Sustainable Forest Management Plan

FOR

Pocomoke State Forest

Sustainable Forests for People and the Bay

MARYLAND DEPARTMENT OF NATURAL RESOURCES

FOREST SERVICE

December 21, 2010

(Revision #7: May 2023)

POCOMOKE STATE FOREST 18,492 ACRES

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Preface

(Revision #7, May 2023)

The information contained within the Pocomoke State Forest Sustainable Management Plan was derived from a variety of sources. These include the 1996 *Pocomoke State Forest Ten Year Resource Management Plan: Volumes I & II,* the *Maryland Scenic Rivers: THE POCOMOKE Planning for its Scenic, Wild, and Recreational Resources,* and the 2009 *Chesapeake Forest Sustainable Management Plan*. Data presented in tables and charts that are specific to Pocomoke State Forest was generated from field data collected by the Maryland Forest Service and the Maryland Wildlife & Heritage Service from 2002 through 2021. Other information contained within this document is referenced as to its source.

The 18,492-acre Pocomoke State Forest is almost entirely contained within Worcester County except for 388 acres in Somerset County and 150 acres in Wicomico County. The 75,559 acre Chesapeake Forest which is spread over the lower six counties of the Eastern Shore has 20,093 acres within Worcester County. Several tracts from both State Forest adjoin each other offering greater habitat and recreational management opportunities. In addition, since both State Forest contain similar forest types many of the same management guidelines and principles will be used. However there are differences between the two Forest's in that Pocomoke State Forest contains many older tracts of forestland still in its natural state including a state scenic river and areas of state designated Wildlands. These factors require a different approach to management of these areas and are outlined in this plan.

For additional information about Pocomoke State Forest and to provide feedback concerning management policies please visit the website at https://dnr.maryland.gov/forests/Pages/publiclands/eastern_pocomokeforest.aspx.

Revision #1 on 3/29/2011:

- added additional acreage for a new land acquisition to the State Forest

Revision #2 on 3/9/2012:

- added a section to Chapter 2 on *Climate Change and Maryland Forest*

Revision #3 on 10/24/2013:

- Added revisions to Delmarva Fox Squirrel Management guidelines via review and agreement by U.S.F.W.S and DNR Natural Heritage
- New 84 acre Mohr tract added to the State Forest along Cottingham Mill Run and the 593 acre Furnace Tract located off of Millville & Old Furnace Roads

Revision #4 on 1/3/2017

- Added DFS Future Translocation language (Chapters 5 & 8)

Revision #5 on 4/4/2018:

- Updated style formatting, table of contents, and cross-reference links
- Updated web links
- Updated tables and figures using the best available data
- Removed blank pages and areas, resulting in page reduction
- Updated the Riparian Stream Buffer distance to match the best management practices described in the *2015 Maryland Soil Erosion and Sediment Control Standards and Specifications for Forest Harvest Operations* guide
- Updated SFI Standards to the 2015-2019 Management Standard
- Updated FSC Standards to the 2010 FSC-US Forest Management Standard (v 1.0)
- Updated tract maps

Revision #6: 04/22/21

- Incorporated OGEMA map, table, and descriptions into Section 3.2
- Revised Section 6.4: Riparian Forest Buffer Delineation for High Conservation Value Forest
- Updated tables and figures using the best available data
- Updated acreage throughout document

Revision #7: 05/10/23

- Incorporated and updated climate change language in Sections 1.4 and 2.19
- Updated SFI Standards to the 2022 Management Standard (Appendix C)
- Grammar corrections throughout document

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CHAPTER 1

Introduction

1.1 Background and History of the Forest

Pocomoke State Forest is located in the southwestern section of Worcester County and is unique in many ways that set it apart from other State Forests in Maryland (See **Figure 1**). It is located in the Coastal Plain physiographic province. The elevation ranges from sea level to fifty-five feet. The terrain is flat and drainage ranges from very poor in the swamps to very good at the higher elevations. The climate is generally temperate and humid. Seasonal temperatures are influenced by moderating effects of the Chesapeake Bay and Atlantic Ocean. Native stands of loblolly pine dominate uplands while cypress and other hydric species are found in the swamps and bottomlands.

Soils are composed of many classifications ranging from silt and clay loam to nearly pure sand. These soils developed from gravel, sand, silt, and clay transported by the Delaware, Susquehanna, and Potomac Rivers from the Allegheny Ridges.

Pocomoke State Forest was covered by ocean waters during the interglacial periods. The entire Forest is now drained by the Pocomoke River, which flows southwesterly into the Chesapeake Bay at the Maryland-Virginia boundary line.

Archaeological findings indicate that Indians inhabited the area dating from around 10-12000 BC. The various tribes present were part of the Indian linguistic family - the Algonquin Nations. Europeans began to colonize the area in the early 1600s. By the late 1600s, an Indian reservation called "Askiminokonson" was set aside on the west side of the Pocomoke River near the present site of Snow Hill. Their town contained the largest Indian concentration in Maryland.

Primary pioneer activities included logging, trapping, fishing, and farming. Early white settlers used the abundant natural resources for trade. By the late 1700s and early 1800s shipbuilding, brick manufacturing, the smelting of iron ore, and tobacco cultivation expanded.

The 19th century village of Furnace Town has been re-created and it and the original Nassawango Iron Furnace are found adjacent to State Forest lands. The Civil War period brought slaves, deserters, and smugglers to the Forest area; the dark, remote swamps of the Pocomoke River were an integral part of the Underground Railroad. Prohibition brought bootleggers.

In the early 1900s before the establishment of the State Forest, much of the land had been cleared for farming or used as farm woodlots. When the depression era hit in the late 1920s and early 1930s many of the farmers fell on hard times, resulting in the acquisition of large amounts of land by the Federal Government. In the mid to late 1930s, two Civilian Conservation Camps were located in the federally owned Forest. The camp workers did considerable road and trail work, established boundary lines, provided for fire protection and suppression, planted trees, and performed improvements to the recreational area at the Milburn Landing property along the Pocomoke River. Then in 1954, the Federal Government deeded all of its holdings to the State, the State in turn combined these lands with their holdings that they had acquired during the same period, thus creating the Pocomoke State Forest. In 1964, the Milburn Landing and Shad Landing areas were separated from the Forest and developed for intensive recreational uses both areas are now known as the Pocomoke River State Park. The State continues to purchase in-holdings and other ecologically important areas along the Pocomoke River to add to the State Forest system. The current acreage of the forest is 18,492 acres.

1.2 State Forest Planning & Sustainable Forest Management

The resources and values provided by state forests reach people throughout the State and beyond. These resources and values range from economic to aesthetic and from scientific to inspirational. The Department of Natural Resources is mandated by law to consider a wide variety of issues and uses when pursuing a management strategy for these forests. The importance of considering these factors is acknowledged in the Annotated Code, which establishes the following policy pertaining to state forests and parks:

> *"Forests, streams, valleys, wetlands, parks, scenic, historic and recreation areas of the state are basic assets. Their proper use, development, and preservation are necessary to protect and promote the health, safety, economy, and general welfare of the people of the state. It is the policy of the state to encourage the economic development and the use of its natural resources for the improvement of the local economy, preservation of natural beauty, and promotion of the recreational and leisure interest throughout the state."* (Annotated Code of Maryland, Natural Resources Article §5-102)

The Department recognizes the many benefits provided by state forests and has established a corresponding management policy in regulation.

> *"The state forests are managed to promote the coordinated uses of their varied resources and values for the benefit of all people, for all time. Water, wildlife, wood, natural beauty and opportunities for natural environmental recreation, wildlands experience, research demonstration areas, and outdoor education are major forest benefits."* (Code of Maryland Regulations 08.07.01.01)

To ensure that benefits are realized by and resources are protected for future generations, a statewide system of renewable resource planning has developed. These plans are the foundation for the many activities that can and should occur on state forestlands.

> *"The Department shall develop a system for long-range renewable forest resources planning. The public and private forest land resources of Maryland, including, but not limited to, wood fiber, forest recreation, wildlife, fish, forest watershed, and wilderness potential, shall be examined and inventoried periodically. As part of the forest planning process, the Department periodically shall develop, review, and revise a resource plan that should help to provide for a sustained yield of forest resource benefits for the citizens of Maryland. The forest resource plan shall be made available for public and legislative review and comment."* (Annotated Code of Maryland, Natural Resources Article §5-2l4)

The Sustainable Forest Management Plan for Pocomoke State Forest has been prepared in consideration of these many uses and benefits. The concept of Sustainable Forest Management will be the guiding principle behind the management of Pocomoke State Forest. Sustainable Forestry is defined in COMAR Regulations 08.01.07.01:

> *"Sustainable forestry" means the stewardship and use of forests and forest lands in a way, and at a rate, that:*
> *(a) Maintains their biodiversity, productivity, regeneration, capacity, vitality, and potential to fulfill, now and in the future, relevant ecological, economic, and social functions at local and regional levels; and*
> *(b) Does not cause damage to other ecosystems.*

1.3 Planning Process

The new Sustainable Forest Management Plan for Pocomoke State Forest was developed to replace the former ten-year Resource Management Plan that was developed back in 1996. The initial draft of the PSF Sustainable Plan was crafted from sections of the former ten-year plan and from information contained in the Chesapeake Forest Sustainable Plan. The information utilized in the draft was originally prepared by an interdisciplinary planning team with assistance from the Pocomoke & Chesapeake Forest Citizens Advisory Committee. The current PSF Sustainable Plan went through an extensive review process consisting of representatives from the following agencies:

Maryland Department of Natural Resources
Maryland Forest Service
Maryland Park Service
Maryland Wildlife & Heritage Service
Freshwater Fisheries Division
Land Acquisition & Planning

Following completion of a final draft, the PSF Sustainable Plan was presented to the Pocomoke & Chesapeake Forest Citizens Advisory Committee for additional review & comments. From there the plan went through a 30-day public comment period. The entire process was completed in early December of 2010.

The original planning process for the ten-year plan included extensive opportunity for public participation and relied on public feedback in the refinement of management goals and implementation strategies. The new sustainable plan will adhere to a similar policy. One of the benefits of the new plan format is that it will be open for continual updates as additional resource information is developed. As updates are completed, the revised plan will be reviewed by the Citizen Advisory Committee.

Resource inventory and assessment information for Pocomoke was first compiled during the summer of 1994 and re-measured in 2002. A re-sampling of forest inventory plots was completed in the fall of 2009. This data will be used for forest modeling projections of growth rates and allowable harvest rates.

1.4 Purpose and Goals of the Plan

The Sustainable Forest Management Plan for Pocomoke State Forest updates and expands the previous ten-year resource management plan. This plan is intended to provide guidance and direction for forest staff to base daily decisions on the management of the forest. The plan also provides direction to the Forest Manager in the preparation of the Annual Work Plans and to DNR staff in the preparation of related resource protection guidelines for sensitive habitats.

Included within the appendices are forest modeling projections of growth rates and sustainable harvest levels, as well as several detailed sections outlining planning and management tools that support the proposed management direction and strategies.

The primary goal of the Pocomoke State Forest Sustainable Management Plan is to demonstrate that an environmentally sound, sustainably managed forest can contribute to local and regional economies while at the same time protecting significant or unique natural communities and elements of biological diversity.

This will be pursued subject to the following resource goals for the Forest:

A) Manage the wetlands, waterways, and floodplains of the forest to protect valuable water resources.

- That the quality of the water flowing through the forest will not be impaired due to any actions on the land, and in many cases will be improved. Where feasible, wetlands, riparian areas, and ditches will be the site of watershed improvement practices specifically aimed at improving the quality of water entering both the Chesapeake Bay and Coastal Bays.

B) *Provide sustainable levels of diverse recreational fishery opportunities through management strategies that emphasize protection and enhancement of aquatic resources and forested riparian buffers.*

- Monitor proposed projects within Pocomoke State Forest that may potentially result in blockages to fish passage and recommend design changes that will allow continued fish passage during all stream flow conditions. Continue to identify existing blockages to fish passage and make recommendations for providing access to upstream habitat.

C) *Protect and enhance biological diversity native to Pocomoke State Forest and perpetuate indigenous natural communities and habitats of species that are rare, threatened, endangered, or in need of conservation.*

- Ensure that management policies and actions are consistent with state and federal requirements for protecting and managing rare, threatened, and endangered species of plants and animals. The Department will identify locations of rare, threatened, and endangered species habitat and forest conditions associated with the habitat requirements of these species. Management actions will consider opportunities to enhance existing habitats and provide for corridors. Abundance and distribution goals for common species will be periodically updated through DNR based resource assessments. Habitat goals for common species will be reflected in forest management activities.

D) *Through Sustainable Forestry practices, maintain and improve the timber resource, while at the same time protecting other resource values consistent with responsible forest management.*

- That forest harvest levels comply with targets established by a long-term sustainable harvest plan. To the extent possible, harvest and thinning activity levels will produce reasonably uniform flows of products and contractor activities year-to-year. Short-term deviations due to natural disturbances, operational logistics, or unusual events are anticipated, but exceptions for an extended period will require re-evaluation of the sustainable harvest level. Spatial and timing constraints will prevent thinning or harvesting operations from concentrating impacts in any watershed or visual scene in violation of water quality goals, habitat diversity and connectivity goals, or the green-up requirements imposed by the Sustainable Forestry Initiative (SFI) Standard (See **Appendix C**). The plan will be re-evaluated periodically and updated according to changes in circumstances.

- That the Department makes use of the best available data to determine what activity levels are consistent with the sustainability of the forest ecosystems so that harvests will not decrease the ability of the forests to continue that average level of yield. Ecosystem sustainability means, in addition to the factors listed in goals A, C & D, no net loss in soil fertility and no loss of non-target species due to on-site forestry practices. Past and present data are limited, so future harvests will be based on adaptive response to appropriate monitoring, forecasting, and revision.

E) *Utilize best available scientific data to formulate climate change approaches and develop adaptive management strategies to be integrated in sustainable forestry practices.*

- That forest stands are maintained at optimum densities to reduce susceptibility to disease outbreaks, insect infestations, drought stress, severe weather events or wildfires while simultaneously maximizing stand productivity and carbon sequestration and reducing the buildup of greenhouse gases. Regular monitoring for non-native and invasive species invasions will be conducted to prevent the displacement of native species. Management will focus on retention and expansion of native cornerstone species biodiversity, both timber and non-timber resources, to prevent/limit species migration.
- Forest infrastructure and drainage methods will be modified to accommodate potential significant increase in runoff and to prevent accelerated erosion resulting from a projected increase in large scale weather events.

F) Promote forest resiliency through the implementation of sustainable forestry practices to limit the susceptibility of forest resources to negative consequences of wildfires and promote the benefits of prescribed burning for critical ecological processes.

- That forest stands are maintained at optimum densities to reduce susceptibility to adverse effects of wildfires. Thinning harvests will be implemented to reduce competition and promote the health and vigor of the residual stands as well as to minimize the amount of continuous fuels within the stands that may contribute to large scale conflagrations. Sustainable forest management techniques reduce the possibility of wildfires while providing protection for wildlife habitats, recreational opportunities and timber resource values.
- That forestry staff is adequately trained in current wildfire mitigation and suppression standards and is equipped with proper firefighting equipment to quickly and effectively minimize negative effects of wildfires.
- That prescribed fire is used appropriately to promote hazard fuel reduction, restoring/maintaining/enhancing critical habitat for rare, threatened and endangered species communities, reducing undesirable interfering vegetation, providing bare mineral soil for desirable seedling establishment, controlling/eliminating non-native invasive species and reducing threats of wildfire to life and property. Outreach and educational efforts will be made to destigmatize prescribed burning as a negative activity and highlight the myriad of benefits associated with it.

G) Provide opportunities for the enjoyment of the natural resources on the Forest by making appropriate areas available for resource-based, low impact recreational activities and environmental education programs that are consistent with the resource values of the Forest.

- That forest recreational and educational opportunities will be provided as appropriate and are consistent with the above goals. Recreational and education program opportunities available on the forest should be integrated with those available within Pocomoke River State Park and the Pocomoke Wildlife Management Area. The Department will determine the appropriate levels of recreational activities on the Forest as part of its ongoing evaluation and monitoring process.

1.5 Future Land Acquisition Goals for Pocomoke State Forest

The original Pocomoke State Forest properties are located in Worcester County lying on both sides of the Pocomoke River. The addition of new parcels to Pocomoke Forest Lands could help alleviate a

number of management issues as described below and build upon a network of well-managed forest lands that would in perpetuity contribute to the goals for protecting and restoring the Chesapeake Bay and Coastal Bays. All potential acquisitions are based on a Stewardship review that scores each property on their ecological, cultural, and recreational values.

Guidelines to be considered when pursuing new properties not currently in state ownership for addition to Pocomoke State Forest:

1. The property is an in holding within a Pocomoke Forest Compartment and/or the parcel connects additional Pocomoke Forest properties thereby creating a larger contiguous management unit.
2. The property contains significant natural resources as identified in this plan that would help contribute toward their management and protection. Examples of such resources would be Ecologically Significant Areas (ESAs) as identified in **Chapter 7**, Wildlife Habitat resources described in **Chapter 8**, Water Quality Areas (Riparian areas and wetlands) as indicated in **Chapter 6** and economically important forest resources as described in **Chapter 5**.
3. The property improves on or provides additional access to a Pocomoke Forest parcel, thereby improving on the implementation of management activities and or providing additional public access.

Properties that would meet one or all of these criteria will go through an internal DNR review process and if they are determined to be good candidates to be added to the Forest they would then be prioritized for acquisition.

Currently there are a number of potential private acquisitions being considered for addition to Pocomoke State Forest that would greatly enhance management opportunities on the forest. Information on the new private acquisitions to Pocomoke State Forest can be found in **Appendix K**, "*Land Additions and Acquisitions to Pocomoke State Forest*".

See **Appendix L** for maps that display all the lands that comprise Pocomoke State Forest.

CHAPTER 2

Maryland's Lower Eastern Shore - Resource Assessment

(Three County Area: Wicomico, Worcester, Somerset)

2.1 Maryland's Lower Eastern Shore

The Lower Eastern Shore of Maryland, as described in this assessment, consists of three Maryland Counties (Wicomico, Worcester, and Somerset) located on the Delmarva Peninsula. The region is surrounded on two sides by the Atlantic Ocean and the Chesapeake Bay. It is bounded by the State of Delaware on the North and connected to two Virginia counties on the South (**Figure 1**). Part of the Atlantic Coastal Plain, it is a mix of lowland flats, fresh-water swamps, salt marshes, forested and non-forested wetlands and uplands. Elevations run from sea level to a maximum of only about 75 feet above sea level, and topography is flat to gently sloping. The climate is temperate, semi-continental, and fairly uniform. Summers are hot and humid, with periods of drought common; winters are fairly mild, but can be marked by cold, harsh winds. Occasional Atlantic hurricanes and associated extreme weather disturbances may affect forest ecosystems, but they are rare. The average growing season ranges from 180 to 232 days per year depending on the area and water availability.

Table 1 and **Figure 1** show that land use patterns within the three lower shore counties are dominated by, water, wetlands, forests and farmland. Taken together, water areas and wetlands make up nearly 35 percent of the area within the boundaries of the region.

Table 1: Land use on Maryland's Lower Eastern Shore

Major Land Cover Category	Total Area	Percent
Urban	32,042	3.1%
Agriculture	286,267	28.1%
Forest	**332,091**	**32.6%**
Water	83,639	8.2%
Wetland	266,176	26.1%
Open Areas	19,754	1.9%
TOTAL	**1,019,969**	**100.00%**

Source: U.S. Geological Survey, 2001

Agriculture and forestry are the most common industries on the Eastern Shore. Farming includes fields' crops such as soybeans, small grain, corn, and vegetables. The main agricultural enterprise is the raising of poultry as broilers, most of which are processed locally before they are shipped to market. Some rearing of livestock is also present but not nearly as common as chickens. Forest products are also a significant source of income. Forested lands are also used for recreational purposes, and hunting leases are a common income generator.

Wet soils dominate the landscape and wetness is a primary factor in determining vegetative cover and management options. Drainage is the most common problem in managing soils, and artificial drainage practices have been common as a means of making soils suitable for agriculture or forestry.

The shores of the Chesapeake Bay and Pocomoke River, and the fields and forests of the adjoining lands are favorable habitat for a variety of wildlife, including game species such as deer and turkey. It is a key portion of the Eastern flyway for migratory waterfowl. Fish and shellfish in the Chesapeake are a major source of economic activity as well as an attraction for sportsmen and outdoor recreation.

