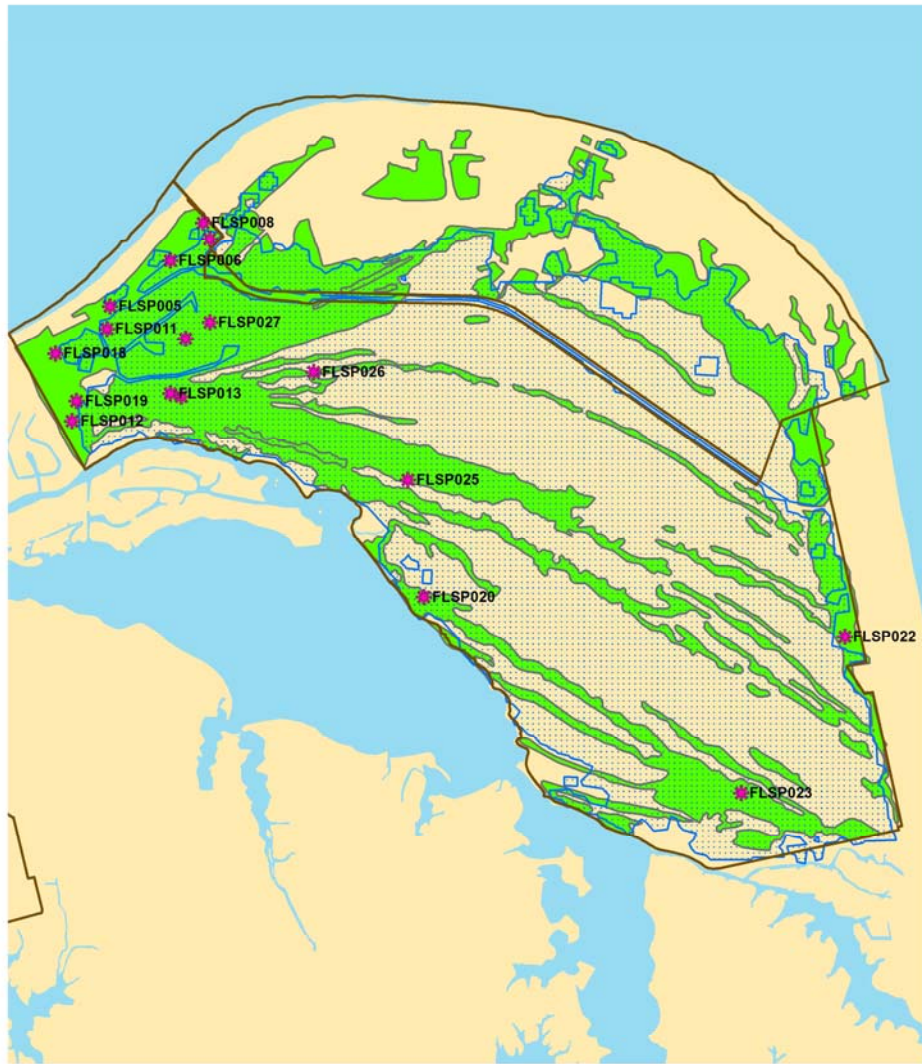Map 2 - Site 1**

APPENDIX 4.  City of Virginia Beach

Site 1.  First Landing State Park