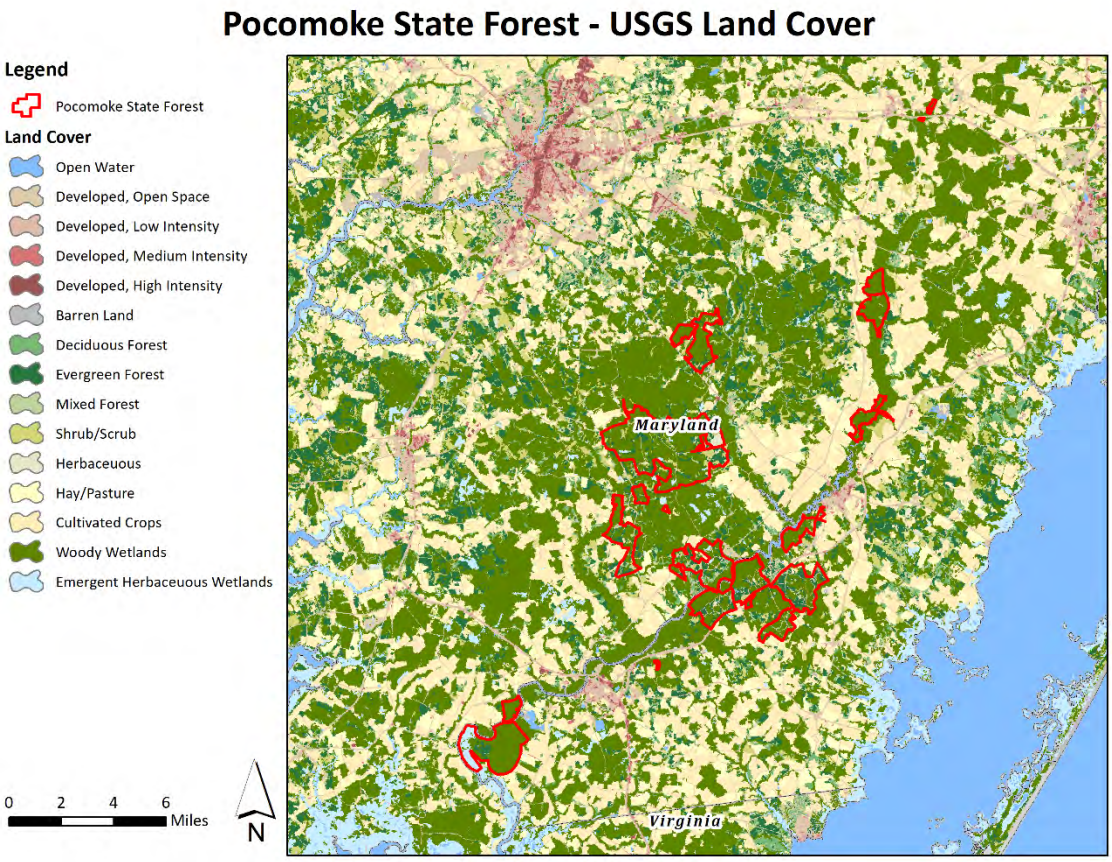

Figure 1: A complex mix of agricultural land and woodlands surrounds Pocomoke State Forest (2021)

Much of the land on the Lower Eastern Shore had been cleared for farming or used as farm woodlots before the establishment of Pocomoke State Forest. When the depression era hit many of the farmers fell on hard times, resulting in the acquisition of large amounts of land by the Federal Government. In the mid to late 1930s, the State was purchasing lands for management activities, and in 1954, the Federal Government deeded its holdings to the State. In 1964, the Milburn Landing and Shad Landing areas were separated from the Forest and developed for intensive recreational use. The State continues to purchase in-holdings and other ecologically important areas along the Pocomoke River, as large forest blocks are valued as contributors to the Maryland State Smart Growth objectives. Taking adjacent lands into state ownership is seen as a way to prevent their further loss to development, and the further fragmentation of what remains of the intact blocks of forest in the region. At the same time, keeping them in sustainable forest use is seen as a way of contributing to the future of the forest-based portion of the region's economy.

2.2 General Geology and Soils

Much of the region is made up of nearly level lowland flats characterized by windblown materials overlying alluvial and marine sediments consisting chiefly of gravel, sand, silt, clay, and shell fragments. These sediments can extend to depths of several thousand feet. There are three general elevation zones: 1) the flood plains, tidal marshes, and swamps, at elevations near sea level in many places; 2) the Pamlico Terrace, at 0 to 25 feet above sea levels; and 3) the Talbot and Wicomico Terraces, between 25 and 57 feet in elevation. Melt waters from the continental ice sheet formed the terraces.

There is not enough topographic relief to cause micro-climatic change, and most of the soils have formed under fairly uniform climatic factors. Because precipitation exceeds evapo-transpiration, the humid, rather uniform climate has caused the soils to be strongly leached. As a result, most of the soluble materials that have been released over time through soil weathering have been removed by leaching. Due to this leaching, the soils are generally low in plant nutrients and strongly acid. The leaching process has also moved clays down into the subsoil on many of the soil types, except for those that were formed in sands or recent alluvium.

Topsoil textures for the mineral soils are commonly sandy loams or loamy sands. Some areas of dunes exist, with deep sands or sand over finer-textured sub soils. In the lowlands and marshes, there are large areas of organic muck soils. In general, the organic muck soils are very poorly drained, and many are too wet for any type of forest or agricultural management. The lowland mineral soils are poorly drained but are often highly productive forest sites where stands can be established. The sands are droughty, and often of low productivity.

2.3 Water Resources

The low elevation, flat topography, sandy soils, and shallow groundwater of the outer coastal plain create close contact between human land use activities and aquatic systems, making this region a focal point for water quality issues. Aquatic systems can be grouped into four (4) categories: groundwater, wetlands, streams, and tidal waters.

2.3.1 *Groundwater*

The coastal plain of the Delmarva Peninsula is generally characterized by shallow unconfined aquifers, namely the Columbia Group, which extends 3 to 60 meters deep. However, the depth and flow paths of groundwater vary across the landscape. It can be three (3) categories that better describe the groundwater characteristics:

A. Well-drained upland – The surficial aquifer in this region is unconfined within sediments 24-30 meters thick, and the depth of water ranges from 3-10 meters in topographic highs to surface level in low-lying areas. Groundwater flow paths range from about 1 km to several km. The longest, oldest flow paths originate in topographic highs; extend to the base of the aquifer and discharge to 2nd and 3rd order streams through the hyporheic zone (beneath the stream channel). The water contained in them can be 50 years old when it is discharged to the stream system. Shorter, younger flow paths originate in near-stream recharge areas and are the main source of base flow to first order streams.

B. Poorly drained uplands – The surgical aquifer in this area is found in sand and gravel sediments greater than 30 meters thick. Groundwater tables in this area are generally less than 3 meters deep. This area is characterized by a combination of high-water tables and small degree of stream incision that results in groundwater gradients too low to effectively drain the area. Groundwater flows tend to be shorter in the northern part than the southern part due to the increased aquifer thickness further south. As a result, groundwater flow paths tend to be shorter and shallower in the northern part (100 m to 1 km) and longer and deeper in the southern part (several km). Local flow patterns vary seasonally, however, smaller localized flow paths associated with depressional wetlands and intermittent streams can occur during the wet season. A more regional flow system from topographic highs to perennial streams is active throughout the area during the drier seasons.

C. Surficial Confined – a confining unit of fine-grained material, which separates two sand layers, characterizes this area. The 0-13 meter thick confining layer composed of clay, silts, and peats 1-6 meters thick underlies the top sand layer. The lower sand unit can be 25-30 meters thick. Generally, the groundwater is within 3 meters of the surface and occurs in the upper sand unit. Local groundwater flow paths, in the upper unit, are relatively shallow and generally less than 300 m. Regional flow paths in the lower sand unit are up to 10 km long and flow from drainage divides to major streams and rivers. Residence time in the upper sand unit is 15 years or less and in the lower sand unit it is at least 40 to 50 years except where hydrologic connections occur when the confining unit is absent.

Because of its shallow nature, groundwater on the lower Eastern Shore is subject to anthropogenic influences. Certain areas, particularly around highly developed areas, are subject to large groundwater withdrawals that can create cones of depression that may affect environmental conditions. In highly permeable areas, groundwater can also be affected by nutrient or chemical loadings. The USGS has documented a close relationship between land use and permeability of soils to groundwater quality and chemistry and has identified the Delmarva Peninsula as an area at risk of groundwater contamination due to the high nutrient loading on the land. A groundwater monitoring study by the USGS found that 70% of the wells in the surficial aquifer on the Delmarva Peninsula had detectable levels of nitrate with some samples reaching 48 mg/l (EPA drinking water standard is 10 mg/l).

2.3.2 *Wetlands*

Relative to the rest of Maryland, wetlands are abundant on the lower Eastern Shore occupying approximately 10% of the area. Wetlands vary greatly in their form and community type, ranging from vast emergent marshes to isolated vernal pools. The predominant types on the lower Eastern Shore can be divided into four (4) categories by their hydro geomorphic features: tidal, riverine, depressional, and flats.

A. Tidal: Tidal wetlands are subject to regular flooding by tides either on a daily basis or an infrequent basis due to season high tides. In low-lying areas surrounding Tangier Sound and its tributaries, wind events may cause flooding on a periodic basis. Some Pocomoke State Forest lands may be subject to seasonal or periodic tidal influence, which may affect timber production. Sea level rise has caused tidal influence to move further inland and will be a factor to consider in the management of low elevation tracts.

B. Riverine wetlands are located on floodplains or adjacent to stream and rivers. If the floodplain is still functional, the Riverine wetland will be flooded by high stream-flow events. If the stream has been channelized, the floodplain may not receive regular flooding from storm events but will receive water from groundwater moving toward the stream. Many of the Riverine wetlands are forested with mixed hardwoods but may have scrub/shrub and emergent components as well.

C. Depressional wetlands do not have defined outlet channels and receive water from seasonal groundwater and/or surface water flows from a small contributing watershed. Because of their relative isolation, depressional wetlands are typically nutrient poor, creating a habitat for numerous rare plant and animal communities. Some of these are locally called Delmarva Bays. The size of depressional wetlands varies from less than an acre to over 10 acres and their vegetative communities range from forested to open water.

D. Wetland flats are large expansive wetlands, which occur on interstream divides. They are generally only temporarily or seasonally flooded by high groundwater levels and are

commonly forested wetlands with either deciduous or evergreen stands. These wetlands are the most common type of wetland on the Eastern Shore.

2.3.3 *Streams*

There are approximately 838 miles of mapped first through third order streams on the lower Eastern Shore. The Maryland Biological Stream Survey has conducted stratified random samples of streams within the Pocomoke River stream basin. Based on those results, **Tables 2**, **3**, and **4** indicate the biological and physical conditions estimated to exist in the streams sampled in the region.

Totals of assessment categories do not sum to 100% in some cases because some sampling stations were not rated due to lack of access or sample size. According to the MBSS, the primary stressors, which were associated with decreased biological conditions, were agricultural land, physical habitat quality, acid deposition, and riparian buffer width.

Table 2: Est. percentage of stream miles by category, Fish Index of Biotic Integrity

River Basin	Good	Fair	Poor	Very Poor
Pocomoke	12.5	48.1	9.7	0
Statewide	19.5	25.7	14.5	14.0

Table 3: Est. percentage of stream miles by category, Benthic Index of Biotic Integrity

River Basin	Good	Fair	Poor	Very Poor
Pocomoke	0.3	11.5	18.5	69.2
Statewide	10.8	37.7	25.7	25.3

Table 4: Est. percentage of stream miles, by category, Physical Habitat

River Basin	Good	Fair	Poor	Very Poor
Pocomoke	1.8	43.3	35.5	19.4
Statewide	19.9	28.5	29.1	22.4

2.3.4 *Tidal Waters*

All of the Pocomoke State Forest flows to the Chesapeake Bay through the Pocomoke River, and eventually the Pocomoke Sound. Other major tributaries on the Lower Eastern Shore include the Nanticoke and Wicomico Rivers in the western portion of the region, and numerous coastal bays in the eastern portion of the region. Within the Chesapeake watershed, these waters flow first through the Tangier and Pocomoke Sounds. These have traditionally been some of the most critical fish and shellfish habitats in the Bay.

2.3.5 *Hydrologic Modifications*

As settlement and use of the land on Maryland's lower Eastern Shore expanded, wetlands were ditched and drained. Maryland has lost approximately 70% of its historic wetland area with a large portion of the wetland conversions occurring on the lower Eastern Shore (**Table 5**). Historically and still today, wetlands are drained primarily to support agriculture and development. To provide early growing season access to fields and to prevent flooding of houses built on former wetlands, major drainage ditches are maintained by public ditch associations which are legislatively established and have taxing authority.

Table 5: Percent of historic wetlands that are mapped as unmodified wetlands by the National Wetland Inventory

Watershed	% Of Unmodified Historic Wetlands
Lower Pocomoke	23.7
Upper Pocomoke	17.2
Nassawango Creek	24.6
Dividing Creek	31.9

While ditching of wetlands has allowed farming and development to occur in areas otherwise inaccessible, drainage has had a significant impact on the wetlands and water quality of the lower Eastern Shore. In addition to the direct loss of wetland habitat, drainage also alters the biological, physical, and chemical processes that allow wetlands to filter nutrient and sediment pollution from surface and groundwater flows. By increasing the rate at which water is moved off the land, drainage ditches bypass much of the nutrient cycling that occurs in wetlands and streams and delivers greater amounts of nutrients and sediment to downstream reaches, including Tangier Sound and the Chesapeake Bay. During the hastened runoff and drainage, opportunities for sedimentation to remove suspended solids are reduced. Drainage of wetland soils makes them more aerobic, thereby decreasing rates of denitrification, which is the primary mechanism for nitrogen removal in wetland soils.

As with wetlands, streams have been subject to a high degree of hydrologic manipulation on the lower Eastern Shore (**Table 6**). Historically, dredging and straightening facilitated drainage and provide flood control commonly channelized streams. These actions cause the same impacts described in the wetlands section above, but also degrade stream habitat as well. Channelization disconnects a stream from its floodplain and can cause greater scouring, greater bank instability, and disruption of the natural riffle/pool habitat pattern.

Table 6: Estimated percentage of stream miles with evidence of channelization

River Basin	Percent of Stream miles
Pocomoke	81
Statewide	17

2.3.6 *Water Quality Indicators*

Water quality in the tidal tributaries and Tangier and Pocomoke Sounds is generally poor due high nutrient and suspended solid concentrations. With a few exceptions, water quality monitoring by the Maryland DNR has documented fair or poor conditions for total nitrogen, total phosphorus, total suspended solids, algae abundance and water clarity (secchi depth) (Source: www.dnr.maryland.gov). Conditions have significantly worsened from 1985 to 1998 in Tangier Sound for total suspended solids, algae abundance, and water clarity.

As a result of the declines in water quality in Tangier Sound, the area of underwater grasses, which are considered the best single indicator of water quality in the Bay, declined by 62% between 1992 and 1998. Accordingly, the lower Eastern Shore has been identified as a priority area in Maryland's Clean Water Action Plan and under the US EPA Chesapeake Bay program. All of the tidal tributaries to the Chesapeake Bay have been listed on the EPA 303(d) list as impaired water bodies for nutrient pollution, and some reaches have been listed for other water quality issues as well.

2.4 Wildlife Resources

Pocomoke State Forest wildlife habitats occur within a landscape that has been heavily fragmented by agricultural and residential development. The Pocomoke State Forest lands, themselves, have been fragmented to a lesser degree through decades of timber management, road building, and historical conversion of native hardwoods to agricultural fields and pine plantations. Management opportunities for wildlife on Pocomoke State Forest include provision of habitat conditions that are critical to rare or declining species. Some critical habitat conditions will require adjustment of spatial and temporal provision of early successional pine habitats. Other critical habitat conditions will require incorporation of additional vegetative diversity by allowing hardwoods to re-infiltrate or dominate on some sites.

Finally, some critical habitat conditions will require adjustment of rotation length to provide for forests that are allowed to grow beyond economic maturity.

Some species of wildlife present on Pocomoke State Forest are forest obligates. The viability of forest obligate populations depends solely on the characteristics of these forestlands. Populations of other species of wildlife found on Pocomoke State Forest are more affected by the characteristics of adjacent wetland or agricultural habitats. Pocomoke State Forest lands in those cases will contribute to, but not ensure, species viability.

2.5 Endangered and Threatened Species of Special Concern

Species of special concern were identified by staff of the Wildlife and Heritage Service of the Maryland Department of Natural Resources and/or identified through reference to the Rare, Threatened, and Endangered Animals of Maryland and the Rare, Threatened and Endangered Plants of Maryland (2010). However, this list represents DNR's current knowledge, and is constantly changing as new information is collected.

Delmarva Fox Squirrel – The U. S. Fish and Wildlife Service has published a Recovery Plan for the Delmarva Fox Squirrel (DFS) (USFWS 1993) and sources of data for this section include the Recovery Plan and personal communication with personnel from the USFWS and the Maryland DNR. The DFS was one of the first species listed under the Federal ESA. The Recovery Plan has been revised once and is currently under review for a second revision. Population levels of DFS are believed to be stable or slightly increasing. The original range of DFS included southeastern Pennsylvania, southern New Jersey, and Delaware, Virginia and Maryland portions of the Delmarva Peninsula. Remnant populations of DFS persist naturally in portions of Kent, Queen Anne's, Talbot, and Dorchester Counties, Maryland and Sussex County, Delaware.

DFS have been translocated into southeastern PA (1 site), Delaware (2 sites), Virginia (2 sites), and Maryland's Eastern Shore (13 sites). Not all translocations have established viable populations. **Figure 12** in **Section 8.3.2**, shows DFS sites on or in near proximity to Pocomoke State Forest Lands.

DFS are opportunistic, but generally occupy mature pine and hardwood forests, both bottomland and upland, with a relatively open understory. Forest areas that contain a variety of nut and suitable seed bearing trees, over-age hardwood trees with hollows for den sites, and nearby supplemental food sources are preferred. DFS feed on mast (oak, hickory, beech, walnut, and loblolly pine) in the fall. Summer and spring foods include green loblolly pine cones, tree buds and flowers, fungi, insects, fruit and seeds. Like most squirrel species, body condition of DFS individuals depends primarily on fall mast supplies. Caching of fall mast provides nutrition during winter shortages. Spring food resource availability may be a limiting factor on DFS abundance.

DFS prefer dens in tree hollows, which afford greatest protection from weather and predation. DFS will also construct and use leaf nests as small day shelters, feeding platforms, or winter and rearing nests.

Quality habitat can be expected to support one DFS per 10 acres on average, though an individual squirrel's range is approximately 40 acres. Food abundance, disease, and predation affect DFS numbers from year to year. The exact causes for the DFS decline are unknown, although forest clearing and changing patterns of land use are suspected to have contributed to endangerment.

DFS can be reclassified to threatened when population viability is better understood, benchmark populations are shown to be stable or expanding for at least five years, and ten translocated colonies are shown to be stable or expanding. Delisting will be considered when an additional five colonies are

established, monitoring establishes that translocated populations are stable or thriving, perpetual protection of suitable habitat areas in all counties in which the species occurs is achieved, and mechanisms are in place to facilitate establishment of new populations, species range expansion, and population interchange.

Bald Eagle – According to the USFWS, the Chesapeake Bay ecosystem may have once hosted 3,000 nesting pairs of bald eagles (*Haliaeetus leucocephalus*). In the late 1800s, people began to clear parcels of land for farm and agricultural use thereby affecting eagle-nesting areas. With the development of chemical pesticides in the late 1950s, DDT caused reproductive failure in eagles with disastrous consequences. The bald eagle was placed on the Endangered Species List in 1967. With the banning of these pesticides and an aggressive monitoring, reintroduction, and recovery effort, the eagle has made an impressive comeback here, and nation-wide. In 1995, the eagle was upgraded from endangered to threatened status. Due largely to protection measures provided for the Bald Eagle through the Endangered Species Act the population of Bald Eagle in the United States has seen an incredible recovery. Subsequently, in 2007 the Bald Eagle was removed from the Federal ESA but is still protected by the State Endangered Species Act.

The Chesapeake Bay watershed provides the open marsh, undisturbed shoreline habitat that eagles need for nesting, roosting and feeding. Pocomoke State Forest has several Bald Eagle nesting sites.

2.6 State Listed Species of Concern on Maryland's Lower Eastern Shore

According to Maryland DNR, a summary of current and historical rare, threatened, and endangered animal species potentially found on or within ¼ mile of Pocomoke State Forest lands would include:

Species	Counties of Occurrence
Eastern Tiger Salamander	Somerset
Eastern Narrow-Mouthed Toad	Somerset, Worcester
Swainson's Warbler	Wicomico, Worcester
Palamedes Swallowtail	Somerset, Worcester
Red-cockaded Woodpecker	Worcester
Red-bellied Water snake	Somerset, Wicomico, Worcester

Eastern Tiger Salamander – According to The Nature Conservancy (TNC), Eastern tiger salamanders spend most of their lives underground in self-made burrows, mole tunnels or under logs and come to the surface only to mate and lay eggs, which has made them difficult for researchers to study. They typically congregate in vernal and fishless ponds or rain-filled gravel pits in late fall and then breed through early spring. Destruction of critical habitat, use of pesticides and pollution are among the chief reasons for their endangered status.

Eastern Narrow-Mouthed Toad – According to the Savannah River Ecology Lab, narrow-mouthed toads can be found by flipping over debris in woodland areas near water, or in the wetlands at night during breeding season (summer mostly). Narrow-mouthed toads eat ants.

Swainson's Warbler – According to TNC, mature, rich, damp, deciduous floodplain and swamp forests with deep shade from both canopy and understory cover are preferred habitats of Swainson's Warbler. On the coastal plain, the species occurs in the shadiest parts of the forest, with dense upper canopy, lower canopy and shrubs, and little herbaceous cover. The shrub stratum is often nearly monospecific stands of giant cane in floodplain forest; sweet pepperbush or fetterbush in swamps at the northern end of range such as the Great Dismal Swamp in Virginia and Pocomoke Swamp in Maryland and Virginia

and headwater swamps of the Atlantic Coastal Plain; or scrub palmetto in bottomlands. Although often reported to inhabit canebrakes in the literature, it is clearly not exclusively a cane species; structure of the habitat - both over story and dense shrub understory canopies characteristic of successional forests - is apparently of primary importance, and a variety of shrubs will do. Since the habitat is successional, rather than climax, management must be aimed at regenerating suitable dense-shrub understory conditions on a temporal and spatial rotation adequate to maintain the warbler in the general area. It has been observed to reoccupy clear-cut stands after a few years in South Carolina coastal plain bottomland hardwood habitat, but this has not been formally studied in the region. Published management recommendations suggest selective cutting of mature trees in warbler territories could be practiced if at least 70% canopy closure were maintained, clear cuts were no larger than 4 ha to minimize habitat disturbance, and contiguous woods should not be cut for 10 to 15 years to allow canopy regeneration in the cut-over area.

Palamedes Swallowtail – USGS reports that Palamedes Swallowtail caterpillar feed on plants of the Laurel family especially redbay. Adult swallowtails feed on nectar from flowers of sweet pepperbush, thistles, blue flag, and azalea. Habitat includes wet woods near rivers and broadleaf evergreen swamp forests. Range of the Palamedes Swallowtail spans the Atlantic coast from southern New Jersey (rare) to Florida and west and south along Gulf Coast to central Mexico.

Red-bellied Watersnake – Maryland's Eastern Shore is the northern extent of this species North American range. It occurs in forested swamps, freshwater marshes, drainage ditches, and low, wet areas (Mitchell 1994). It feeds on fish, crayfish, frogs, and salamanders. It is named for its characteristic flame-red chin, neck and belly.

Red-cockaded Woodpecker – Red-cockaded Woodpecker is extirpated from Maryland, but is present in Southeastern U. S. pine timberlands similar to those found or potentially found within Pocomoke State Forests. The Department has no immediate plans to reintroduce the species. PSF lands will be of critical importance to any reintroduction effort in the future. Critical habitat for Red-cockaded Woodpecker is pine savannah.

2.7 Plants of Special Concern (Federally Listed)

There are no Federally Listed plant species known to occur on Pocomoke State Forest. There are a number of species of plants listed as Rare, Threatened, or Endangered by the State of Maryland. These species are discussed in some detail in the Ecologically Significant Area portion of this document.

2.8 Plant Communities and Habitats of Special Concern

Inland Sand Dunes*:* This natural community is found on late Pleistocene-aged inland dunes and ridges in the Pocomoke River watershed. Inland dunes are best developed on the east sides of rivers and characterized by low-relief and a parabolic shape suggesting formation by northwest winds. Medium- and fine-grained sands of the Parsonsburg Sand Formation and other associated soil types comprise these dunes. Habitats are very dry and support fire dependent mixed woodlands of pine, oak, ericaceous shrubs, and light-demanding species. Stands are often codominated by short-leaf pine (*Pinus echinata*), loblolly pine (*Pinus taeda*), Southern red oak (*Quercus falcata*), water oak (*Quercus nigra*), and sand hickory (*Carya pallida*) and are classified as a globally rare vegetation type in the U.S. National Vegetation Classification system (USNVC) restricted to the Delmarva Peninsula.

Delmarva Bays (Carolina Bays): Delmarva Bays are seasonally flooded basin wetlands of nearly flat Coastal Plain uplands with fluctuating, seasonally perched water tables. These can vary from less than one-tenth hectare to four hectares in size and are generally one-half meter to one meter deeper than the

surrounding landscape. In some cases, Delmarva Bays may be bordered by a subtle sand rim. Seasonal fluctuations in groundwater recharge and precipitation cause these wetlands to be irregularly flooded or seasonally inundated—often void of surface water during very dry seasons or with standing water much reduced to a smaller area at the deepest point within the bay. Vegetation and community structure in a Carolina Bay is closely linked to its hydrologic regime. Fluctuations in water levels may vary based on precipitation, evapotranspiration from bay vegetation, and groundwater pumping or depletion (for nearby agricultural purposes). Depth and duration of flooding is also important in influencing the vegetation of a particular community type. Based on water levels during the growing season, changes in vegetation or community structure are often exhibited as concentric rings around the pond perimeter -- with community changes progressing to the center or lowest point within the interior of the pond. Species characteristic for this community type on Pocomoke State Forest include warty-panic grass (*Panicum verrucosum*), reticulate nutrush (*Scleria reticularis*), and swamp tupelo (*Nyssa biflora*). All Delmarva Bay vegetation types classified in the USNVC are considered globally rare based on a limited distribution, overall condition, and small patch size.

Tidal Bald Cypress Forests and Woodlands: Tidal forests dominated by Bald Cypress (*Taxodium distichum*) bordering mid to upper portions of the Pocomoke River and associated tributaries. Habitats are predominately freshwater and subject to periodic inundation by diurnal or irregular lunar tides. Stands are best developed on low floodplains forming a corridor between open tidal marshes and non-tidal habitats further inland. On the Pocomoke River, this community primarily forms a large (> 40 hectares) continuous fringing stand. Smaller stands typically form physiognomically distinct pockets and points along tributaries. Microtopographic features include pronounced hummock-and-hollows with numerous protruding cypress knees. Hollows are regularly inundated by tidal water, whereas hummocks are less frequently flooded thus supporting the establishment of trees and mesophytic herbs. Soils are poorly drained slightly acidic tidal muck consisting of variable amounts of silt, clay and fine sands mixed with root-rich peats. Species characteristic for this community type include bald cypress, swamp tupelo (*Nyssa biflora*), Easton's witch grass (*Dichanthelium spretum*), and creeping rush (*Juncus repens*). Tidal bald cypress swamps are recognized as globally rare natural communities.

***Tidal Hardwood Swamps*:** Tidal woodlands of regularly or irregularly flooded freshwater systems bordering the upper reaches of Maryland's Coastal Plain rivers and tributaries. Habitats are species rich and structurally complex with open canopies and floristically diverse multiple lower strata. Development and persistence of these habitats is apparently limited downstream by salinity gradients and upstream by the availability of sufficient sediment. Therefore, these habitats are primarily associated with the upper end of the freshwater portion of the salinity gradient. Typically, these woodlands form a distinct zone on low floodplains between dry, gradually sloping uplands and tidal emergent vegetation. Stand size is variable ranging from small patches in to large (>40 hectares), linear stands. Pronounced hummock-and-hollow microtopography is characteristic of this community type. Hollows are regularly inundated by tidal water, whereas hummocks are less frequently flooded thus supporting the establishment of trees and mesophytic herbs. Soils are poorly drained slightly acidic tidal muck consisting of variable amounts of silt or fine sands mixed with partially decomposed organic matter. Species characteristic for this community type include pumpkin ash (*Fraxinus profunda*), swamp tupelo (*Nyssa biflora*), and halberd-leaved tearthumb (*Persicaria arifolia*). Tidal hardwood swamps are considered globally rare and threatened by sea-level rise and non-native invasive species.

Atlantic White Cedar Swamps: This is a mixed Atlantic white-cedar (*Chaemaecyparis thyoides*), red maple (*Acer rubrum*) swamp. In addition to Atlantic white-cedar and red maple other canopy associates include sweet bay Magnolia (*Magnolia virginiana*) a, swamp tupelo (*Nyssa biflora*), black gum (*Nyssa*

sylvatica), loblolly pine (*Pinus taeda*), and pumpkin ash (*Fraxinus profunda*). The shrub layer is diverse and includes high bush blueberries (*Vaccinium corymbosum* or *Vaccinium formosum*) and laurel-leaved greenbriar (*Smilax laurifolia*). The herbaceous layer may have sparse to moderate cover and includes species such as cinnamon fern (*Osmunda cinnamomea*), partridge pea (*Mitchella repens*), Virginia chainfern (*Woodwardia virginica*) and various species of sedges (*Carex* spp.) growing on hummock of peat mosses. Remaining examples have a limited distribution, small patch size, and are susceptible to sea-level rise. Atlantic white cedar forests are globally rare and now reduced to small remnants of their former distribution by logging and suppression of infrequent catastrophic fire (i.e., stand replacement fires).

Vernal Pools: Vernal pools are typically flooded in winter to early spring or after a heavy rainfall, but are usually dry during summer. Many vernal pools are filled again in autumn. Substrate is typically dense leaf litter over hydric soils. Vernal pools typically occupy a confined basin (i.e., a standing waterbody without a flowing outlet), but may have an intermittent stream flowing out of it during high water. This community includes a diverse group of invertebrates and amphibians that depend upon temporary pools as breeding habitat. Since vernal pools cannot support fish populations, there is no threat of fish predation on amphibian eggs or invertebrate larvae. Characteristic animals of vernal pools include species of amphibians, reptiles, crustaceans, mollusks, annelids, and insects. Vernal pool species can be categorized as either *obligate* (species that depend upon vernal pool habitat for their survival), or *facultative* (species that are often found in vernal pools, but are not dependent on them and can successfully reproduce elsewhere). Obligate vernal pool amphibians include spotted salamander (*Ambystoma maculatum*), marbled salamander (*A. opacum*) and wood frog (*Rana sylvatica*). Fairy shrimp (Anostraca) are obligate vernal pool crustaceans, with *Eubranchipus* spp. being the most common. Facultative vernal pool amphibians include fourtoed salamander (*Hemidactylium scutatum*), red-spotted newt (*Notophthalmus viridescens*), spring peeper (*Pseudacris crucifer*), gray tree frog (*Hyla versicolor*), green frog (*Rana clamitans*), American toad (*Bufo americanus*), and Fowler's toad (*B. woodhousei fowleri*). Facultative vernal pool reptiles include painted turtle (*Chrysemys picta*), spotted turtle (*Clemmys guttata*), and snapping turtle (*Chelydra serpentina*). Facultative vernal pool mollusks include freshwater fingernail clams (*Sphaerium* sp., *Musculium* sp., and *Pisidium* sp.) and aquatic amphibious snails (*Physa* sp., *Lymnaea* sp., and *Helisoma* sp.). Facultative vernal pool insects include predacious diving beetles (Dytiscidae), whirligig beetles (Gyrinidae), dobsonflies (Corydalidae), caddisflies (Trichoptera), dragonflies (Anisoptera), damselflies (Zygoptera), mosquitoes (Cuculidae), springtails (Collembula) and water striders (*Gerris* sp.). Leeches (Hirudinea) are a facultative vernal pool annelid. Plants are predominantly hydrophytic, typically with a combination of obligate and facultative wetland species. Floating and submergent plants may be common, but emergent plants should be sparse or lacking.

***Pond Pine Woodlands*:** This natural community consists of woodlands or open forests dominated by pond pine *(Pinus serotina)* with a saturated hydrological regime that occupy low swales and fringes of basin wetlands dominated by maple, gum, and hydrophytic oaks. Stands of pond pine are occasionally mixed with Loblolly pine and have sparse to moderate shrub layers of high bush blueberry *(Vaccinium corymbosum)* and sweet pepperbush *(Clethra alnifolia)*. Few remaining examples exist and the ecological dynamics of these wetlands are poorly understood. Additional survey work is needed to identify representative stands, management needs, and threats of these natural communities. In its range (southern NJ, south to FL west to AL) pond pine is associated with globally rare communities susceptible to fragmentation and low viability due to contemporary fire suppression. In Maryland, this community is restricted to the lower Delmarva Peninsula with documented occurrences in Worcester County.

Coastal Plain Seepage Swales: This seepage bog is currently known from the inner Coastal Plain from central and southern Maryland to southeastern Virginia. It occurs in saturated swales and headwater streams with extremely acidic, infertile soils, through which a constant supply of groundwater is discharged. Compositionally identical vegetation is more common where artificially maintained powerline rights-of-way intersect small streams and swales. The vegetation is usually a patchy shrubland, although scattered small trees of red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), and loblolly pine (*Pinus taeda*) occur at a few sites. The principal shrubs are smooth alder (*Alnus serrulata*), and sweet bay Magnolia (*Magnolia virginiana*). Small to large, graminoid-dominated herbaceous openings occur among the shrubs. Characteristic herbaceous patch-dominants are slender beaksedge (*Rhynchospora gracilenta*), brownish beaksedge (*Rhynchospora capitellata*), and broome grass (*Andropogon glomeratus*). Areas of bare mineral soil are frequently carpeted by slender bladderwort (*Utricularia subulata*).

***Bottomland Hardwoods*:** A diverse group of temporarily and seasonally flooded forests, encompassing most bottomland sites of the Coastal Plain. These areas have been heavily cut over and high quality examples of this community type are scares. Characteristic tree species vary with habitat conditions. Seasonally flooded swamps are usually dominated by combinations of green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), swamp tupelo (*Nyssa biflora*), willow oak (*Quercus phellos*), and overcup oak (*Quercus lyrata*). Well-drained levees support swamp chestnut oak (*Quercus michauxii*), cherrybark oak (*Quercus pagoda*), American elm (*Ulmus americana*) and river birch (*Betula nigra*) are often abundant in disturbed, cut-over stands. On small stream bottoms, where alluvial landforms and habitat conditions occur at very small scales, trees typical of both levees and swamps may occur in mixed stands. On exceptionally well-drained small stream bottoms, tulip-poplar (*Liriodendron tulipifera*) is often important. Small tree, shrub, and herbaceous composition is highly variable between sites.

***Coastal Plain Non-Riverine Saturated Forest*:** This community type is all but absent from the landscape with only small scatterings of the diagnostic species remaining yielding speculation to their pre-settlement condition and composition. Using neighboring states as a reference this community would be characterized by late-successional stands of hydrophytic oak species such as willow oak (*Quercus phellos*), pin oak (*Quercus palustris*) overcup oak (*Quercus lyrata*), swamp chestnut oak (*Quercus michauxii*), cherrybark oak (*Quercus pagoda*), and water oak (*Quercus nigra*). Cutting and other disturbances converts the forest by increasing the cover of sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), and other intolerant trees. Small trees and shrubs commonly encountered are American hornbeam (*Carpinus caroliniana ssp. caroliniana*), American holly (*Ilex opaca*), sweet pepper-bush (*Clethra alnifolia*), and highbush blueberries (*Vaccinium spp.*). The herb layer is less diverse but usually contains netted chain fern (*Woodwardia areolata*) and a variety of sedges, (*Carex*) occasionally dominate. These forests have been greatly reduced in extent or modified by extensive agricultural clearing, logging, conversion to pine silvicultures, and hydrologic alterations such as ditching and draining. This community is globally uncommon to rare.

2.9 Game Species of Special Concern

Maryland first began licensing hunters in 1916, with hunting license sales peaking at 180,000 in the early 1970s. Sales have since declined to about 135,000 now and today a small fraction (3-4%) of Maryland residents hunt. The current number of youth hunters has shown a 70% decline from peak numbers in the early 1970's. Maryland hunters are mostly males between the ages of 30-49 years of age. Most hunters live in urban settings. Residents of Baltimore County bought 11.9% of licenses sold

statewide. Residents from the five lower shore counties accounted for 9.7% of hunting licenses sold statewide.

The majority of the Pocomoke State Forest acreage is open for public hunting, with exception to safety zones and other similar areas. Hunting opportunities are primarily for white-tailed deer, but other species, depending upon the site, include waterfowl and quail.

Wild Turkey – Wild turkey populations were established by a trapping and transplanting program coordinated by the DNR Wildlife and Heritage Service with assistance from the Wild Turkey Federation at three locations in each of Worcester, Wicomico, and Somerset Counties. Within the last few decades, turkey numbers have increased steadily in the 3-county region that contains Pocomoke State Forest. In 1990 only 12 turkeys were harvested during the Spring season; that figure rose to nearly 1,000 in 2001 and has remained near or exceeds 1,000 turkeys each year through the Spring 2006 Season. Brood habitat (typically herbaceous openings and edges) is reported by the Department to be the main limiting factor affecting populations in the Lower Eastern Shore region.

Northern Bobwhite Quail – Bobwhite populations have steadily declined throughout Maryland, and eastern shore counties now represent the bulk of bobwhite quail range in the state. Quail harvest numbers have decreased over 90%. The Maryland Wildlife Diversity Conservation Plan list the northern bobwhite as a Species of Greatest Conservation Need. The Partners in Flight Mid Atlantic Coastal Plain Bird Conservation Plan lists the Northern Bobwhite as a species with high physiographic priority indicating moderately high global vulnerability and a relatively high abundance but declining population trend within the physiographic area. The Department has ranked Northern Bobwhite as a priority concern species for PSF lands. Research indicates that long-term habitat changes in both agriculture and forested areas are the primary causative factors. Predator populations and human development have likely hastened declines, but hunting has not shown to be harmful to existing populations.

Furbearers – Resident furbearer populations are stable or growing within the 3-county region. Beaver and otter populations are at their highest levels witnessed in the last century. Nutria, an invasive exotic rodent introduced into Dorchester County in 1943 is now present throughout the 3-county region. A coalition of federal, state, and private partners have undertaken the eradication of nutria on the Delmarva Peninsula. Eradication efforts on Blackwater NWR and surrounding areas appears to have been successful, and teams of trappers form the US Department of Agriculture Wildlife Services are expanding their efforts into other areas. Nutria damage or destroy root masts of marsh plants, leading to severe degradation of marsh structure and function.

White-tailed Deer – Harvest trends seem to indicate that white tailed deer thrive in the 3-county region, Wicomico, Worcester & Somerset (**Figure 2**). Over-abundant deer populations can threaten the existence of some sensitive plant species and can change forest structure and composition. Department personnel have expressed concern over their ability to control white-tailed deer populations, especially in areas closed to deer hunting.

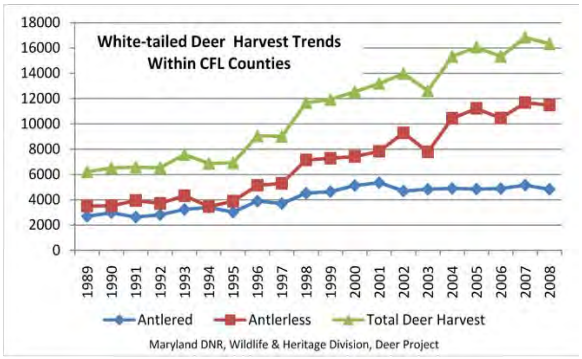

Figure 2: White-tailed deer harvest trends

Sika Deer – Sika deer, a native deer of Asia introduced to Maryland in the early 1900s, inhabit marshes,

swamps and associated woodlands primarily in Dorchester County and Assateague Island in Worcester County. Sparse populations are also present in Wicomico, Worcester, and Somerset Counties. The population appears to be stable and is controlled through hunting.

2.10 Migratory Birds of Special Concern

Waterfowl Associated with Wetlands – Important waterfowl areas occur throughout the Eastern Shore. Bottomland hardwood floodplains, beaver impoundments, Delmarva Bays, and freshwater/brackish emergent wetlands serve as wood duck, mallard, teal and black duck habitat. Black Duck are recognized by Partners in Flight Mid Atlantic Coastal Plain Bird Conservation Plan as a species of special concern.

American Woodcock – Spring "singing ground" surveys performed by the U.S. Fish and Wildlife Service suggest that eastern woodcock numbers have been declining by an average of 1.9 percent per year since these surveys were started in 1968. However, population estimates are stable over the most recent 10-year period. Most woodcock biologists suspect that alterations of habitat, losses to development and changes due to maturation of abandoned farmland are the cause of the population decline. Woodcock use Pocomoke State Forest as breeding and wintering habitat. Woodcock prefer moist soil areas with dense seedling/ sapling cover and rich humus layers because earthworms, their primary food, are most plentiful in these habitats. Pocomoke State Forest lands are important to woodcock as breeding and nesting areas. However, Pocomoke State Forest lands are probably more important as migration and wintering habitat because of their proximity to major migration pathways. Large numbers of woodcock migrate through New Jersey crossing Delaware Bay near Cape May and continuing south along the Eastern Shore of Virginia.

Neo-tropical migrants – Many neo-tropical migrants breed, nest, or migrate through the region. One of the largest conservation concerns in the region with migratory birds is the fragmentation of forest blocks. Other conservation concerns within the region include the loss of wetlands, loss of habitat due to development, and loss of habitat due to intensive agriculture. Rather than list each bird species individually, examples of critical habitats that serve broad migrant bird guilds are listed. The Partners in Flight Mid-Atlantic Coastal Plain Bird Conservation Plan recognizes five critical habitat types that are present throughout the Eastern Shores, as well as on the Pocomoke State Forest. Those habitat types and the birds that use them are listed below:

1. ***Pine Savannah*** – A pine savannah is a habitat with large scattered mature pine trees and very open understory. Prescribed burning within mature pine stands frequently creates pine savannahs. Along with Red-cockaded Woodpecker, seven species identified as high priority within the Partners in Flight Mid Atlantic Coastal Plain Plan include Prairie Warbler, Bachman's Sparrow, Brown-headed Nuthatch, Eastern Wood Peewee, Red-headed Woodpecker, American Kestrel, and Chuck-will's-widow. Historically, the absence of fire and the types of management on PSF lands suggest very few acres of pine savannah are currently available.
2. ***Forested Wetlands*** – From cypress swamps to seasonally wet floodplains, forested wetlands provide critical habitat for a host of high priority species. Highest concern is centered on Swainson's Warblers, Cerulean Warbler, Kentucky Warbler, Acadian Flycatcher, Yellow-throated Vireo, and Prothonotary Warbler.
3. ***Freshwater/Brackish Wetlands*** – Besides Black Duck, freshwater/brackish wetlands on Pocomoke State Forest lands also provide critical habitat for King Rail, American Bittern, Least Bittern, Pied-billed Grebe, and Common Moorhen.

4. ***Upland Mixed Forests*** – Mixtures of mature pine and hardwood within forest tracts provides critical habitat for Cerulean Warbler, Wood Thrush, Kentucky Warbler, Acadian flycatcher, Worm-eating Warbler, Eastern Wood-pewee, and Louisiana Water thrush. Most of these species also have an area requirement to maximize productivity. Maximum Cerulean Warbler density for example, occurs in forest of at least 1,000 acres. Pocomoke State Forest has 5,155 acres (28.3% of the total forest) variously typed as mixed hardwood/pine.
5. ***Early Successional Scrublands*** – Recent clear cuts and young pine plantations provide critical habitat conditions for Prairie Warblers, Bachman's Sparrows, Field Sparrows, Yellow Breasted Chats, Brown Thrashers, Eastern Towhees, and White-eyed Vireos. Pocomoke State Forest has 1,679 acres (9.2% of the total forest) currently typed as open (0-5 years) or sapling stage (6-15 years).
6. ***Pine Plantations*** – Older pine plantations, if managed with thinning to maintain relatively open canopies, will provide critical habitat for species that adapt to grass/shrub under stories beneath open pine canopies. These high priority species include (see also Early Successional species listed above) Blue-winged Warbler, Brown-headed Nuthatch, Northern Bobwhite, Carolina Chickadee and Gray Catbird.