Site 2.  Back Bay Wildlife Refuge

Site 3.  Little Creek

**Maritime Forest**
**City of Virginia Beach**
**Site Location**
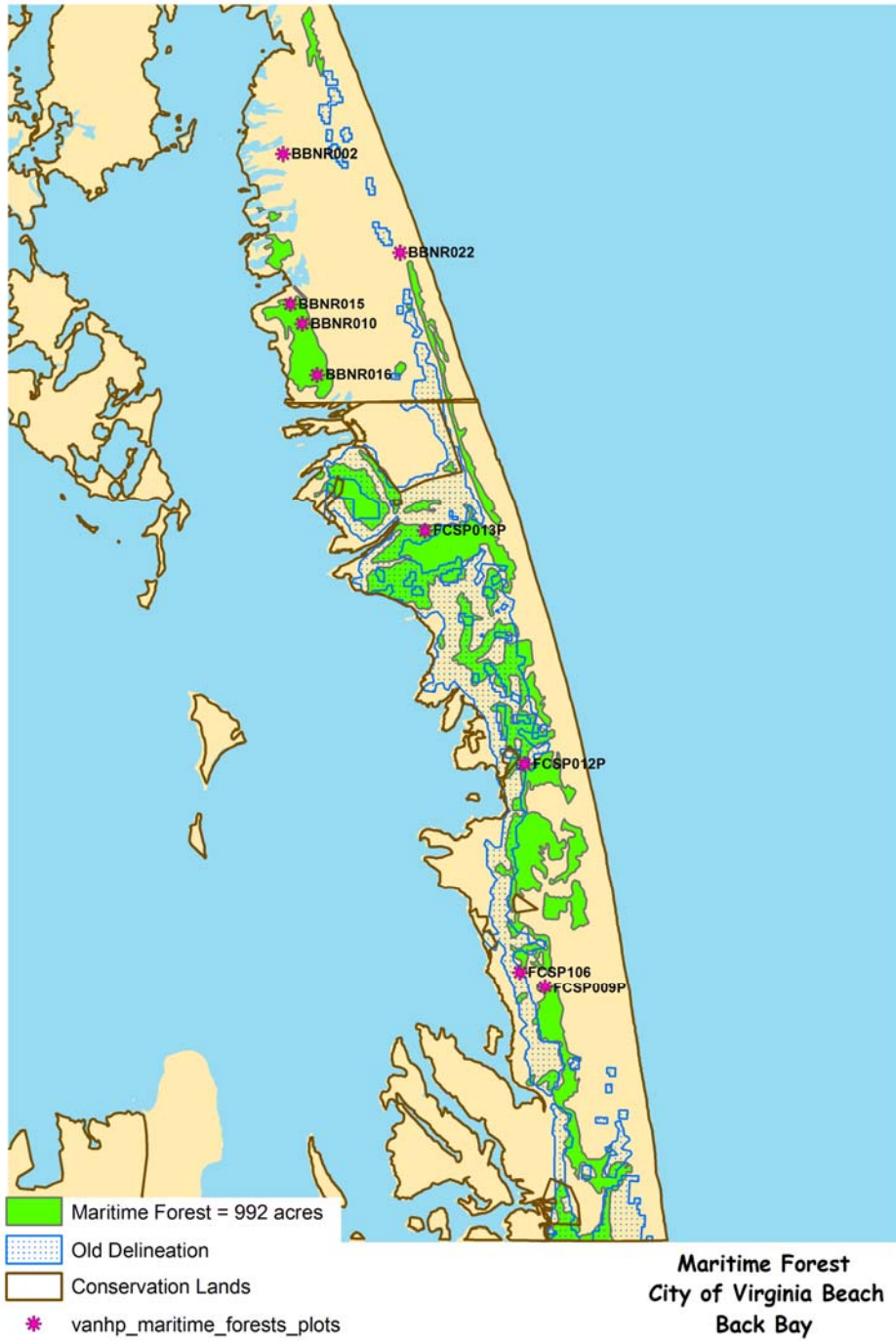
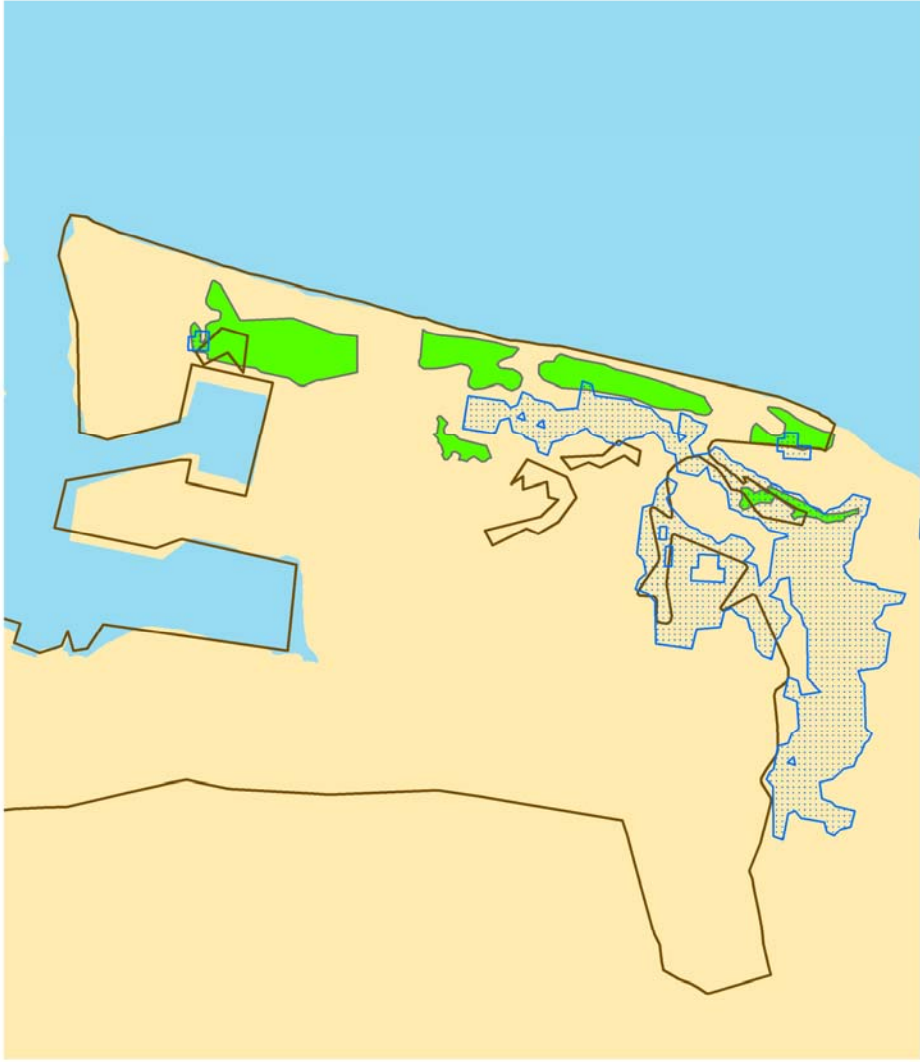Maritime Forest = 1,610 acres