2.11 Fish Species of Special Concern

Rare Fishes- All fishes in this table compiled by DNR's Wildlife and Heritage Service occur (or were historically known to occur) in the Pocomoke River basin. Of these, only mud sunfish, banded sunfish, glassy darter, white catfish, and longnose gar have been collected from Pocomoke State Forest lands. Given the small number of samples conducted within such a large area, it is possible that the other species on this list also still occur on Pocomoke State Forest. Little is known about the environmental or man-caused factors limiting the abundance of many of these species, but it is logical to assume that strict adherence to BMPs will help to lessen any impacts.

Species	Status	Recent Record	Historical Record
Banded Sunfish (*Enneacanthus obesus*)	S2	X	
Blackbanded Sunfish (*E. chaetodon*)	S1; Endangered		X
Mud Sunfish (*Acantharchus pomotis*)	S2; In Need of Conservation	X	
Ironcolor Shiner (*Notropis chalybeus*)	S1; Endangered		X
Glassy Darter (*Etheostoma vitreum*)	S1S2; Threatened	X	
Swamp Darter (*Etheostoma fusiforme*)	S2; In Need of Conservation	X	
White Catfish (*Ameirus catus*)	SU	X	
Longnose Gar (*Lepisosteus osseus*)	S2?	X	

Rare fish recorded in the waters of the Pocomoke River: Source MD DNR Fisheries Division

2.12 The Forests of the Eastern Shore

Historic land cover shows the region dominated by hardwood forests mixed with pine softwoods. The oak species present included white oak, willow oak, pin oak and cherry bark oak (Smith, 1998). Other hardwood trees found historically on the Eastern Shore include sweetgum, silver and red maple, black gum, dogwood, birch, beech, bay, and holly. "In very wet areas some black pine and pond pine grow; cypress was plentiful in the swamps. Loblolly pine and Virginia pine probably were also present, but these trees were not found in pure stands until after many areas had been cleared of hardwoods. The northern range of natural loblolly pine runs roughly through the middle of the Eastern Shore, with hardwoods increasingly dominating stands as one moves northward through the region. Loblolly pine

became dominant in heavily cut areas and on abandoned cropland. Virginia Pine became dominate in areas of sandier more droughty soils." (Somerset, 1966)

Practically no virgin forests remain on the Eastern Shore, and most forests have been cut over several times. Many areas (including many that are once again in forest) have been cleared for conversion to agriculture in the past. As **Table 7** illustrates, non-industrial private owners own the majority of the forests on the Eastern Shore. With over 70,000 acres moving from the "industry" column to the "public" column as a result of the Chesapeake Forest & Glatfelter Pulpwood transactions, the industry share will decline significantly in the near future.

Table 7: Area of timberland by forest type and ownership group

Eastern Shore	*(thousands of Acres)*			
Forest Type	**All Owners**	**Public**	**Industry**	**NIPF***
Loblolly& shortleaf pine	224.2	5.9	80.1	138.2
Softwood total	224.2	5.9	80.1	138.2
Percent of Total Softwoods	100.0%	2.6%	35.7%	61.6%
Oak- Pine	176.2	6.5	34.3	135.5
Oak-Hickory	279.1	11.7	24.3	243.1
Oak-Gum-Cypress	117.2	12.3	13.4	91.5
Elm-Ash-Cottonwood	16.5	0	3.2	13.3
Maple-Beech-Birch	7.3	0	0	7.3
Hardwood total	596.4	30.5	75.2	490.6
Percent of Total Hardwoods	100.0%	5.1%	12.6%	82.3%
All forest types	820.6	36.4	155.4	628.8
Percent of Total All Types	100.0%	4.4%	18.9%	76.6%

Source: MD/DNR Forest Service, 1996 data. * Non-industrial private forest owners

Streams: Several of the State Forest lands fall within Stronghold watersheds for aquatic biodiversity (specifically the 12-digit watersheds of #0664, #0667, and #0632). Stronghold watersheds are those watersheds in the state that are most important for the protection of Maryland's aquatic biodiversity. Stronghold watersheds are the places where rare, threatened, or endangered freshwater fish, amphibians, reptiles, or mussel species have the highest numbers (abundance and number of occurrences). Special protection of these watersheds is necessary to ensure the persistence of these imperiled fauna. Additionally, there are reaches of Dividing Creek just upstream from a section of the State Forest located along Fleming Mill Road that are classified as Tier II (High-Quality Waters). These areas have high biological integrity and are afforded additional protection under MDE's Anti-degradation regulations. The portion of Dividing Creek downstream from this within the State Forest lands is not classified Tier II, but should be afforded the same protection given its location.

2.13 Forest Management on the Eastern Shore

Most of the forests on the Lower Eastern Shore are privately owned, and most are managed for multiple objectives, but chiefly for revenue from the sale of timber and for wildlife habitat to support wildlife-related recreation. The forests on the Lower Eastern Shore are well suited to meet these objectives because of their ability to provide valuable products and diverse habitats.

As described above, the forests on the Lower Eastern Shore tend to be dominated by either loblolly pine or a mix of southern hardwood species, including many oaks. Most of the forests are even-aged, having regenerated from the abandonment of agricultural land in the middle of the century, or from previous clear-cut timber harvests. Some areas have probably seen timber harvests for several centuries, as both

Native Americans and early European settlers cleared land and harvested wood for a variety of uses, such as building boats and houses.

Of the many commercial products that a forest on the Lower Eastern Shore can generate, the most valuable is loblolly pine sawtimber. There is a strong market for this because of the many local sawmills engaged in the production of dimensional lumber and structural timbers. Stumpage rates average between $130-200 MBF depending on the quality of wood, tract accessibility, and local market fluctuations. Most mature pine stands are well-stocked and average 8-12 MBF/acre. Thus, a clear-cut harvest could generate $1040 – 2400 per acre in stumpage revenue.

There is also a limited market for pine pulpwood and, to a lesser extent, hardwood pulpwood. These markets are weak, and the prices are low compared to other parts of the southeast. Despite the abundance of the hardwood forest, there are very limited markets for hardwood sawtimber, whether it occurs mixed with loblolly or in pure stands. The local mills will typically pay $50-100/MBF for the average hardwood saw log (a small fraction of the loblolly pine stumpage price). This is because the wet soil conditions, limited merchantable species, and history of high grading have resulted in a very poor quality of hardwood logs on the Lower Eastern Shore. While it is possible to grow high-quality oak and tulip poplar saw logs, the hardwood forests are more often characterized by less valuable species, such as red maple, sweet gum, and black gum that are often poorly-formed and/or marked with mineral stains or decay. On the Upper Shore, the log quality is much better and the markets are much stronger.

As a consequence of these markets and growing conditions, most Lower Eastern Shore landowners that desire a commercial return from their forestland focus on loblolly pine. Loblolly pine is managed commercially throughout the Southeast and is one of the most important timber and paper-producing species in the country. It is a fast growing, early successional species that is shade-intolerant. It grows in a wide range of soil and moisture conditions. It will not be successful without direct sunlight. Dense even-aged stands can become established either through planting or by natural regeneration on cutover sites or old farm fields. In the first few decades, individual loblolly pines will aggressively compete for sunlight and nutrients with other pines and with other species. Through a natural process of self-thinning, the slow-growing trees will die from lack of sunlight, and the overall stocking will gradually decrease as the stand develops. Some mature trees will begin dying of natural causes starting at 60 to 80 years of age. However, due to the economic value of this species, it is rare to find loblolly trees greater than 80 years old even though this species can survive at ages well in excess of 100 years.

Management of loblolly pine on the Lower Eastern Shore varies considerably from practices elsewhere in the Southeast. For the most part, Lower Eastern Shore landowners choose to manage extensively, rather than intensively. Many stands are managed for natural regeneration and long rotations, typically 40-60 years old. Perhaps because of a lack of knowing the management benefits of commercial thinning, most landowners do not incorporate a mid-rotation thinning as part of their management regimes. Additionally, most regeneration is done with minor site preparation, typically only a chemical release treatment. Intensive management practices that are common elsewhere in the Southeast or on the former Chesapeake Forest lands under past ownership, such as mid-rotation fertilization and competition control, pre-commercial thinning to control sapling stocking, and bedding for site-preparation, are not common on NIPF land on the Lower Eastern Shore, although they are occasionally pursued.

In Maryland from 1976 to 1999, the number of private forest owners grew from 95,800 to 131,000. In 1976, 55% of the owners held less than 10 acres of forest; by 1999, that proportion had grown an

additional 62% to over 85,000 small woodlot owners. These small woodland holdings are primarily home sites that now account for 11% of the state's private woodlands. What can be inferred from these trends is that over 2/3 of the forestland owners in the area are now essentially homeowners who will seldom be able (or desire) to manage their forest for timber production. Some properties will be managed for wildlife and recreation value, but small, fragmented pieces are limited in their capacity to produce those values.

Convincing private landowners to manage forests on a long-term, sustainable plan is affected by the rapid turnover of forest properties. In this area, each tract is sold on average once every 12 years and the size often decreases at the time of sale. This produces a constantly changing clientele for forestry education, and a constantly shifting set of land management objectives that can disrupt or destroy long-term planning.

To assist the landowner with the management of their forest, there are a variety of forestry services and sources of information available. The Maryland Department of Natural Resources, Forest Service, maintains at least one forester in each county. Many landowners rely on them for impartial advice concerning timber sales, the development of forest stewardship plans and the carrying out of forest management activities such as reforestation after a timber sale. In addition, several private consulting foresters assist landowners with all aspects of forest management. Most of the actual management activities, such as road building, site preparation, tree planting, and harvesting, are contracted out to separate businesses. The Lower Eastern Shore has access to many of these types of contractors but not in the quantity that characterize other, less isolated, areas of commercial forestry. Consequently, some specific management practices have not been feasible because there has not been sufficient demand to support an operator.

In general, the Lower Eastern Shore landowners do not seem driven to achieve maximum economic returns, with many owners who are as likely to be interested in providing good habitat for game species as in generating revenue.

2.14 The Forest Products Industry

About 205 million board feet of pine sawtimber, hardwood sawtimber, and pine pulpwood is consumed annually in the Lower Delmarva Peninsula. The big users are four pine sawmills, and two-pine pulpwood chipping operations for papermaking. There are also three hardwood sawmills and a variety of other users that are influenced by the availability of timber. The pine sawmills produce a variety of wood products, most of which are designed to be treated with a preservative and used outside or in contact with the ground. Some examples of these products include piling; utility poles; building poles; bulk heading; dimension lumber and decking. The hardwood mills also manufacture an array of products, e.g., timbers, construction lumber, railroad ties, pallet stock, and some high quality lumber. There is a sharp contrast in the quality of the hardwood from the northern and southern portions of the Peninsula. Hardwood grown on the Lower Peninsula is of poorer quality due to the soils, which can stain the wood. These soils also favor higher percentages of less desirable hardwood species, such as gum and maple.

Although most Eastern Shore forests are hardwood or mixed forest types, loblolly pine is the species that drives most of the local forest economy. Close to 90% of the wood used on the Lower Eastern Shore is loblolly pine. An analysis by a local consulting firm Parker Forestry Services indicates that mills compete for pine across the whole Eastern Shore. About 18,000 acres per year is being harvested and that is close to the available capacity according to Parker Forestry Services. However since this analysis was completed the largest Pine Sawmill on the Shore shut down operations with the mill being

sold off in the fall of 2006. Also with the economic downturn beginning in 2008, both lumber prices and acres harvested have fallen off considerably. The average pine sawtimber price in 2009 was around $130 per MBF about half of what it used to bring just a few years prior, pulpwood prices however have remained stable.

2.15 People and Forests on the Eastern Shore

2.15.1 *Historic Settlement and Forest Use Patterns*

The earliest settlers in the region were Native Americans who are thought to have moved to the area between 3500 B.C. and 500 A.D. They were hunters and fishers who also developed agriculture during the later period of their settlement. They made extensive use of fire as a tool for land clearing, ridding areas of brush, brambles, and insects, and providing defensible space around villages. Their fire management practices were an important aspect shaping the development of forest ecosystems, favoring species like pine and oak that have higher fire-tolerance.

The first English settlers arrived in the mid-1600s and were generally trappers and traders who settled along the waterways that provided the main transportation routes. Much of the land was transferred by land grants from Lord Baltimore. Tobacco was a mainstay crop, and was used as a medium of exchange for many years. By the end of the 18th Century, tobacco had depleted soil fertility and the markets were becoming unstable, but the extension of the railroad from Wilmington to the Eastern Shore, as well as the growth of steamboat shipping, opened urban markets for agricultural products such as vegetables, chickens, corn, and soybeans. Timber for boat building was plentiful, and buyers from the North came to the Eastern Shore to purchase pine for masts. The oyster industry thrived around the turn of the 20th Century, increasing the demand for boat-building timber.

The widespread industrial destruction of Maryland's forests began in the 18th Century, when there were estimated to be 17 or 18 iron forges in the state at the start of the Revolutionary War. Records indicate that it took 22 cords of oak and hickory wood a day to make the 800 bushels of charcoal needed to produce two tons of pig iron. One furnace that operated almost continuously for a century required 10,000 acres of woodland. As cypress swamps and upland forests were logged, more wood was wasted than was used, and the great forests were largely exhausted by 1890.

The conversion of forests to cultivated farmland probably peaked somewhere in the early years of the 20th Century. In a forest inventory conducted during the years 1907 to 1914, Besley (1916) reported the percentages of forest cover for the Lower Eastern Shore counties as: Caroline (30%); Dorchester (37%); Somerset (25%); Wicomico (46%); and Worcester (47%). By comparison, those percentages today are 31, 21, 25, 42, and 38, respectively, indicating that forest cover continued to decline somewhat in the 20th Century.

2.15.2 *Fire and Its role In Shaping the Forests of the Region*

The average pre-European-settlement fire frequency was approximately 7-12 years for forests of the Eastern Shore of Maryland, with higher frequencies of 4-6 years in the southeastern Maryland counties of Wicomico, Worcester, and Somerset (Frost 1988). These frequencies are high compared to most areas of the Northeast. Since it is unlikely that lightning was a significant contributor to these fires, Native American populations must have been. Pyne (1982) concluded that fire in the Northeast was predominantly a phenomenon associated with human activity.

The forest that covered the Eastern Shore in Indian times was predominantly a hardwood one, though increasingly mixed with pine to the southward (Rountree and Davidson 1997). The large patches of pine-dominated woods today are largely second growth, the result of extensive clearing in historic times. In aboriginal times, the woods of the Eastern Shore were likely to be oak-hickory, oak-gum, or oak-pine types, all of which still exist in second-growth form.

Captain John Smith said in the early seventeenth century, "A man may gallop a horse amongst these woods any waie, but where the creekes or Rivers shall hinder". Father Andrew White wrote that the woods around St. Mary's were so free of underbrush that a "coach and fower horses" could be driven through them (Rountree and Davidson). The open conditions could be partly attributed to the closed canopies of these mature forests, which shaded out undergrowth, but it is also likely that periodic fire helped to maintain the park-like conditions.

Pre-European fire occurrence was probably highest near sites of major Indian settlements or seasonal fire activity. Open woods, when containing large stands of deciduous, nut-bearing trees, must have been the most desirable ecological zone to have near an Indian town. Aside from all the food and other things it has for people, this zone is extremely attractive for browsers like deer and elk (extinct in eastern Virginia and Maryland by about the eighteenth century).

It is reasonable to assume that Eastern Shore tribes also used fire to periodically burn the marshes that were important sources of mollusks, fish, furbearers, waterfowl, edible tubers, and reeds for housing. Fire would have been useful for herding game, enhancing visibility or access, or retarding invasion of woody growth. More often than not, these fires would have spread into adjacent woodlands and, if of sufficient intensity, created the open seedbed conditions conducive to establishment of loblolly pine. Even today the pattern of loblolly pine "islands" and "stringers" in and adjacent to marshes of the lower Eastern Shore is common.

If, as Rountree and Davidson suggest, oaks were the most prevalent species in pre-settlement times, then the possible role of fire in maintaining these forest types must also be considered. Frost stated, "Light, understory fires may have been the norm for millions of hectares of eastern hardwood forest..." Most oak species are mid-tolerant to intolerant of shade, indicating that disturbance is desirable to promote regeneration and growth. Furthermore, acorn germination and initial seedling establishment are most successful where light understory burns have scarified the seedbed and reduced competition. The extensive presence of oaks on the Shore was an indicator that low-intensity understory fires were common, either intentionally set by Indians to create "open woods" or drive game, or the incidental result of land-clearing.

The displacement of Native American populations by European settlers in the seventeenth and eighteenth centuries may have had surprisingly little effect on the use of fire or the frequency of occurrence. Like the Indians, the settlers used fire to clear land for farming and houses, though the technique might have been felling and burning rather than girdling and scorching, and more area would have been cleared; in any event, the inevitable result was that some fires escaped and burned into adjacent woodlands. Accounts from the colonial period indicate that fire was also used to drive game, facilitate trapping, clear undergrowth for horse travel, enhance foraging opportunities for free-ranging hogs, and even clear the woods of ticks.

Natural stands of loblolly pine (*Pinus taeda*) became much more widespread around the turn of the 20th Century, particularly in the counties south of the Choptank, largely due to the influence of economic factors. First was the abandonment of agricultural fields as farmers moved to more lucrative jobs in the towns and cities. Loblolly pine is an opportunistic species, which found the recently abandoned fields prime sites for reproduction by natural seeding. The second factor was the rise of large-scale commercial lumbering. Steam locomotives, often used to haul logs from the woods, were notorious for throwing sparks along the tracks and starting fires. Both the clearing of the forests by large-scale logging and the subsequent fires resulted in large areas of open, scarified land suitable for pine regeneration. By the middle of the twentieth century, loblolly pine had become the predominant forest cover type in the lower counties of the Eastern Shore.

2.15.3 *Recent Population and Development Trends*

The Lower Eastern Shore, while remaining largely rural, is within the "gravitational field" of a large (11 million people plus) urban population. The result is fairly rapid population growth, and pressure to convert farm and forestland to developed uses. This is particularly true in Worcester County, where beach-related recreation on the Atlantic coast may be the main cause. Wicomico County, location of Salisbury, grew slightly faster than the region's rate between 1990 and 2000, while Somerset and Dorchester on the Chesapeake Bay side, grew much more slowly (**Table 8**).

Table 8: Population characteristics of MD/DE compared to selected Eastern Shore Counties (US Census Bureau)

State/County	Population 2000	Population 2010	Increase %	Under 21 % of total, 2010	Age 21-64 % of total, 2010	Age 65+ % of total, 2010
Delaware	783,600	897,934	14.59%	27.60%	58.00%	14.40%
Maryland	5,296,486	5,773,552	9.01%	27.67%	60.07%	12.26%
DELAWARE & MARYLAND	6,080,086	6,671,486	9.73%	27.66%	59.79%	12.54%
Caroline, MD	29,772	33,066	11.06%	29.11%	57.55%	13.35%
Dorchester, MD	30,674	32,618	6.34%	25.12%	57.18%	17.69%
Somerset, MD	**24,747**	**26,470**	**6.96%**	**27.18%**	**59.00%**	**13.83%**
Sussex, DE	156,638	197,145	25.86%	23.60%	55.56%	20.83%
Talbot, MD	33,812	37,782	11.74%	22.37%	53.92%	23.71%
Wicomico, MD	**84,644**	**98,733**	**16.65%**	**30.07%**	**56.92%**	**13.01%**
Worcester, MD	**43,300**	**51,454**	**18.83%**	**21.10%**	**55.66%**	**23.25%**
E. SHORE COUNTIES	403,587	477,268	18.26%	25.26%	56.16%	18.58%

2.15.4 *Maintaining Working Forests in an Urban-Affected Region*

Urban populations require a constant inflow of natural services, such as food, fiber, and freshly cycled water and air. These needs create economic incentives to use undeveloped land for farming and forestry to produce these goods. However, many of the natural services, such as cycling of water and air, or wildlife habitat, are not priced in a market where landowners can be financially rewarded for keeping land in forests. This lowers forest owners' ability to compete as landholders where areas urbanize.

Urbanization also creates large outflows of influence that tend to push land uses such as farming and forestry further away. Used water, air, waste material are exported from the urban areas to cheaper rural land. Farming, forestry, and other open space uses are generally out-priced when push comes to shove and a large population center needs to expand or export a problem. The lands then move into higher priced uses that generally feature more houses, more highways, and other developed amenities. As land use changes radiate outward, the industries such as forest products manufacturing experience supply reductions as well as growing urban attitudes that discourage or even legislate against activities like logging, trucking, or manufacturing. Where business leaders sense that the future of the industry is

limited, they begin to limit investment in new facilities, and the future of the industry can become locally tenuous.

This situation is clearly affecting the Eastern Shore, and while the Pocomoke State Forest can resist the pressures to be converted to other uses due to their status as public lands, the management of the lands will be affected by the fate of the private lands around them as well as the future of community factors such as the forest products industry and the pressures for outdoor recreation.

Studies by the Department, using 1997 Census of Agriculture data, indicate that land in the Eastern Shore counties is attracting market prices that are 2-5 times higher than the land's agricultural or forest value. The higher that ratio becomes, the more vulnerable the land is to conversion. By comparison, some Maryland watersheds on the Western Shore close to the Baltimore-Washington corridor have price ratios as high as 10 to 15.

Land prices cut both ways in a situation like this. High prices near the urban areas mean high taxes, and commodity producers are squeezed out of production because they cannot afford to pay development-price taxes on farm or forestland. They are then forced to sell to protect their family's asset value. On the other hand, lower land prices in areas adjacent to heavy growth pressures encourage leap-frogging. The Eastern Shore, while not in the immediate high-pressure zone, is close enough to allow developers to think that distance is not as much a problem as price, so they are encouraged to build on cheaper, more remote lands.

One signal that this leapfrog effect is occurring on the Shore is the informal estimate that there are 20 new golf courses nearing completion in the area, and another 20 on the drawing boards. This is a land use that can pay more for land and taxes than farming or forestry, but less than condominiums or shopping malls.

Several large resort developments have also just been announced. The fact that these uses are currently expanding in the Shore counties means additional focus on the area as a recreation destination, which spells more visitors, more traffic, and more residential development in the coming decades. Some of this growth will take agricultural land; some will take forests. The future of agricultural land is important to forestry, because as agricultural land is developed, and agricultural cultural values are replaced by urban values in the region, the pressures against production forestry will mount. That trend is already well underway and seems destined to continue in the future.

In the three Maryland counties where Pocomoke State Forest is located, populations are older and less affluent than the averages for their respective States (U.S. Census, 2010). This sets the stage for significant amounts of land turnover, fragmentation, and land use change in the coming decades. Moreover, it leads to considerable concern for the future of rural lands as development pressures spread south from Wilmington, east from Baltimore-Washington, and west from the recreational beach resorts.

2.16 **Landscape Considerations**

2.16.1 ***Shifting From Stands to Landscapes***

In the past, management of forests was done primarily on a stand-basis, and most of the time, as stands within specific property holdings. From an ecological perspective, the stand was taken as a unit that could be accessed independently of others. Economic considerations, such as the desire to have consistent product to sell from year to year, and to minimize costs of treatments, linked the management of different stands, but otherwise it was assumed that a stand, by definition, was a management unit on which treatments could be scheduled independently of all others.

In recent years, however, there has been a strong movement toward management at a landscape level. Landscape level considerations means that the status of any specific stand, and what forestry treatments are applied to it, depend not only on its internal conditions (stand age and structure, site index, etc.) but on the condition of other stands and of other lands in a region. The landscape-level perspective leads to a view of stands within landscapes. The condition of other stands includes not only their stand age and structure, but also the frequency distribution of stands on the landscape of different kinds and stages. Landscape considerations also take into account land holdings by other landowners and government agencies. The management of a stand is perceived within a regional context.

All of the major goals of this project need to be examined from a landscape-level perspective, and decisions made in light of this perspective. Among the factors that are leading in the direction of management from a landscape level perspective are: the requirements of the Endangered Species Act; the Clean Water Act; the habitat needs of migratory species that make use of forest stands; the habitat needs of game species and other species of recreational value; the perception that recreational uses can benefit from a variety of stand types, not just from the existence of a certain kind of stand.

There are a number of examples that illustrate the landscape perspective. Recent approaches by Boise-Cascade illustrate landscape level forest management as a result of concerns with endangered species. Boise-Cascade has holdings in the southeast that are habitat of the Red-cockaded woodpecker. The company has taken the position that, while it can affect habitat for this species within its own holdings, it cannot be held responsible for the status of the species, specifically for the population abundance of the woodpecker. Instead, Boise-Cascade has initiated voluntary, cooperative agreements with other landholders and with government agencies so that planning for forest use is done on a regional basis. In this case, the decision about how a specific stand will be treated is influenced by more than the condition of that stand, and more than the holdings of Boise-Cascade. That treatment depends on the availability of habitat for the woodpecker in an entire region, and, by voluntary action, the corporation chooses to harvest stands under its own control to meet the regional needs of the endangered or threatened species, as well as to meet its corporate needs. A similar approach dealing with the endangered Delmarva Fox Squirrel is underway on the lower eastern shore of Maryland. The Blackwater NWR in conjunction with Maryland DNR and other partners are in the process of developing a Habitat Conservation Plan (HCP) for management of the DFS for the entire peninsula.

Similarly, the desire to have clean water leads to a consideration of water quality within a region, as well as within a specific ownership. On the Eastern shore of Maryland, drainage is complex, with many areas affected by tidal influences, and, during periods of high-water following storms, drainages may shift direction of flow, or flood, or water from different watersheds might mingle. Water quality is affected by the condition of water in the bay, on lands that are in agriculture and housing, as well as on the forestland, making clean water a landscape.

Thus, a landscape-level perspective is intrinsic, if generally unspoken, in forest planning on the Eastern Shore, and is likely to become increasingly important in the future. As the experiences and practices of Boise-Cascade illustrate, this level of planning and management can be done on a voluntary, cooperative basis, and be driven by market forces. Landscape-level planning means that a stand is seen within a regional context, but this does not require that planning be done from an external or regulatory perspective.

2.16.2 *Watersheds as a Landscape Issue*

Regional attention to water quality in the Chesapeake Bay and its tributaries has led to concern for some of the resource management activities in use on the Eastern Shore. Declining water quality in the Bay

has resulted in major interstate efforts, many of which have identified the treatment of the land within the watershed as the primary factor in reversing the decline and restoring the Bay's aquatic environments.

In its Clean Water Action Plan, the State of Maryland identified 138 "8-digit" watersheds, averaging about 75 square miles each, as the unit of analysis most suited to identification of watershed condition and treatment priorities. The "Unified Watershed Assessment Report" published by the State evaluated clean water and other natural resource goals on these watersheds. The clean water goals were based largely on the State's biennial water quality report, prepared in response to Section 305(b) of the Federal Clean Water Act. Waters that were reported to have violated water quality standards were assigned to "Category 1," as "in need of restoration." In addition, watersheds that were not in violation of water quality standards, but which were shown to need restoration in order to meet two or more natural resource goals, are also placed in Category 1.

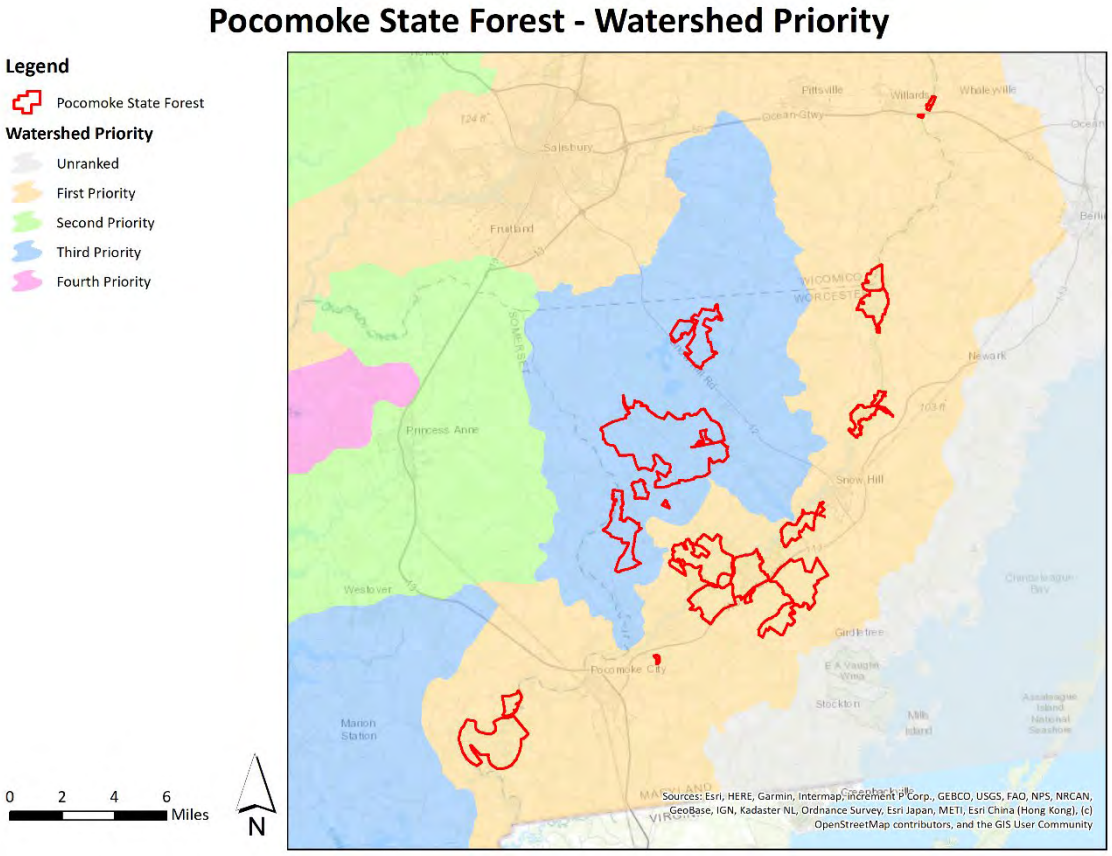

Figure 3: Watersheds on Maryland's Lower Eastern Shore, illustrating priority levels for restoration. (2021)

Category 2 watersheds are those that meet current water quality and natural resource goals but need preventative actions to sustain existing water quality. Category 3 is high quality pristine watersheds where protection was a high priority. In selecting water quality indicators that might be most affected by forest management within the watersheds, we chose nutrient loading. See **Section 3.5** for additional characterization of Watersheds on Pocomoke State Forest.

2.17 Water Quality Issues

Pocomoke State Forest plays a pivotal role in water quality on the lower Eastern Shore. Forestlands provide a steady source of clean water to streams and tributaries. Forests act as nutrient sinks across the landscape, absorbing more nutrients than they supply. Additionally, as has been illustrated in the Regional Settings section, Pocomoke State Forest contains a large amount of land on the lower Eastern Shore and therefore is critical to the viability of the timber industry and consequently, the forest cover in the region. Without the infrastructure of the timber industry, forestlands may be converted to other more polluting land uses. Finally, the location and landscape position of Pocomoke State Forest provides opportunities to capture additional nutrients and sediments traveling across the watershed.

Nutrients are the largest water quality concern on the lower Eastern Shore due to their negative impact on the Chesapeake Bay and its tributaries. Based on the water quality model used by the US EPA Chesapeake Bay Program, forests supply 12% of the nitrogen and 1% of the phosphorus to the tidal streams of the watershed where the Pocomoke State Forest is located. Although agricultural sources are clearly the largest source of nutrients on the lower Eastern Shore, forests still supply a substantial amount of the total nitrogen entering tidal waters because of their extent in the region. In terms of per-acre contribution, forests supply far less nitrogen than they receive from atmospheric deposition. Forests are estimated to contribute only 2 pounds of nitrogen per acre per year at the same time that they are receiving 9.5 pounds of nitrogen per acre per year from the atmosphere. See **Section 3.4** for additional characterization of water quality.

2.18 Potential Water Quality Impacts of Forestry Operations

Timber operations have the potential to create unacceptable impacts on water quality. However, with proper best management practices, these impacts are generally minimal and temporary. While the low relief of the Delmarva coastal plain reduces the risk of causing significant water quality impacts, it also increases the occurrence and therefore the exposure of aquatic systems, and thereby reduces the opportunity to mitigate any impact that does occur. See **Chapter 5**, for additional information on mitigating impacts from forestry operations.

2.19 Climate Change and Maryland Forests

Research has speculated how forests and their management could be affected by a changing climate. While much of the research has been somewhat general, some researchers have focused their attention to areas including Maryland (McKenney-Easterling et al.: Climate change impacts on forests in the Mid-Atlantic Region, Climate Research Vol. 14: pages 195–206, 2000). In 2022, The Maryland Forest Service (MFS) partnered with Chesapeake and Coastal Service to prepare a climate change adaptation and resilience planning guide for the Pocomoke State Forest that evaluates climate hazards, impacts from climate change, and potential adaptation strategies and implementation opportunities. It is intended that this guidance document will support forest staff in decision making and resilience planning and will be used in coordination with the Sustainable Forestry Management Plan to achieve the goals of continued forestry operations, recreational access, and infrastructure maintenance. The latest version of the Pocomoke State Forest Climate Change Adaptation and Resilience Planning Guide can be found here: https://dnr.maryland.gov/ccs/Documents/Pocomoke-Plan-Outline.pdf

2.19.1 *Species Migration*

According to some of these studies, two major forest-related shifts may result from the common climate-change scenarios. One, resulting warmer temperatures will likely cause a species distribution shift. Within this scenario, some species may benefit while others will experience a range reduction. Certain

forest-types such as oak-hickory, oak-pine and southern pine forest types, would probably benefit from dryer conditions while those requiring a moister site will not.

> *"Large increases in some species of oak and pine, particularly those better adapted to warmer and dryer ecosystems. Consequently, those species preferring more moist conditions, such as elm-ash-cottonwood and maple-beech-birch forest types may be reduced from some landscapes, results generally show warm-temperate mixed forest/evergreen forest moving northward, displacing temperate deciduous forest in the southern part of the MAR, and cool temperate mixed forest (such as maple-beech-birch) disappearing completely from the region."* (McKenney-Easterling et al.: Climate change impacts on forests in the Mid-Atlantic Region, page 204.)

2.19.2 *Forest-Type Changes*

The forest-type distribution in Maryland varies greatly—from the coastal plain to the Allegheny Mountains, ecosystems are quite different and so would the expected response to climate changes.

Eastern Shore

As mentioned elsewhere in this document, the Shore silviculture and ecosystems are dominated by southern yellow pine and pine-hardwoods. It would be expected that this forest-type will largely be unaffected in most of these scenarios.

> *"The southern pine types remain fairly stable even though individual southern pine habitat increases to the north for many pines. The explanation for this pattern is that the oak species also generally increase so that the proportions stay similar, or even favor oak-pine over loblolly pine for a portion of the current southern pine habitat."* (L.R. Iverson et al. / Forest Ecology and Management 254 (2008) 390–406, pg 401)

Western Maryland

The oak-hickory forest type may actually benefit from a warmer climate. Oak regeneration has been less than desirable for several decades due to the reduced occurrence of fire on the landscape, due primarily from human intervention. One study suggests that some disturbances promoted by climate change may open the canopy to actually enhance the probability for oak regeneration. This may not only increase the chance of gaining a larger oak component but also the wildlife that benefit from that forest-type.

> *"Several of these species are currently important commercial species of oak (Quercus) or pine (Pinus). Increased habitat for oak could indicate an increased commercial and wildlife resource (especially in the northern part of the country), but oaks currently are undergoing a regeneration crisis in the absence of fire or other agents that can partially open the canopy (Loftis and McGee, 1993; Iverson et al., 2004b)."* (L.R. Iverson et al. / Forest Ecology and Management 254 (2008), pages 403-404).

2.19.3 *Disturbance Increase*

A secondary effect resulting from increased average temperatures is the increased incidence of insects, disease, and fire. This will affect not only the composition of the forest but complicate their management. In the recent past, Maryland State Forests have been plagued by spongy moth (formerly known as gypsy moth), southern pine bark beetle, hemlock wooly adelgid, and recently emerald ash borer. A variety of other damage agents lay on our borders, namely sirex wood wasp, oak wilt, spotted lanternfly, and others.

2.19.4 *Increased Severe Weather*

The second response identified is the result of more severe weather events and the forest management implications that would result from these events.

> *"Second, we used a survey to gather information on the types of extreme weather events that are currently problematic for forest land managers, and the types of impacts they cause to forests and forestry operations. Respondents indicated that high winds and precipitation-related events have been more problematic than extreme temperatures alone, based on experiences over the past decade. Types of major impacts include operational impacts (in particular, altered access to forest areas) as well as structural impacts (direct damage to trees) and biological impacts (mortality, and increased problems with insects, disease, and fire). This information, in conjunction with our results from the tree species distribution modeling, was used to make inferences about the potential impacts of extreme events in the future. We note that climate change may lead to alterations in the frequency, severity, and duration of extreme events such that the past is an imperfect predictor of the future."* (McKenney-Easterling et al.: Climate change impacts on forests in the Mid-Atlantic Region, page 205.)

2.19.5 *Sea-level Rise*

The National Wildlife Federation report (2008) entitled Sea-Level Rise and Coastal Habitats of the Chesapeake Bay: A Summary, states that the Maryland Shore could lose 16,000 acres of undeveloped dry land by 2100. This would dramatically affect forest management on the Pocomoke State Forest and Chesapeake Forest Lands, effectively reducing the area of management acres and altering more.

> *Coastal habitats in the Chesapeake Bay region will be dramatically altered if sea levels rise globally about two feet by the end of the century, which is at the low end of what is predicted if global warming pollution remains unaddressed. Over 167,000 acres of undeveloped dry land and about 161,000 acres of brackish marsh would be lost, replaced in part by over 266,000 acres (415.6 square miles) of newly open water and 50,000 acres of saltmarsh. Ocean and estuarine beaches also fare poorly, declining by 58 percent and 69 percent, respectively, by 2100. In addition, more than half of the region's important tidal swamp is at risk.*
>
> *Over 167,000 acres of undeveloped dry land would be lost or replaced with wetlands. As dry land becomes saturated, the water table will increase, contributing to the expansion of open water inland. Furthermore, sea-level rise will make coastal and inland areas more susceptible to storm surges.*

2.19.6 *Wildfire Risk*

A wildfire risk analysis was conducted in 2022-23 to determine potential wildfire issues for Pocomoke State Forest. Most of the forested area on Pocomoke State Forest is low-risk due to ongoing timber management and prescribed burning. Higher-risk areas are primarily located in marshes and low, wet areas where *Phragmites australis* is prevalent. The full analysis document is located here: https://dnr.maryland.gov/land/Pages/Stewardship/default.aspx

2.19.7 *Agency Response*

The State of Maryland has been addressing the threats of global warming and climate change through varies committee studies and reports.

In the Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change, Chapter 5, one of the key recommendations, in which DNR State Forests can have a role, was:

Retain and expand forests, wetlands, and beaches to protect us from coastal flooding. Identify high priority protection areas and strategically and cost-effectively direct protection and restoration actions. Develop and implement a package of appropriate regulations, financial incentives, and educational, outreach, and enforcement approaches to retain and expand forests and wetlands in areas suitable for long-term survival. Promote and support sustainable shoreline and buffer area management practices.

The Maryland DNR Forest Service response to these factors will be to maintain an adaptive management approach considering current research and regular forest (and other resource) inventories, monitoring and assessments and by proper staffing to maintain the ability to respond to these potentially destructive forces. (Western Maryland State Forests have begun a five-year forest inventory project beginning in 2011 and expected to be completed in 2016 that will provide baseline data to monitor forest changes and allow adaptive forest management approaches).

Additional information:

Sea-Level Rise and Coastal Habitats of the Chesapeake Bay: A Summary
(National Wildlife Federation, 2008)
http://www.nwf.org/~/media/PDFs/Global-Warming/Reports/NWF_ChesapeakeReportFINAL.ashx

Fighting Climate Change to Secure a Sustainable Future for Maryland (MDE website)
http://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Pages/index.aspx

Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change Phase I: Sea-level rise and coastal storms (July 2008)
http://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Publications/2008ClimateActionPlan.pdf

Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change, Phase II: Building societal, economic, and ecological resilience (Jan 2011)
http://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Publications/IAN2991.pdf

CHAPTER 3

Pocomoke State Forest - Resource Characterization

The Pocomoke State Forest covers approximately 18,492 acres of land with the vast majority of it located in Worcester County, but some small acreage is located in Wicomico and Somerset Counties (**Figure 4**).

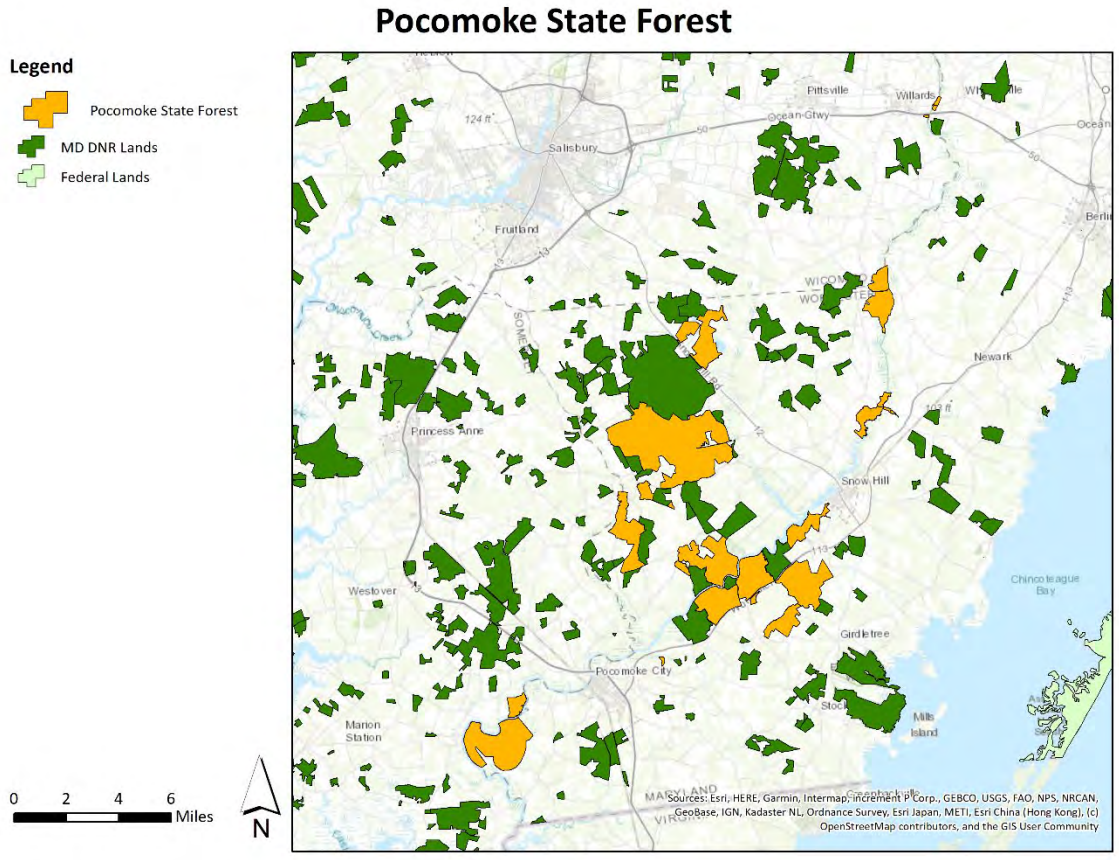

Figure 4: Pocomoke State Forest on the lower Eastern Shore of Maryland. (2021)

3.1 The Forests

Mature mixed pine-hardwood, bottomland hardwood, and bald-cypress forests are what characterize a high proportion of the Pocomoke State Forest, and this is illustrated in **Table 9**. In general, the mixed pine-hardwood, hardwood, and bald cypress stands are older, mature forests, while loblolly pine stands are more evenly distributed across all age classes. **Table 9** also provides a habitat diversity matrix that provides a current baseline from which future changes in age structure or forest type diversity can be assessed for potential habitat or biodiversity effects.