Old Delineation

Conservation Lands

vanhp_maritime_forests_plots

**Maritime Forest
City of Virginia Beach
First Landing**

FLSP008

FLSP006

FLSP005

FLSP011

FLSP027

FLSP018

FLSP026

FLSP019

FLSP013

FLSP012

FLSP025

FLSP020

FLSP022

FLSP023

Maritime Forest = 1,610 acres

✳ vanhp_maritime_forests_plots

**Maritime Forest
City of Virginia Beach
First Landing**

Maritime Forest
City of Virginia Beach
Back Bay

Legend:
- Maritime Forest = 992 acres
- Old Delineation
- Conservation Lands
- * vanhp_maritime_forests_plots

Plot labels: BBNR002, BBNR022, BBNR015, BBNR010, BBNR016, FCSP013P, FCSP012P, FCSP106, FCSP009P

Maritime Forest
City of Virginia Beach
Back Bay

Legend:
* vanhp_maritime_forests_plots
Maritime Forest = 992 acres

Maritime Forest = 102 acres
Old Delineation
Conservation Lands

Maritime Forest
City of Virginia Beach
Little Creek

Maritime Forest = 102 acres

✳ vanhp_maritime_forests_plots

**Maritime Forest
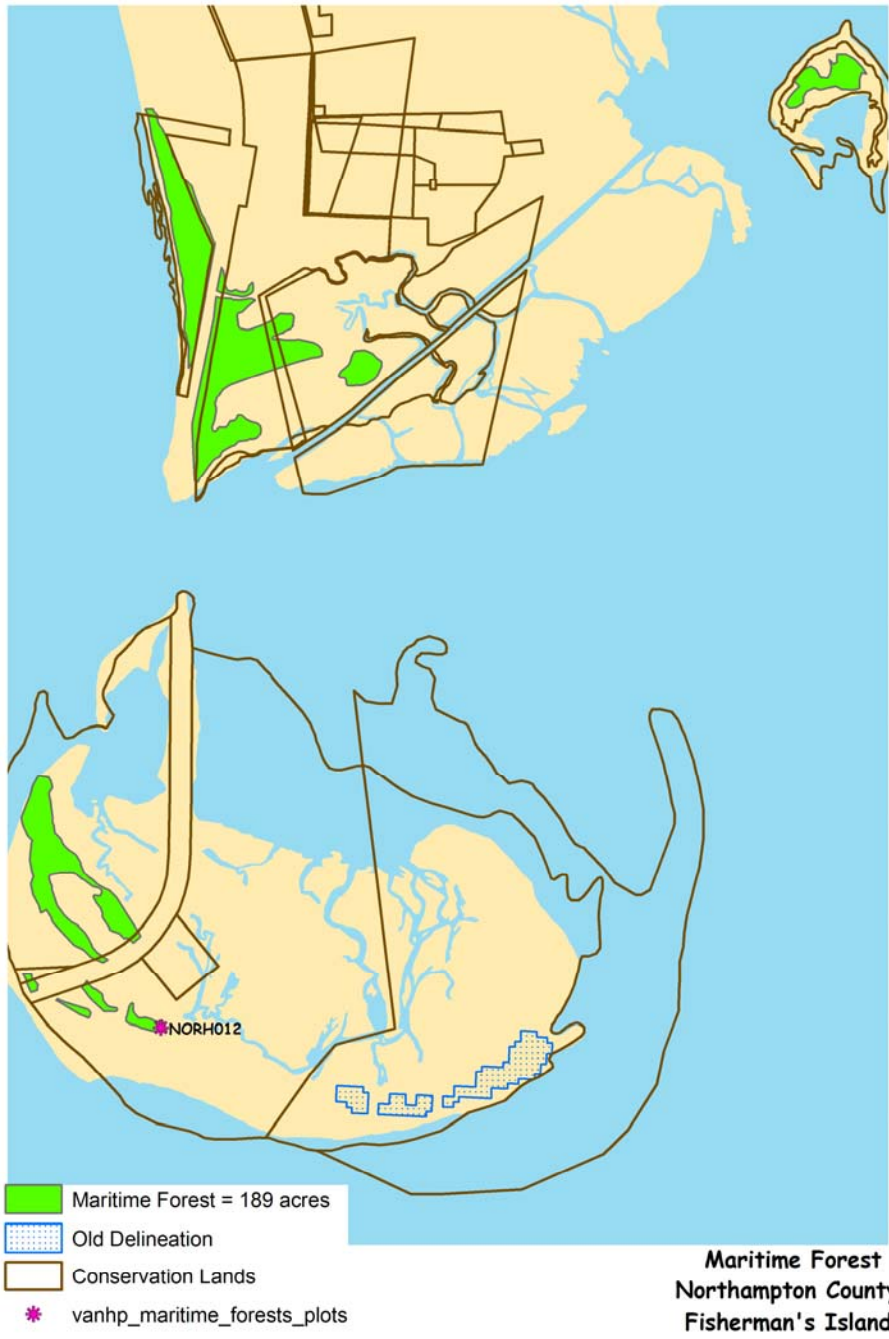City of Virginia Beach
Little Creek**

APPENDIX 5.  Northampton County

Site 1.  Fisherman's Island

Site 2.  Kiptopeke State Park

Site 3.  Savage Neck – Great Neck

**Maritime Forest**
**Northampton County**
**Site Location**

Maritime Forest = 189 acres
Old Delineation
Conservation Lands
✳ vanhp_maritime_forests_plots