*Information contained in **Tables 9**, **11**, **12**, **13**, **14**, **15** & **16** and **Figures 5** & **9** is based on data from a 2021 GIS analysis of PSF using forest inventory data collected from 2014-2016, periodic site visits, historical data, and aerial imagery.*

Table 9: Forest Diversity Analysis (2021):

Acres of forest type and forest structure by structural groups, with percent of total area in each forest type/structure group combination.

Forest type	Structure Stage							Total Area
	Open	**Sapling**	**Growing**	**Maturing**	**Mature**	**Big Trees**	**Uneven Aged**	
	0 - 5 yrs	6 - 15 yrs	16 - 25 yrs	26 - 50 yrs	51 - 90 yrs	91+ yrs		
Loblolly Pine	35	146	670	3,032	1,177	265	33	**5,357**
(Percent)	0.19%	0.79%	3.62%	16.40%	6.36%	1.43%	0.18%	28.97%
Shortleaf Pine	0	12	0	12	227	109	17	**378**
(Percent)	0.00%	0.07%	0.00%	0.07%	1.23%	0.59%	0.09%	2.04%
Mixed Pine (Pond, Pitch, Virginia, etc.)	0	20	0	0	15	87	75	**198**
(Percent)	0.00%	0.11%	0.00%	0.00%	0.08%	0.47%	0.41%	1.07%
Atlantic White Cedar	0	5	0	0	0	0	0	**5**
(Percent)	0.00%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%
Mixed Pine/Hardwood	11	249	602	1,000	913	2,481	0	**5,257**
(Percent)	0.06%	1.35%	3.25%	5.41%	4.94%	13.42%	0.00%	28.43%
Bottomland/Mixed Hardwoods	0	0	0	83	265	2,264	0	**2,611**
(Percent)	0.00%	0.00%	0.00%	0.45%	1.43%	12.24%	0.00%	14.12%
Bottomland Hardwoods/Bald Cypress	0	0	0	0	18	3,842	0	**3,860**
(Percent)	0.00%	0.00%	0.00%	0.00%	0.09%	20.78%	0.00%	20.87%
Cut/Marsh/Field/Powerline/Road	826	0	0	0	0	0	0	**826**
(Percent)	4.47%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.47%
Total	**873**	**433**	**1,272**	**4,127**	**2,615**	**9,049**	**124**	**18,492**
(Percent)	***4.72%***	***2.34%***	***6.88%***	***22.32%***	***14.14%***	***48.94%***	***0.67%***	***100.00 %***

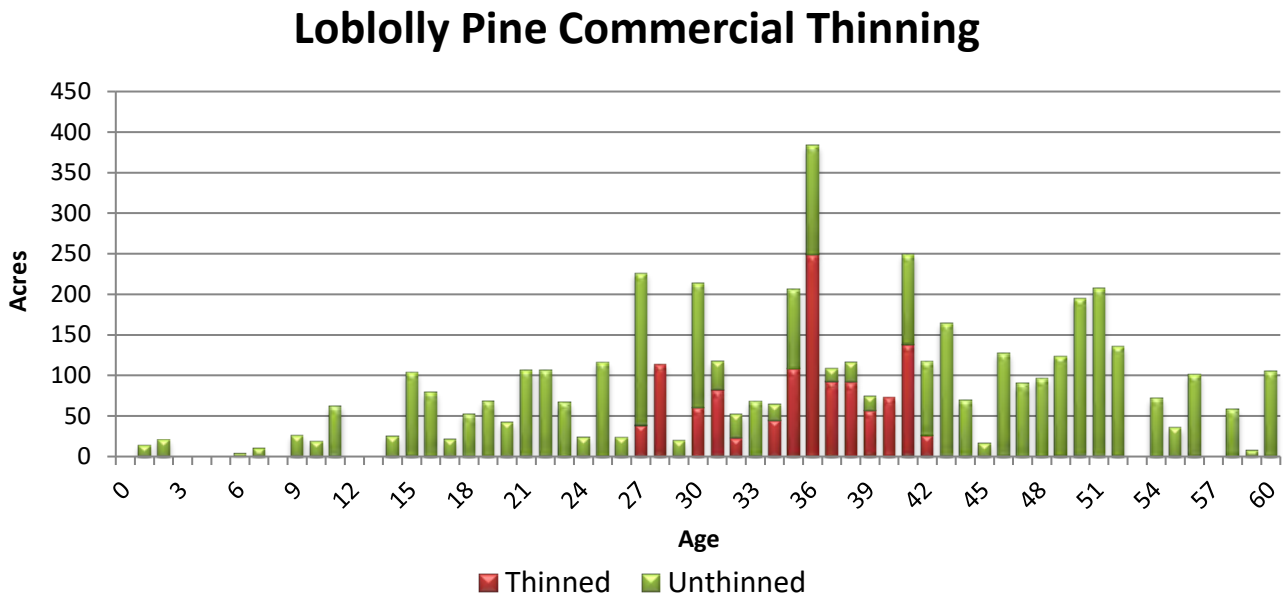

Figure 5: Age distribution of loblolly pine stands on Pocomoke State Forest (2021)

Figure 5 shows a modest acreage of loblolly pine in the age classes that might be available for a final harvest in the next 15 years. First thinning of pine plantations is usually scheduled around age 15 to 25, there are many acres eligible for thinning now. For stands selected for longer rotations, second thinning will generally occur in the 35 to 50 year age range, and these operations will increase significantly over the next decade.

3.2 Old Growth Forest

Old growth forests have generally been defined as forests in existence since pre-settlement times and lacking any significant Euro-American disturbance. The definition can differ according to climatic and eco-regional perspectives and the growth characteristics of specific native forest systems. In Maryland, an old growth forest is defined as a minimum of 5 acres in size with a preponderance of old trees, of which the oldest trees exceed at least half of the projected maximum attainable age for that species, and that exhibits most of the following characteristics:

1. Shade tolerant species are present in all age/size classes.
2. There are randomly distributed canopy gaps.
3. There is a high degree of structural diversity characterized by multiple growth layers (canopy, understory trees, shrub, herbaceous, ground layers) that reflect a broad spectrum of ages.
4. There is an accumulation of dead wood of varying sizes and stages of decomposition, standing and down, accompanied by decadence in live dominant trees.
5. Pit and mound topography can be observed, if the soil conditions permit it.

It is also important to recognize that old-growth forests are not static and may not be a permanent fixture on the landscape. The forests and trees within and around them change continuously. This would be true even if human influence could be eliminated. All forests, including old-growth, succumb to natural, destructive disturbances and regenerate over time. A functional old-growth ecosystem includes the loss of old trees due to natural disturbances and the death of old trees. An old-growth system is not static, nor is it always dominated by old trees. Natural processes dictate the age composition at any time. The important factor in this process is that the trees have the opportunity to reach old age if natural disturbances do not intercede.

Pocomoke State Forest currently has an isolated remnant area of Old Growth Forest approximately 5 acres in size; however, many other portions of Pocomoke State Forest will be managed as Old Growth Ecosystem Management Areas (OGEMAs). If any other old growth areas are found, they will be mapped and surrounded by a 300-foot buffer.

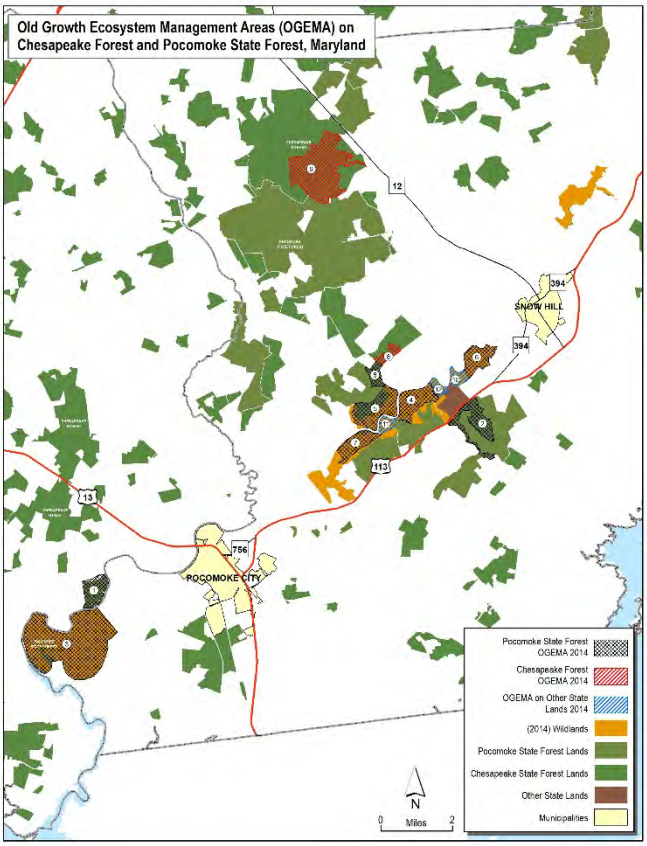

Figure 6: Old Growth Ecosystem Management Areas on Chesapeake Forest and Pocomoke State Forest

OGEMAs on Chesapeake Forest and Pocomoke State Forest are shown in **Figure 6** and **Table 10**. A goal of Pocomoke State Forest is to provide areas for future old growth forest by managing the riparian forest buffers as described in **Chapter 6**. The fragmented nature of stream buffer areas may create areas of Pocomoke State Forest that are not congruent with old growth forest management guidelines. Therefore, as a whole, riparian forest buffers are not all explicitly managed as old-growth forests. In areas where stream buffers overlap with designated old growth management zones or old-growth forests, there will be adherence to old growth management guidelines. This process is fully described in **Appendix H** "*Management Guidelines for the Conservation and Protection of Old-Growth Forest*". Also, see **Section 5.4** for management guidelines for the identified "nearly old growth forest" areas.

Table 10: Old Growth Ecosystem Management Areas

Old Growth Ecosystem Management Areas		
Tract Name	Map ID	Acres
Beauchamp (PSF)	1	305.1
Chandler L. U. (PSF)	2	417.4
Hickory Point (PSF)	3	2163.8
Hudson (PSF)	4	410.4
Milburn Landing (PSF)	5	703.2
Poc. River Corridor (PSF)	6	317.8
Tarr (PSF)	7	305.9
Pocomoke State Forest Total		4623.6
Cox Farm (CF)	8	107.3
Foster Estate (CF)	9	1291.1
Chesapeake Forest Total		1398.4
Shad Landing (PRSP)	10	123.5
Pocomoke River WMA	11	100.9
Shad Landing (PRSP)	12	85.3
Other State Lands Total		309.7
TOTAL		6331.7

3.3 Forest Production

A significant portion of Pocomoke State Forest had been managed for industrial forest production for decades and was a major contributor to the region's forest products economy. Five Pine Sawmills and two pulpwood-chipping operations provided an outlet for timber from local forests, which are largely isolated from outside markets by water and distance. Under the new sustainable management plan, the harvesting of forest products to support local economies will continue to be an important goal of this forest. However, when harvests are proposed all environmental factors are considered in the development of annual work plans. These plans are reviewed by an interdisciplinary team of resource professionals from the Department and the local Citizens Advisory Committee for the Forest that is followed by a Public Comment period. Pocomoke State Forest makes up about 5.1% of the productive forests in the three-county area (**Table 11**). However, PSF is managed in a similar manner as Chesapeake Forest and these two state properties comprise almost 19% of forest in the three counties. In the past these forests produced about 15-20% of the annual timber harvest in the region.

Table 11: Pocomoke State Forest as a percentage of forest type by County (2021)

County	*Total Area acres	*Total Forest acres	PSF acres	PSF as % of Total Area	PSF as % of Total Forest
Somerset	209,400	87,800	388	0.2%	0.4%
Wicomico	241,400	115,400	150	0.1%	0.1%
Worcester	302,900	156,700	17,954	5.9%	11.5%
Totals	753,700	359,900	18,492	2.5%	5.1%

**Source: USDA Forest Service-Forest Statistics for Maryland: 1986 and 1999*

3.4 Water Quality

Water quality in the Chesapeake Bay is a major environmental concern, fueled by the fact that nutrient contributions from airborne pollution as well as local development and agriculture have been cited as a basic cause of water quality decline in recent decades (**Figure 7**). The Pocomoke State Forest management plan focuses on several aspects of this issue, including the expansion of water quality and wildlife buffers to remove as much nutrients as possible. This can be accomplished through the maintenance of healthy, growing forests that will maximize nutrient uptake and by controlling other management impacts on soils where the risk of direct nutrient transport into shallow groundwater or surface waters is high.

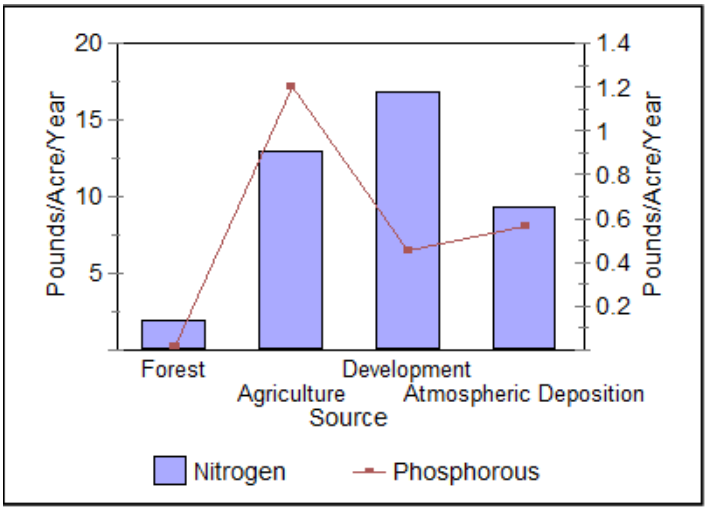

Figure 7: Contribution of nitrogen & phosphorous to tidal waters from land uses in the Chesapeake Bay. (Source: EPA)

3.5 Watersheds

Pocomoke State Forest contributes to four watersheds draining into the Chesapeake Bay and comprise up to 19% of the forestland within drainages identified as high priority for conservation action by the Maryland Clean Water Action Plan (**Table 11**).

Table 12: Lower Eastern Shore Watersheds, Priority Rank% Forest Cover & % Forest Cover on PSF (2021)

Watershed	Rank*	Forest Area	Total Area	% of WS in forest	PSF Acres	PSF as a % of forest
Lower Pocomoke River	1	57,456	101,315	57%	9,075	16%
Upper Pocomoke River	1	50,770	95,550	53%	1,121	2%
Nassawango Creek	3	31,376	43,877	72%	2,261	7%
Dividing Creek	3	31,112	39,700	78%	6,035	19%

* Maryland's Clean Water Action Plan ranks watersheds on several criteria. This rank reflects priority for prevention of nutrient pollution, which is a major benefit from sound forest management. (1= highest) Note: Acres and Percentages are rounded to the nearest whole number.

3.6 **Soils**

The region features flat topography, near-sea level elevations, and poorly drained soils. Soils are naturally low in fertility, but soil erosion and sediment runoff is seldom a problem, given reasonable management care. Seasonally wet conditions affect the timing and type of management activities. In the process of plan development, the soils in the region were classified into five Soil Management Groups (SMGs), based on soil characteristics directly affecting forest management. (See **Appendix D** for a listing of soil types by soil management group and a listing by county of symbols used by soil survey reports.) ***The Five (5) Groups (SMGs) were defined as follows:***

1. SMG 1 - wet soils with firm sub-soils that can physically support machines when wet.
2. SMG 2 - wet soils with non-firm sub-soils that cannot support machines when wet.
3. SMG 3 - soils that are less wet than either 1 or 2; highly productive forest sites.
4. SMG 4 - very sandy, often dry soils that are generally not highly productive forest sites.
5. SMG 5 - very wet, low-lying soils that are too wet for forestry operations.

To facilitate plan development and future management, digital soils data were prepared for all the areas where the Pocomoke State Forest occurs. Digital soils data were available from USDA Natural Resources Conservation Service in Wicomico, Worcester, and Somerset Counties.

When the current land cover was compared to the soil survey data, it was clear that the majority of Pocomoke State Forest occurs on SMGs 2 and 5 (**Table 12**). It was also clear that the most favorable land for field activities during wet weather (SMG 3 and 4) make up a fairly small proportion of the pine plantations, so scheduling field activities must remain flexible enough to accommodate unusually long periods of wet weather.

Table 13: Current Forest Cover by Soil Management Group (2021)

Soil Management Group	CURRENT COVER - ACRES						
	Loblolly Pine	Mixed Pine/Hdwd	Hardwood/ Cypress	Shortleaf Pine	Mixed Pine	Other	Total
0 - Not Rated	3	0	20	0	0	26	49
1 - Wet, firm sub-soils	1,013	777	187	16	25	53	2,070
2 - Wet, non-firm sub-soils	2,261	2,393	979	74	127	111	5,945
3 - Most favorable	760	950	106	1	1	30	1,848
4 - Sandy, dry	1,199	763	220	287	44	140	2,654
5 - Very wet, floodplains	122	374	4,958	1	0	471	5,925
Total	5,357	5,257	6,471	378	198	831	18,492

Another cross-comparison was done to see how well the current identification of Water Quality Areas and buffers matched up to the soil surveys. It indicates that there is considerable work to be done in the field to identify and classify additional riparian forest buffers and wetlands correctly (**Table 13**). It may also require that the SMG classifications be revisited to assure that the proper soils are included in each. The distinctions between many of these soils are fairly slight, and there is often little or no slope or topographic position to help assure accurate identification and classification, so experienced field personnel and accurate assessments are vital to the process.

Table 14: Soil management groups for Uplands, Estuarine, Palustrine, and Riverine Wetlands (2021)

Soil Management Group	Current Identification			
	Upland	Estuarine	Palustrine	Riverine
0 - Not Rated	2	11	29	7
1 - Wet, firm sub-soils	271	0	1,799	0
2 - Wet, non-firm sub-soils	1,390	0	4,555	0
3 - Most favorable	1,636	0	212	0
4 - Sandy, dry	2,237	0	417	0
5 - Very wet, floodplains, etc	210	479	5,213	24
Total (includes roads, etc.)	5,747	489	12,225	31

3.7 Complexes

To facilitate management planning of the Pocomoke State Forest, the forest was grouped into Complexes. A Complex is defined as contiguous properties made up of individual tracts that make sense to be managed as one unit. This involves some arbitrary decisions, since there are often minor gaps of private ownerships within individual units. The resulting management units provide a very useful tool for developing individual operating plans that then comprise the annual work plan on the forest. **Table 14** reflects the identification of the 15 Complexes.

Table 15: Pocomoke State Forest – Complexes (2021)

Complex	Total Acres	Loblolly Pine Acres
P01 – Old Furnace I&II/Castillo/Sturges Creek	1,212	348
P02 – Nazareth Church/Furnace/Ginn/ Mirey Gulley/Sand Rd./Warren	5,747	2,354
P03 – Blake/Whitesburg	218	106
P04 – Dividing Creek	1,119	508
P05 – Milburn Landing/Mohr	1,587	639
P06 – Hudson/Tarr/Blades/Bradley	2,102	472
P07 – Chandler L.U.	1,443	694
P08 – Colburne	544	26
P10 – Hickory Point	2,145	87
P11-15 – Pocomoke River Corridor/Quillen/Banks	2,093	123
P16 – Beauchamp	282	0
Totals	**18,492**	**5,357**

The majority of the land base is in large, contiguous blocks (**Table 15**).

Table 16: Complex Statistics by Size (2021)

Size Class	Count	Ac Sum	Ac Avg.	Min	Max
0-99	9	414	46	18	90
100-499	16	4,066	254	100	370
500-1999	10	9,719	972	544	1,487
2000+	1	4,293	4,293	4,293	4,293

Nine (9) of the management units on Pocomoke State Forest are less than 400 acres in size. Most of these areas adjoin or are adjacent to the Pocomoke River Corridor or the Chesapeake Forest.

Adjoining land uses such as agriculture or development may constrain forest management activities such as prescribed fire. These forests provide needed habitat and esthetic diversity as well as the opportunity for water quality improvement projects to buffer the impact of surrounding lands. The Department must weigh the effects of various management activities as they may affect adjoining properties and seek to maintain good community relations with neighbors.

Private forest landowners are under increasing economic pressure to convert their land to development as populations grow and industries expand. Maintaining local economic uses and technical resources that help individuals keep their land in forests is crucial to maintaining or expanding the amount of forestland on the Eastern Shore. Thus, the concern for the economic effects of this plan, and the value of these forests for transferring technical knowledge to other owners are both central to the management of Pocomoke State Forest. By maintaining these working landscapes and contributing to the timber industry, local markets and infrastructure (logging crews, mills, etc.) will be available to private landowners thus reducing the need to convert land to other uses.

CHAPTER 4

Land Management Area Guidelines

4.1 Land Management Areas

Due to the diverse landscape of the Pocomoke State Forest, this plan will not make specific prescriptions for each tract. Rather, the planning team identified specific areas based on physical attributes that are needed to dominate future management decisions.