NORH012
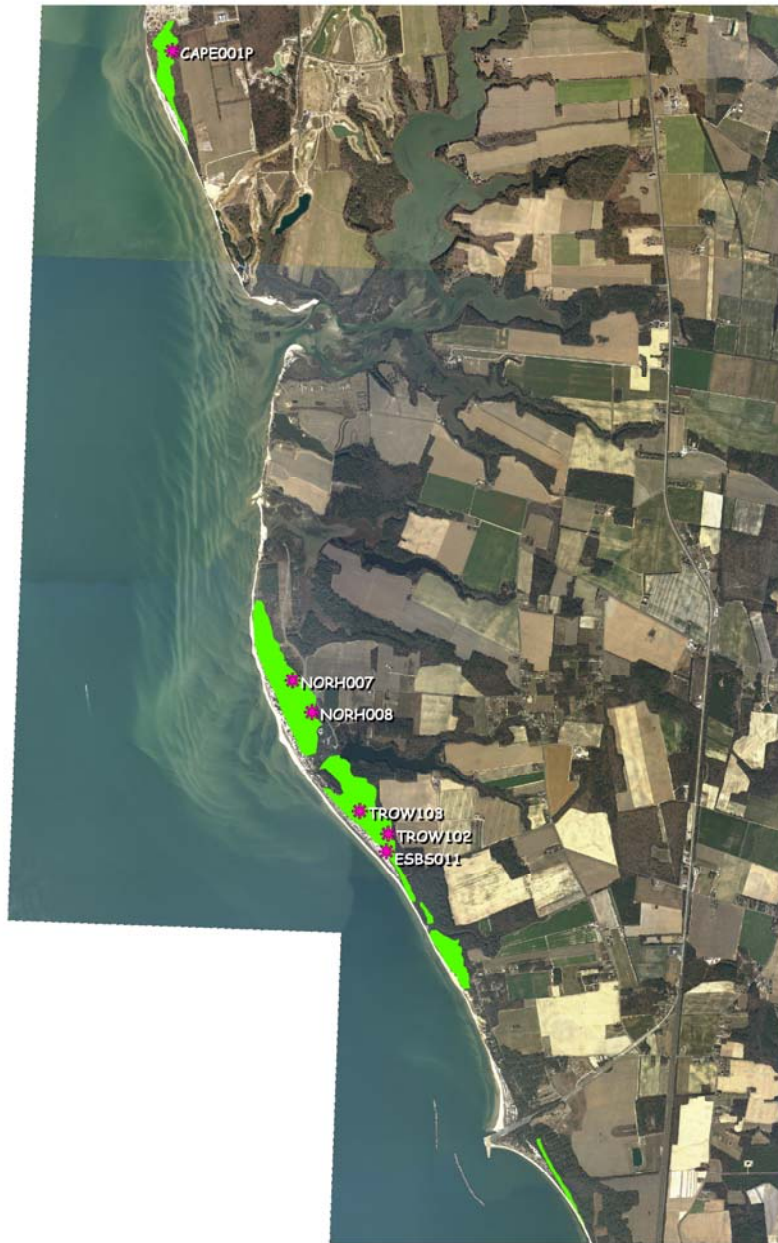
Maritime Forest
Northampton County
Fisherman's Island