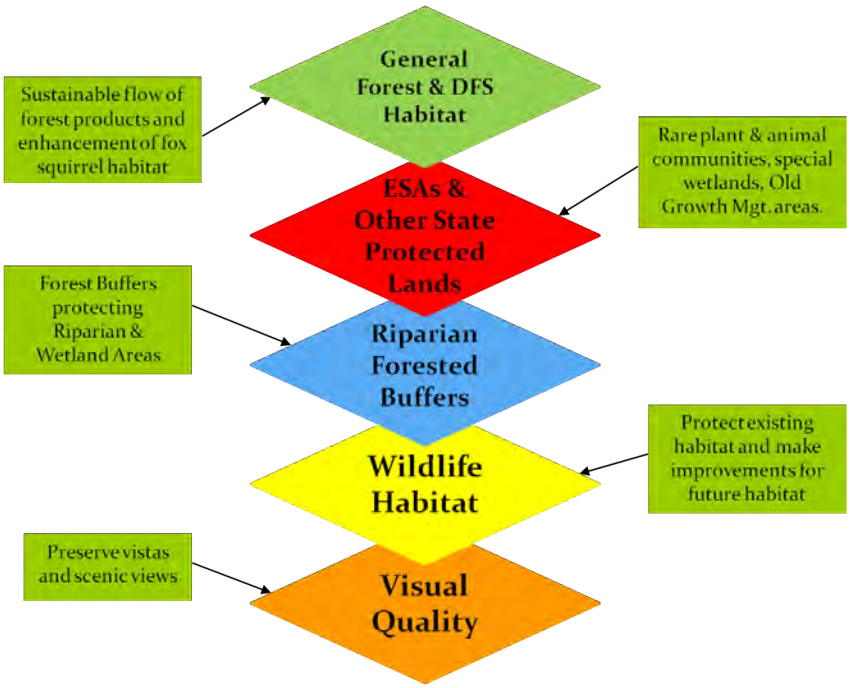

Figure 8: How special areas are added to the landscape to build a complex mosaic of managed lands.

Figure 8 illustrates the sequence of identifying these areas for planning purposes. Beginning on top, the general forest management area is first constrained by identifying the ecologically significant areas where a particular site requires special management attention. This is followed by riparian forest buffers or wetland buffers. Next wildlife habitat areas may need to be established, where a special combination of management recommendations are required by a species or suite of species. Finally, attention must be paid to the visual impact of a practice, considering its location or neighbor concerns. Recommendations for each area have been developed and are listed in this plan and they serve to provide guidelines to field managers, who will need to address each situation based on good inventory, analysis, and planning methods. Additionally there are special sites within each of these areas that fall into the High Conservation Forest (HCVF) designation, these are areas to be managed and protected because of identified unique conservation values, see **Section 5.1** for additional information.

4.2 General Forest & Future Core Delmarva Fox Squirrel (DFS) Area

This area is comprised of loblolly pine plantations and mixed pine-hardwood stands in various age classes. An important factor in the management of the General Forest area is to maintain an economically sustainable forest that will help contribute to the local economy through providing forest-related employment and products.

Under the Management Guidelines in **Section 5.3.1** most of this area is designated as a DFS Future Core area, however several other designated management areas are afforded certain protections due to their sensitive attributes. These areas are not part of the General Forest designation but will still contribute to the goal of maintaining an economically sustainable forest. These management areas comprise over 60% of the State Forest and are further described in **Chapters 6**, **7**, and **8** of this document.

Figure 9 below shows that two of the forest stand age ranges (16-25 and 26-40 years), are the prime ages for first and second thinning of pine stands. There is approximately 2,543 acres in these age groups, which will require an active thinning program each year to keep these stands actively growing.

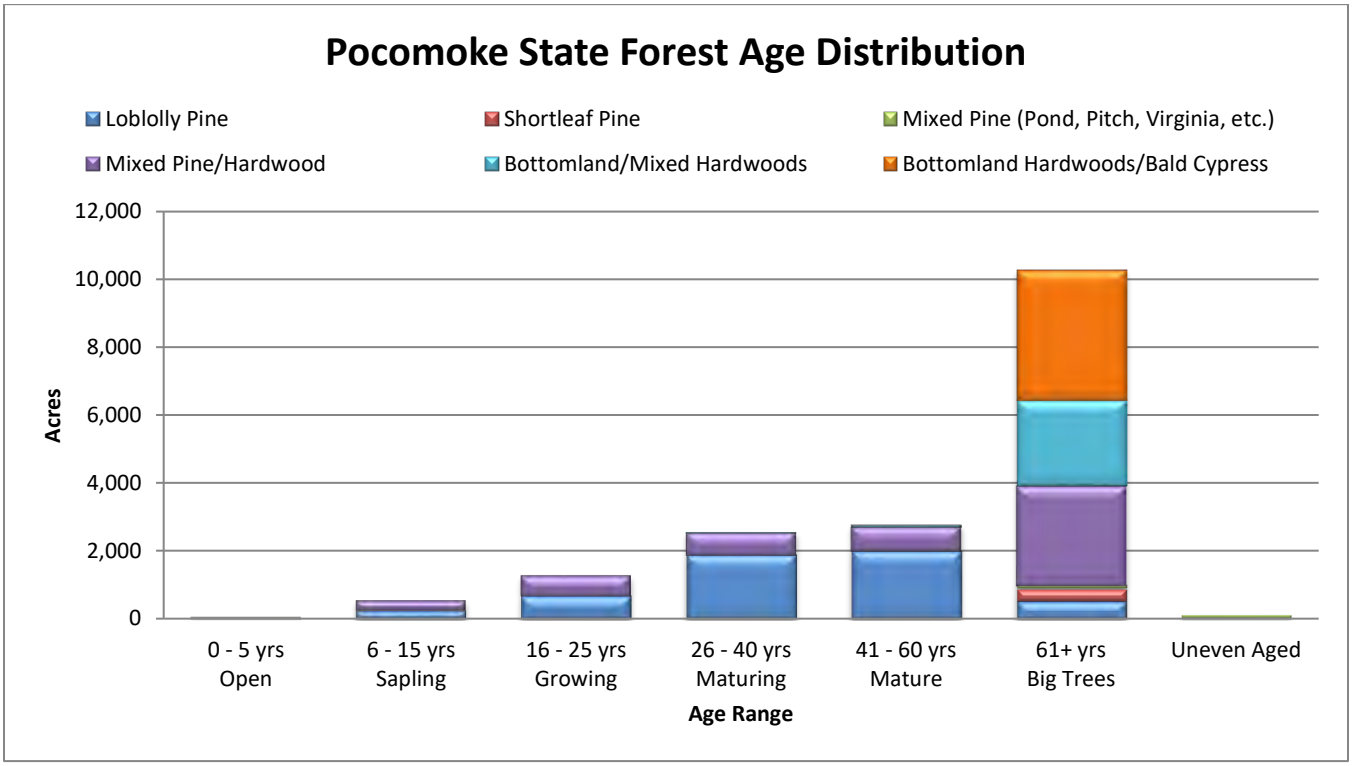

Figure 9: Pocomoke State Forest - Forest Type Age Distribution

4.3 Ecologically Significant Areas (ESA) & Other State Protected Lands

Sites containing rare plant and or animal communities will be identified and managed for their special qualities. The DNR Wildlife & Heritage Service will be involved in assuring that special sites are properly inventoried, marked, and managed, and that adequate records are created and maintained for each site. Specific prescriptive management recommendations have been developed for each site by the Wildlife and Heritage Service. A breakdown on the locations and description of the special sites that have been identified on the Pocomoke State Forest can be found in **Chapter 7**.

Other State Protected Lands: Most of these areas fall under an ESA layer, and those sites that do not are listed as an additional layer along with ESAs. These land designations are State designated Heritage Areas, State Wildland Areas, Wetlands of Special State Concern (WSSC), Shortleaf Pine community types found on certain soil types, and Designated Old Growth Management areas. Many of these sites fall under some type of state protection through legislation.

4.4 Forested Riparian Buffers

Three hundred foot (300 ft.) riparian forest buffers or wetland buffers will be marked, established, and maintained according to the guidelines listed in **Chapter 6**. All management activities within these areas will be designed to protect or improve their ecological functions in protecting or enhancing water quality. The long-term goal is to achieve and maintain a mature mixed forest stand. Where the current forest is a pine plantation, the shaping of the riparian forest buffers will generally commence at the time of the first silvicultural activity on the adjoining stands. Management will generally focus on thinning pines to encourage hardwood growth, marking boundaries so that field personnel and contractors can conduct operations properly, and closely monitoring activities to prevent soil disruption or damage and protect stream bank and wetland integrity. In the areas where young pine plantations currently exist, the desired forest conditions may take several decades (and appropriate treatments) to emerge.

4.5 Wildlife Habitat Areas

The rich diversity of wildlife species located within Pocomoke State Forest, from endangered to recreational game species, requires the use of a wide array of adaptive management techniques. The objective is to utilize adaptive management to address the ecological needs of this diversity of wildlife species and habitat types. Wildlife habitat is also enhanced in large measure by the riparian forest buffers and establishing other corridors where needed. Riparian forest buffers expand on water quality protection and take advantage of the important habitat and life zones associated with riparian areas. The Guidelines (See **Chapter 6**) call for creation of a 300-foot riparian forest buffer along all blue line streams. Buffers will be added to other riparian or wetland areas that once examined through a field review are determined to be in need of protection. The long-term goal for these habitat areas is the maintenance of a mature mixed pine/hardwood forest that is managed to maintain a desired species mix and canopy at all times. This will also create prime habitat for Forest Interior Dwelling Birds (FIDS) and Delmarva Fox Squirrels (DFS). Currently there is a Core FIDS habitat area and a large DFS Future Core Area designated on Pocomoke State Forest. **Chapters 6** and **8** outline the goals and guidelines for these areas.

4.6 Visual Quality Areas

These areas are managed to serve as visual buffers along public roads and adjacent properties to protect existing scenic views or vistas. Buffers protecting views of the land from the water should also be addressed in the establishment of riparian forest buffers.

4.7 Non-Forested Lands

These lands, although not fully identified as a particular “area” in the management plan, are estimated to cover about 3.9% of Pocomoke State Forest. They consist primarily of roads, transmission lines, wildlife food plots, drainage ditches, and marsh areas. Some of these areas may need to be maintained in non-forest vegetation either to allow management activities on the forest, or to meet legal easement requirements. They can provide important wildlife habitat elements such as grassy areas or food plots that benefit game species management and do not interfere with forest management. Control of invading brush, trees, and invasive species will be an on-going maintenance issue for these areas. Roads that are not needed for fire or emergency access should be considered for closure.

CHAPTER 5

Forest Management

As stated in Chapter 1, the primary goal of the Pocomoke State Forest is *to demonstrate that an environmentally sound, sustainably managed forest can contribute to local and regional economies while at the same time protecting significant or unique natural communities and elements of biological diversity.*

This is to be achieved by objectives that include, but are not limited to, providing for clean water, maintaining soil stabilization, supporting populations of native plants and animals, protecting areas with critical functions or habitats, sustaining compatible economic uses, and providing for scenic, recreational and educational values. Accomplishing these objectives will be done through implementation of an Annual Work Plan. Copies of Annual Work Plans for Pocomoke State Forest can be found on the DNR website at: http://dnr.maryland.gov/forests/Pages/workplans.aspx.

5.1 Priority Management Layer – High Conservation Value Forest (HCVF)

Each portion of Pocomoke State Forest is placed in a particular zone depending upon the highest and best use for that site given its location and characteristics. Each zone features specific resource objectives that are accomplished through implementation of a set of management guidelines for that area. These zones were delineated by an analysis performed by MD DNR Forest Service personnel in 2008 and early 2009. This analysis resulted in the identification of five priority management - High Conservation Value Forest (HCVF) areas, listed here in order of priority: Wetlands of Special State Concern (WSSC), Ecologically Significant Areas (ESA Zones 1 & 2), Riparian Forested Buffers - which are 300-foot stream buffers, Core Forest Interior Dwelling Bird Habitat (FIDS), and Delmarva Fox Squirrel (DFS) translocation sites - these are areas of potentially prime DFS habitat that is being set-aside for future translocation of DFS.

Note: the term CORE means an area of ideal habitat that contains the species to be protected.

The concept of HCVF is to ensure that existing fragile and unique ecosystems are managed to maintain their identified conservation attributes. The identification of unique values of each priority management/HCVF area along with the prescriptive management protocols was a collaborative effort between DNR Forest Service and Wildlife and Heritage Service personnel. Within ESA areas, only ESA Zone 1 and 2 will be included in HCVF designation (see **Chapters 6** & **7** for additional details). *In most cases, areas designated as HCVF do not prohibit timber harvest activities, but instead utilize forestry management operations to enhance the designated high conservation value.* However, the identified High Conservation Value for each of the priority management layers indicated in **Table 16** must be protected or enhanced by the activity.

The remaining acreage on PSF not designated as HCVF falls into the Delmarva Fox Squirrel (DFS) Future Core layer, which covers almost the entire Pocomoke State Forest.

DFS Future Core means the area contains suitable habitat but as of yet no DFS are present. The DFS layer was originally developed as part of the planning effort to improve habitat for DFS on Chesapeake Forest Land tracts. The DFS layer for the Eastern Shore contains twelve DFS Core areas and four DFS Future Core areas. One small part of a larger Core DFS area along with two Future Core areas fall on Pocomoke State Forest.

Pocomoke State Forest – Mapping

PSF Tract Maps are provided in **Appendix L**. Forest type map lines are approximate and subject to minor revisions by the DNR Inter-disciplinary Team (ID Team) as dictated by on-site conditions verified by field review.

Similarly, changes and additions to priority management layer acreages will be subject to ID Team and Advisory Committee review. The boundaries for each layer are maintained in a GIS database and are just one tool and source of information to guide the Forest Manager as to what is best for the resources at a particular site.

The acreage in **Table 16** below is listed based on the priority of that management layer. For example, the ESA Zones 1 & 2 have the highest priority for habitat management. A specific ESA area may also contain some Core FIDS habitat and Future Core DFS habitat, but the priority for management is for that particular ESA species. For a complete breakout of acreage in each Priority Management Area, refer to **Appendix J**.

Table 17: PSF Management Layers (2021)

Management Layers		
Designation	**Total Pocomoke Forest Area**	
	Acres	**% of Area**
ESA Zone 1 & 2	7,539.8	40.8%
Forested Riparian Buffers	1,065.5	5.8%
Core FIDS & DFS Core	264.1	1.4%
DFS Future Translocation	362.9	2.0%
ESA Zone 3	404.1	2.2%
DFS Future Core	8,852.2	47.9%
General Mgt. Area	3.5	0.0%
TOTAL	**18,492.0**	**100.0%**

5.2 Forest Types and Silvicultural Practices – Pocomoke State Forest

Acreages listed for each forest type are only an approximation based on current forest inventory data and survey information. Acreages for each forest type will continually change over time as additional riparian buffers are identified and established and new forest inventory data are provided.

5.2.1 *Non-Forested Lands*

Included in the non-forested types are 500 acres of open marsh & swamps, and 46 acres of power lines. The Pocomoke State Forest road system comprises over 96 miles of main access roads and side feeder roads, which amounts to approximately 47 acres of open land.

5.2.2 *Forested Swamps: Bottomland Hardwoods & Cypress*

Since this forest type tends to retain surface water all year, the management prescription will be to protect their wetland functions. Where possible through restoration activities some of these sites will be restored through the planting of native wetland forest species. The forest type can be further broken down into Cypress/Bottomland Hardwoods (3,819 acres) and the Bottomland Hardwood type (2,479 acres). The majority of these forested swamps are designated as High Conservation Value Forest (HCVF).

5.2.3 *Mixed Pine-Hardwood and Hardwood-Pine*

These forest types, which total just over 5,257 acres, will be managed toward mature stands of mixed hardwood and pine species. This will be done with commercial thinning, selection harvesting, shelterwood harvesting and small-opening harvests designed to encourage regeneration of desired species such as oak, loblolly pine, shortleaf pine, and pond pine. A minimum post-harvest basal area of 70 square feet will be the target. Herbicides will be limited to ground applications to achieve specific goals in improving species balance or removing invasive species. There are many HCVF areas within this forest type that contain sensitive species, management in these areas will be to protect and or enhance that protected species. Some prescribed burning applications may be used in these forest types to manage for a particular species such as Pond Pine. Natural regeneration will be used within harvest sites, possibly supplemented with some planting of native hardwood, shortleaf and pond pine species. Acreage in this type will increase over time as HCVF, the expanded 300-foot water quality buffers, are established along riparian areas in pine plantations.

5.2.4 *Loblolly Pine and Mixed Pine Stands*

This forest type which totals just over 5,554 acres is made up of loblolly pine plantations (approximately 3,608 acres) and naturally occurring stands of mixed pine forest (loblolly, shortleaf & pond pine) 1,947 acres and are consolidated here for ease of discussion. Other tree species mixed in this forest type are a variety of gums, maples, oaks, and Virginia pine.

The loblolly pine plantations will be intensively managed to maintain an annual flow of forest products, unless they are located in a management zone where this is incompatible. This will be determined in the annual work plan process. Silvicultural activities will involve Commercial thinning operations followed by a clearcut or shelterwood regeneration harvest. A year after harvesting reforestation needs will be determined and either done through hand planting or allowing natural pine regeneration to occur.

The mixed but dominant loblolly types will be managed to maintain the naturally occurring species mix. Stands with an abundance of short leaf or pond pine will be managed to encourage these species, because in these situations the loblolly pine is artificial. Silvicultural activities will involve commercial thinning operations followed by regeneration harvesting by the seed tree, shelterwood, or clearcut method.

5.2.5 *Pond Pine*

This community type is currently not classified. The stands being encountered consist of dominant and mature pond pine, with mixed and occasional loblolly pine, and an understory of high bush blueberry. This community is restricted to the lower Delmarva Peninsula (possibly solely Worcester County). The acreage in this forest type is combined in the acreage above for the Mixed Pine Stands and will later be more specifically broken out.

These stands should be identified and inventoried to assist in their proper classification. Until the global rank and security of this community has been determined, this forest type will not be harvested. In the future, if/when timber management occurs prescribed burning will be used to manage for pond pine. In most cases, natural regeneration will be the preferred method to reestablish the stand, some hand planting of pond may occur.

5.2.6 *Shortleaf Pine*

This unique forest type of approximately 378 acres occurs on a dry sandy soil series and is designated as a rare plant community type. A contiguous 250-acre stand makes up the majority of this forest type, but in recent years, cutover areas that have suitable site conditions have been planted with shortleaf pine

cultivated from local seed collections. This natural community occurs on dry, sandy dunes and ridges of the coastal plain. These landforms developed during the late Pleistocene when colder climate processes associated with Wisconsin glaciation influenced much of the region. At the time, prevailing northwest winds transported surficial sands across the Delmarva, deposited them on the east sides of the Nanticoke, Wicomico, and Pocomoke rivers, and formed "dune fields" on uplands in the central part of the peninsula. Today, these landforms support woodland vegetation of pine and oak, as well as a variety of rare and threatened plant and animal species. Currently, there are two globally rare natural community types associated with inland sand dunes and ridges. This community type has many associated species such as pitch pine *(Pinus rigida),* post oak *(Quercus stellata),* sand hickory *(Carya pallida),* and a variety of ericaceous shrubs. In general, the herbaceous layer is sparse and consists primarily of light-demanding species tolerant of dry, sandy conditions. Examples of these species include yellow false indigo *(Baptisia tinctoria)* and the State threatened sundial lupine *(Lupinus perennis).* Frequent low-intensity fire is important in maintaining these natural communities and the distribution of species that depend upon them. This forest type will be protected and is part of our HCVF forest layer.

5.3 Forest Management Guidelines

The above five forest types have been categorized into four different forest management classifications. These different management classifications take into account all ecologically significant areas on the forest. Acreages listed in the PSF database for the different classifications are only estimates that will change over time as field reviews add or remove areas from one management classification to another. The management areas are as follows: 1) DFS translocation sites and Future Core Areas; 2) Ecologically Significant Areas (ESA) & Other State Protected Lands; 3) Core Forest Interior Dwelling Birds (FIDS) areas; G3 Community soil types and 4) Riparian Forest Buffers.

The following are management guidelines for the various management areas on the 18,492 acres of Pocomoke State Forest (see **Table 16** for acreages) It should be noted that nearly 100% of Pocomoke State Forest falls into one of these designated management areas. It will be important, especially in the mixed forest types where harvesting occurs, that consideration is given to managing for natural regeneration and longer age rotation periods. The wide expanse of protected sensitive areas and designated forested riparian buffers will create a prime habitat for a wide range of wildlife species.

5.3.1 *Delmarva Fox Squirrel (DFS) Management Areas*

Even though there are no known existing populations of DFS on Pocomoke State Forest, the following recommendations have been developed to manage specific areas of the forest to function as future translocation sites and then as a source population of DFS for the surrounding landscape following establishment. These recommendations mirror those that have been developed for Chesapeake Forest Lands, which currently have active populations of DFS. Both of these State Forest share adjoining boundaries in Worcester County and are actively managed under the same certification protocols.

In designated DFS management areas, the forest will be managed on longer rotations while encouraging an additional hardwood component in the over story. The goal is to grow an older forest with larger *mature* trees that is held on the landscape for a longer period. This will be accomplished through a regiment of pre-commercial and commercial thinning operations to increase growth rates of the residual trees. Thinning operations will favor retaining larger diameter trees including hardwood mast trees. A minimum basal area of 70 to 80 sq. ft. per acre will be retained in order to maintain adequate canopy closure. The plan requires that DFS Core management areas at any point in time must retain 50% of the forest in "*suitable DFS habitat"*, which is defined as stands that are 40 years old. The individual stands

designated as suitable DFS habitat will be retained on the landscape for 20 years, setting a requirement for a minimum rotation length of 60 years.

In order to accurately track the management of Core habitat, the individual stands that are designated to meet the 50% suitable habitat requirement will be marked and tracked within the stand table database for Pocomoke State Forest. A final harvest cannot be carried out within these designated areas until they reach a stand age of 60 years and there is a corresponding suitable habitat (at least 40 years old) that will replace each acre harvested. At that point the *"suitable DFS habitat"* used to replace the harvested acres will be marked and tracked in the stand table database. The plan also requires that in Future Core management areas, potential translocation sites will maintain a minimum of 800 acres of suitable DFS habitat within an approximate 1,600-acre area at all times for future translocations. These designated potential translocation sites within each Future Core area must follow the same management requirements as DFS Core areas.