Maritime Forest = 189 acres

✳ vanhp_maritime_forests_plots

**Maritime Forest
Northampton County
Fisherman's Island**

Maritime Forest = 199 acres

Conservation Lands

vanhp_maritime_forests_plots

Maritime Forest
Northampton County
Kiptopeke - Cape Charles

Maritime Forest = 199 acres

✳ vanhp_maritime_forests_plots

**Maritime Forest
Northampton County
Kiptopeke - Cape Charles**

Maritime Forest = 146 acres

Conservation Lands

vanhp_maritime_forests_plots

Maritime Forest
Northampton County
Savage Neck - Great Neck

Maritime Forest = 146 acres

vanhp_maritime_forests_plots

SAVA006P

SAVA003P

SAVA004P

ESBS034

**Maritime Forest**
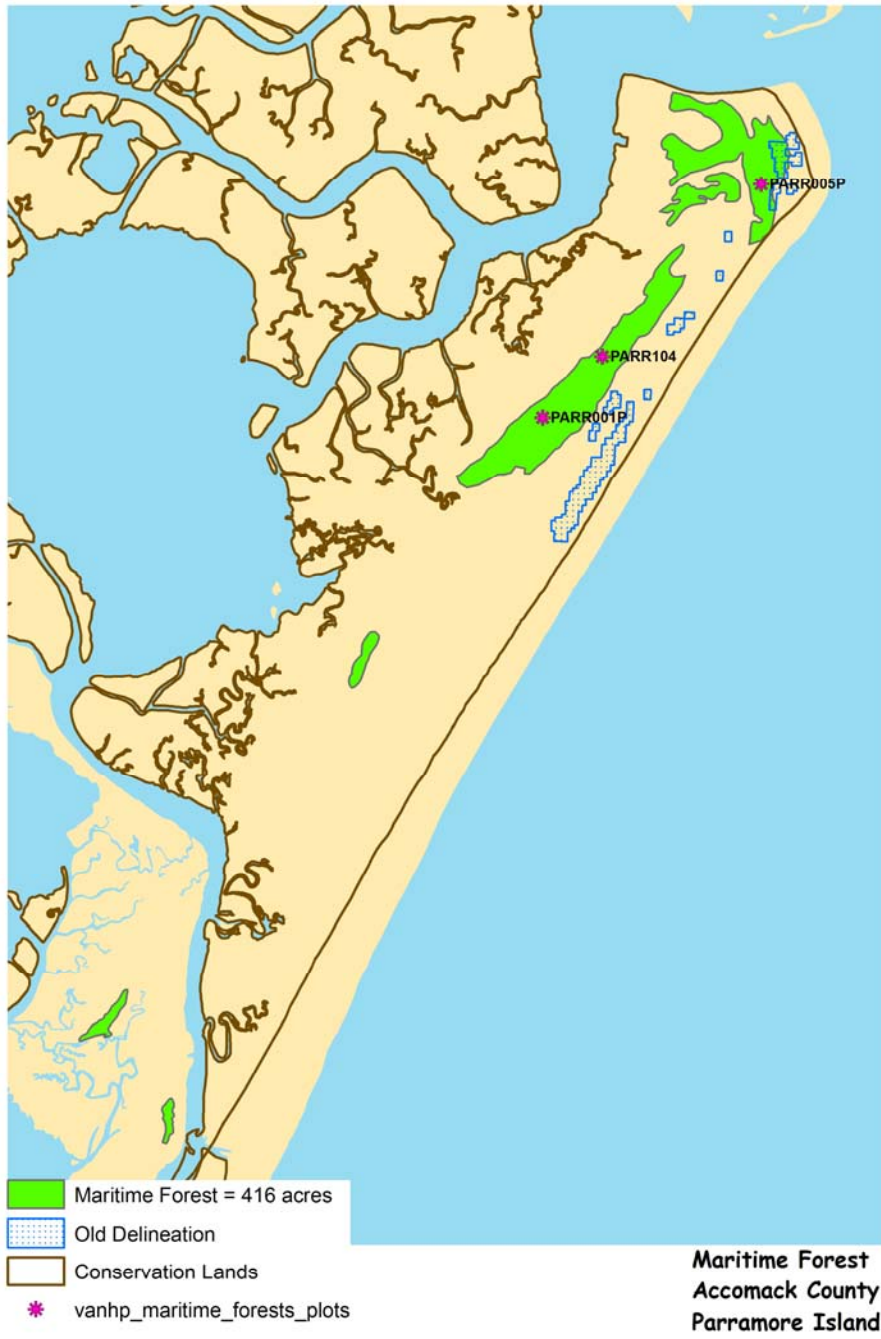**Northampton County**
**Savage Neck - Great Neck**

APPENDIX 6.  Accomack County

Site 1.  Parramore Island

Site 2.  Chincoteague Island

**Maritime Forest
Accomack County
Site Location**

Maritime Forest = 416 acres
Old Delineation
Conservation Lands
∗ vanhp_maritime_forests_plots

Maritime Forest
Accomack County
Parramore Island

Maritime Forest = 416 acres

vanhp_maritime_forests_plots

Maritime Forest
Accomack County
Parramore Island

Maritime Forest
Accomack County
Chincoteague

**Legend:**
- Maritime Forest = 439 acres
- Old Delineation
- Conservation Lands
- * vanhp_maritime_forests_plots

**Plot labels on map:**
CHNR050
CHNR051
CHNR045
CHNR035
CHNR040
CHNR068
CHNR067
CHNR060
CHNR059
CHNR037
WINR009

Maritime Forest = 439 acres
* vanhp_maritime_forests_plots

**Maritime Forest
Accomack County
Chincoteague**