The DFS management recommendations as described in both the Chesapeake Forest and Pocomoke State Forest Sustainable Management Plans, will provide for a matrix of state owned and managed lands that enables colonization by DFS and will provide sufficient habitat for potential translocation sites.

All forest types within the DFS management areas will be managed to produce a rapidly growing, vigorous, and healthy forest while supporting local natural resource-based industries and at the same time protecting water quality through adherence to Best Management Practices.

5.3.2 *Ecologically Significant Areas & Other State Protected Lands:*

Ecologically Significant Areas (ESA):

Portions of a number of the ESA management areas overlap Heritage Areas, State Wildlands, Wetlands of Special State Concern (WSSC), FIDS and the Riparian areas however management prescriptions will focus on enhancing and protecting the designated ESA. Each ESA area has been broken down into as many as three zones with specific management prescriptions for each zone. See **Section 7.4** of the plan for detailed explanations on the type of management activity recommended for each zone and for the specific definition and prescription for each ESA category. ESA zones 1 & 2 areas have been designated as High Conservation Value Forest (HCVF).

Other State Protected Lands including Rare Community Soil types:

Most of the land designations listed below fall under some type of state protection through legislation. Most of these areas are overlapped by the ESA layer, however some sections are not and as such are listed here as a separate layer. See **Chapter 7** for a complete description.

State Wildlands: are designated by the Legislature of Maryland as natural areas that are to be left undisturbed by human activity. Therefore, no management is planned within these areas.

Wetlands of Special State Concern (WSSC): These wetlands contain prime examples of unique habitats. No management activities will take place within these areas.

Old Growth Forest: The few acres of old growth forest known to exist on Pocomoke State Forest will be protected as HCVF and no activities are planned. The area will be monitored for invasive species, which will be suppressed if found.

Natural Heritage Areas: Two Natural Heritage Areas are found within the boundaries of Pocomoke State Forest: Hickory Point Cypress Swamp and the Mattaponi area. No activities will be carried out

here unless it enhances the habitat for the species contained there. Any activities will be planned with WHS personnel.

Inland Sand Dune Forest Communities: Management in these areas that include the rare community soil types will focus on enhancing this unique community that is dominated by shortleaf pine (*Pinus echinata*). Shortleaf pine will be left during limited harvest operations on stands needing enhancement as determined by Forest Service and WHS personnel. Enhancement may include reinforcement plantings of shortleaf seedlings.

5.3.3 *Core Forest Interior Dwelling Bird Habitat:*

In the designated Core FIDS areas, the goal is to improve the stocking of hardwood species so as thinning operations occur; basal areas will not fall below 70 square feet per acre. Long rotation ages greater than 100 years will be the goal and the preferred harvest method will be single tree selection. Mixed stands of pine and hardwoods will be encouraged, and the use of herbicides will be avoided except to control invasive species and for research. All Core FIDS areas have been designated as High Conservation Value Forest (HCVF). See **Section 8.4.1** and **Appendix E** for more detailed explanations.

5.3.4 *Riparian Forest Buffers:*

In the designated expanded stream buffer areas, forests will be managed to encourage a mixed hardwood or mixed hardwood/pine community with a combination of diverse herbaceous, mid-story, and over story plants. Hardwood species will be encouraged to ensure maximum functions for de-nitrification, canopy diversity, woody debris, and nutrient uptake. To accomplish this goal for pine plantations that fall inside the expanded buffer, management prescriptions will include thinning to reduce pine basal area to allow for natural regeneration of hardwood species. The expanded buffers also provide critical habitats and other functions that enhance water quality. Riparian forest buffers have been designated as High Conservation Value Forest (HCVF). See **Chapter 6** for specific guidelines on the functions of the various water quality and habitat zones that comprise the expanded stream buffer.

For a concise breakout of acreages located in each PSF Priority Management Areas, refer to **Table 23** in **Appendix J**.

5.4 Management Guidelines for Old Growth Forest

Currently, old growth forests in Maryland are located in patches that are limited in size, connectivity, and forest vegetation type. To achieve the desired vision of enhancing old growth ecosystem functionality, the current "patch" arrangement of old growth needs to be developed into a larger, connected "network" of old growth forest across the landscape. On Pocomoke State Forest there is only one small six-acre patch of Old Growth Forest along with several identified patches of potential or "nearly old growth forest".

"Nearly old-growth forests" are those forests which are approaching old-growth forest status. They exhibit many of the characteristics of an old-growth forest, but the oldest trees are slightly less than half their maximum age, thus they are almost old growth.

For the purposes of old-growth forest conservation, DNR defines "nearly old-growth forest" as a minimum of 5 acres in size with preponderance of old trees. See **Appendix H** for details on the characteristics of nearly old growth forest.

The conservation of functional old-growth forest ecosystems is the goal. Simply protecting patches of old-growth forest does not result in a functional old-growth ecosystem. A functional system provides a multitude of values and is the desired outcome of DNR for old-growth forests. While patches of old-

growth forest contain essential elements of an old-growth system, DNR will manage old-growth ecosystems in units of approximately 1,000 acres or more whenever practical. Emphasis should be given to those old-growth forests that will most likely become functional old-growth ecosystems. Some old-growth stands will be too isolated to function as an ecosystem and will be protected at the stand level.

The following guidelines are intended to protect old-growth forests while conserving and enhancing the functionality of the forested ecosystem within which the old-growth occurs:

- Designated old-growth forest will be excluded from timber harvest, including salvage, or other physical alterations.
- Designated old-growth forest will be excluded from protection from natural disturbance factors, such as native insect infestations or wildfire, unless such disturbance is introduced by an unnatural cause (e.g., exotic forest pests or invasive species) or will seriously jeopardize the continued existence of the old-growth ecosystem or significant resources adjacent to the old-growth forest.
- Control of the white-tailed deer population will be encouraged to maintain herd size at a level that does not adversely affect regeneration of trees in the understory.
- A no-cut buffer will be established to a width of at least 300 feet from the edge of the designated old growth. This buffer may be expanded based on specific site conditions or threats. The buffer will be excluded from timber harvest or other physical alterations. Any non-forested conditions within the buffer should be reforested, whenever feasible. Salvage harvesting should not occur within this buffer.
- Management zones will be established that includes the old-growth forest(s) and its primary buffer(s). This management zone will be approximately 1,000 acres in size or greater, whenever feasible. This management zone should incorporate as many designated old-growth and nearly old-growth sites as possible. Its shape should minimize edge to area ratio and be as contiguous as possible. Silvicultural treatments within this zone should be techniques that have as their primary objective the fostering of old-growth conditions and would include practices such as uneven-aged management and limited even-aged management, extended rotations, techniques that more closely mimic the natural disturbances found in old-growth forests, structural complexity enhancement practices, or techniques that result in retention of at least 70% of the canopy trees. Standing snags and downed coarse woody debris will be retained. Any non-forested conditions within the secondary zone should be reforested, whenever feasible. Salvage harvesting is allowable with the retention of at least 33% of dead or dying snags (not damaged live trees) and coarse woody debris. At all times, the majority of the management zone shall be in the sawtimber size class, preferably a minimum of 75%. Areas within the management zone not designated old-growth or nearly old growth at the time of initial assessment/inventory will not necessarily be managed as if they are designated old-growth.
- Nearly old-growth forests within the management zone should be managed as if they were designated old growth. Timber harvest or other alterations will be excluded. Protection of natural disturbance factors, such as insect infestations or wildfire, will be excluded unless such disturbance is introduced by an unnatural cause or seriously jeopardize the continued existence of the old-growth ecosystem or significant resources adjacent to the old-growth forest. Salvage harvesting should not occur within this forest.
- Passive recreational and educational use of old-growth forests and their buffers will be allowed, including hiking and hunting. No trails or roads will be built to access the old growth. Existing

trails or roads will be managed to minimize impacts to the old-growth ecosystem or should be retired, whenever feasible. No campfires shall be allowed.

- An aggressive invasive species monitoring, prevention, and control program should be developed and implemented.

On Pocomoke State Forest, four (4) "candidate" Old Growth Ecosystem Management Areas have been identified. These four candidate old growth management areas cover a total of 6,332 acres. Of that amount 4,624 acres are on Pocomoke State Forest, the rest of the acreage falls on Shad Landing State Park, the Pocomoke River Wildlife Management Area, and Chesapeake Forest Lands. Further field studies by the Forest Service and Wildlife & Heritage Service will be carried out to determine if areas of "nearly old growth forest" within these zones exist. Once the nearly old growth areas have been identified, they will be inventoried, mapped, and buffered per the requirements of the "*Management Guidelines for the Conservation and Protection of Old-Growth Forests*." (See **Appendix H**) Once identified and mapped, nearly old growth forest will become part of the High Conservation Value Forest (HCVF) layer per FSC Principle 9 under High Conservation Value (HCV) #3. These are forest areas that are in or contain rare, threatened, or endangered ecosystems. This includes: old growth, roadless areas greater than 500 acres or that have unique attributes, and primary forests.

5.5 Cultural Heritage and Indigenous Peoples

A number of special areas on Pocomoke State Forest have been identified, that require special consideration when developing management prescriptions. Old home sites, research areas, and small cemeteries are common throughout the forest. Special Management Areas may also include historical, cultural, or spiritually significant sites for indigenous peoples. Once a site has been identified and located in the field, its location and description are loaded into the forest GIS database. Protection levels can then be assigned and incorporated into the future planning efforts of forest activities. Most Special Management Areas require some form of preservation/protection. Any proposed activity or management within the vicinity of these special areas will be identified and reviewed as part of the Annual Work Plans (AWP) process. Managers are expected to make diligent field inspections for these areas as part of planning whatever work is planned.

Performance measures to judge the adequacy of those plans, and the subsequent management actions, should include:

a. Each identified special area is appropriately marked on the ground and documented in the data set.
b. Each plan is sufficient to protect the special values identified for each area.
c. Field examination and monitoring reveals that the plan is being implemented properly and that the special values are, in fact, protected or enhanced as the plan indicated.

The Department has a commitment to recognize and respect the rights of Indigenous Peoples. It is the mission of The Maryland Commission on Indian Affairs to "promote the awareness and understanding of historical and contemporary American Indian contributions in Maryland." The role of the State Forest management in promoting this state mission is through the following practices:

a. understand and respect traditional forest-related knowledge;
b. identify and protect spiritually, historically, or culturally important sites;
c. address the use of non-timber forest products of value to American Indians on state forests; and
d. respond to American Indians' inquiries and concerns received.

5.6 Forest Management Activities

5.6.1 *Regeneration & Site Preparation*

Either natural regeneration (seeding from remaining seed trees or adjacent stands) or artificial regeneration will be used to re-establish loblolly, shortleaf and or pond pine stands in accordance with Maryland's pine tree reforestation law. In all cases after a harvest practice, natural regeneration will be the preferred method to re-establish the forest. Determination on method used will be based on site surveys of regeneration within one year of the harvest. Both methods of regeneration will seek to reduce soil disturbance associated with site preparation practices. This will require careful harvest planning to achieve natural regeneration wherever possible, as well as testing new techniques and equipment that promise to achieve desired regeneration results with acceptable costs and reduced soil disturbance.

The Land Manager is responsible for developing a regeneration strategy outlining what practices will be used with each timber harvest plan, based on the specific conditions involved. Pre- and post- harvest data, as well as establishment surveys and BMP compliance (Best Management Practices) data will be collected and evaluated to measure the success of each regeneration project.

There will be situations where artificial regeneration using some form of site preparation would improve seedling growth and survival. Methods used will be limited to prescribed fire, herbicides, and or other less intensive mechanical prescriptions followed by a combination of natural regeneration and hand planting of seedlings.

5.6.2 *Vegetation Control*

Outside of ESA, Core FIDS, and other HCVF areas, chemical control of competing hardwood and herbaceous vegetation may be used to enhance survival and diameter growth of pine trees. Vegetation control can be done with chemical application with no adverse environmental impact if label directions and best management practices are followed. However, the Department will work to minimize the use of chemical control by exploring the use of lower application rates and prescribed burns. Research plots will be established to monitor the effectiveness of various herbicide rates.

5.6.3 *Pre-commercial Thinning*

Pre-commercial thinning in 6 to 10 year old naturally regenerated stands is a form of density control that is useful to concentrate growth on larger stems and to maintain an even distribution of trees across the site and is a practice usually accomplished by hand crews. As management activity shifts away from intensive site preparation and more towards natural regeneration, pre-commercial thinning will play a more important role.

5.6.4 *Commercial Thinning*

Commercial thinning is performed several times during the life of the stand, to extract value at an earlier date while concentrating growth on more desirable, larger diameter stems. Typically, a first thinning between the ages of 15 to 18 years will remove every fifth row in a plantation and smaller trees in residual rows. A first thinning will produce pulpwood-sized material. A second thinning, which typically occurs between the ages of 25 to 30 years, will again remove smaller diameter trees but also produce merchantable sawtimber. Based on management prescriptions for a particular site, any subsequent thinning will produce higher quality merchantable sawtimber. Thinning operations should be suspended when wet soil conditions cause rutting in excess of 8" over more than 5% of the corridors.

5.6.5 *Forest Buffer Thinning*

Riparian and wetland forest buffers (in HCVF areas), as well as any other buffers such as visual buffers, are identified and established at the time thinning projects are planned. Field marking of buffers is done to establish boundaries in the field. GPS mapping provides the means to update the stand boundaries in the GIS data system. Thinning activities within buffer areas are designed to enhance buffer quality and function under the guidelines contained in **Chapter 6** of this plan. They may vary from allowing no thinning where desirable vegetative conditions are well established, to a heavier thinning where dense pine stands need to be opened up to allow hardwood development. Where mechanized thinning is done within the buffer areas, special care will be taken to prevent rutting or other soil damage that could lead to reduction of buffer capacity or quality. Individual buffer prescriptions are proposed by the Land Manager and reviewed by the Interdisciplinary Team as part of the Annual Work Plan Review.

5.6.6 *Regeneration Harvest*

Loblolly, shortleaf and pond pine are intolerant of shade, and regeneration is best on sites with exposed mineral soils and full sunlight. Regeneration harvest by either the clear-cut or seed tree methods provide the optimum conditions for subsequent stand establishment. Clear-cut harvesting on upland pine forests that is properly planned and follows best management practices can be expected to have little or no impact on water quality. The goal will be to maintain a maximum regeneration harvest area of 40 acres per *FSC Principle 10: Plantation Management* and will include "Green Tree" retention areas in keeping with Forest Stewardship Council (FSC) standards. Guidelines for clear-cut harvests larger than 40 acres will be based on forest health, economic, and ecological necessity. Cutting boundaries should follow natural boundaries on land to encourage irregular shapes that help diversify wildlife habitats and improve aesthetic appearance. Trees in clear-cut harvest areas will be at least three years old or five feet (1.5 meters) high at the desired level of stocking before adjacent areas are clear-cut, or as appropriate to address operational and economic considerations, alternative methods to reach the SFI performance measure. Per FSC Indicator 10.2.e: In the Southeast Region, harvest units are arranged to support viable populations of native species of flora and fauna. For southern pine ecosystems, (e.g. upland pine forests, pine flatwoods forests, sand pine scrub), harvest areas are located, if possible, adjacent to the next youngest stand to enable early successional or groundcover-adapted species to migrate across the early successional continuum.

Forest harvest by the shelter wood method will be utilized in some areas based on ecological needs of the site with the intention of developing a new forest stand through natural regeneration.

On all regeneration harvests, excessive soil rutting shall be minimized. On sites where soil rutting can cause erosion or sedimentation, ruts should not exceed twelve inches in depth on average, over a distance of 50'. On these sites, harvesting must be suspended when rutting exceeds the above specifications and ruts in excess of 12 inches must be repaired through back blading or other methods. For harvesting on any wetland soils, high floatation equipment should be used in place of conventional harvesting equipment. In order to protect wetland sites from excessive rutting, the use of shovel logging is an acceptable practice. *(**Shovel logging** uses a log loader to swing logs from the harvest area to the forest road. Rather than driving out to the log and dragging it back to the landing, the loader moves slowly across the harvest area usually on top of a log-matted road, grabbing logs/trees within reach, and swinging them around to drop them closer to the road. Logs further from the road can be shoveled to the landing in a few passes back and forth.)*

5.6.7 *Green Tree Retention*

Over many years, forest managers used a locally developed practice—Habitat Retention Areas (HRA)—to define forested areas and or single trees that were set aside inside a harvest area for long-term protection. The phrase "*Habitat Retention Area*" has been substituted in the Pocomoke Forest Sustainable Forest Management Plans with the nationally recognized terminology of *Green Tree Retention*.

Green Tree retention will vary greatly with each harvest site and depend heavily on factors such as riparian areas, soil types, ecologically significant areas, and Legacy Trees. In designing final harvest areas on Pocomoke State Forest, it is DNR Forest Service policy to retain an appropriate amount of green tree retention within the harvest area. The stated retention goal as outlined in the Policy handbook is to incorporate retention into all silvicultural treatments of five (5) acres or greater. For regeneration harvest twenty (20) acres or greater in size, at least 5 percent or more of the harvested area will contain some form of retention. The retention area can be in addition to or contained in riparian forest buffers and buffers around ecologically significant species.

For example, on much of the forest, loblolly pine plantations are bordered and or bisected by streams and drainages, these areas constitute our managed riparian zones, which are one of our designated HCVF areas. When these areas fall under a regeneration harvest, our retention goal is to expand riparian buffers out to 300 feet. This will encompass plantation acreage which will then be managed as a mixed hardwood pine forest and set aside indefinitely as a protected zone.

Portions of forest stands within a regeneration harvest site will be set aside as retention areas if soil types are such that logging the area would cause considerable site damage. The retention areas will be flagged prior to logging and likely retained through the next stand rotation. Other Green Tree retention would occur if a *Legacy Tree* or a group of *Legacy Trees* are identified within the harvest site. *(Legacy trees are old trees that have been spared during past harvest or have survived stand-replacing natural disturbances.)* A legacy tree or group of legacy trees would be retained for their habitat values. These trees would likely be buffered by other trees to afford them protection during the harvest and retained through the next stand rotation.

Green Tree Retention will be planned into larger regeneration harvest areas by laying out irregular harvest boundaries allowing for peninsulas\islands of un-harvested trees. These undisturbed forest sites can function as habitat corridors, or refugia, enabling species that are sensitive to disturbance to an area to persist in until the surrounding landscape is able to regenerate.

5.6.8 *Prescribed Burning*

The local forests were historically shaped by a regime of frequent, low-intensity wildfires, done primarily by Native Americans who used fire as their primary management tool to gain forest products such as game and edible plants (**Appendix F**). Prescribed fire can re-introduce ecological processes such as seed release and nutrient cycling that may not be possible in its absence and can have beneficial effects on wildlife habitat through the re-distribution of nutrients and vegetation. However, with the urbanizing landscape and increasing number of poultry houses, fire will be difficult to re-introduce on Pocomoke State Forest and will require careful planning. Land Managers will need to designate areas where significant re-introductions of prescribed fire can be tested and results measured. Implementing these projects can result in training for fire management staff including the use of specialized equipment. All prescribed burning applications will be implemented using smoke management practices. Prescribed burns will not take place if smoke conditions impact sensitive areas such as roads, airports, hospitals, homes, or schools. A prescribed fire should be kept at least 1000 feet from any occupied

building, unless otherwise prescribed as necessary for reducing fuel loads. Special areas that might be destroyed or damaged, such as cemeteries, will be protected from burning activities. Fire line construction will follow State BMPs.

5.7 Forest Harvesting Equipment

When planning a forest harvest, the forest manager should consider the soils, weather, seasonal restrictions, necessary harvesting equipment, and other factors that may influence successfully harvesting the site.

In-woods equipment used on forest harvest operations may include whole tree chippers, processors, feller-bunchers, grapple skidders, cable skidders, cut-off saws, and forwarders.

Normally, bidding on forest harvest contracts are not restricted or limited by the equipment available to bidders. This is to maintain competitive fairness to all sized operations. However, forest harvest operations are closely monitored by the state forest staff to ensure compliance with the contract and use of Best Management Practices.

If necessary, the state forest manager can restrict the type of machinery required or allowed on the harvest site. The state forest manager has the authority to temporarily close a forest harvest operation if the conditions become too wet to prevent excessive rutting and damaging of forest soils. Seasonal restrictions may apply during late winter and early spring as the frozen soil begins to thaw. Certain sensitive areas may require specialized equipment such as dual-wheeled skidders, high floatation tires or other specialized equipment.

5.8 Chemical Use

No prohibited products on the FSC list of Highly Hazardous Pesticides will be used (see FSC-POL-30-001a EN 1st May 2019 or most recent equivalent) unless a derogation has been successfully awarded. The Pesticide Use Tracking Form will be used to document the identification of an area to be treated, the procedures that will be followed, and who will be doing the application, including their qualifications.

The *FSC Guide: To integrated pest, disease and weed management in FSC certified forests and plantations* (FSC Technical Series, No. 2009-001) to be reviewed by the state forest manager and the Core Decision Key (Figure 1, page 16), the Pesticide Decision Key (Figure 2, page 17) and Decision Recording Sheet (Figure 3, page 18) attached to each pesticide use report with the Decision Recording Sheet having been completed by the state forest staff or contractor.

All pesticides used to control pests and competing vegetation are used only when and where non-chemical management practices are: a) not available; b) prohibitively expensive, taking into account overall environmental and social costs, risks and benefits; c) the only effective means for controlling invasive and exotic species; or d) result in less environmental damage than non-chemical alternatives. If chemicals are used, the forest manager will use the least environmentally damaging formulation and application method practical.

As opportunities are available, the state forest will employ and encourage the creation and maintenance of habitat that discourages pest outbreak; that encourages natural predators; will work with cooperating agencies to evaluation pest populations and control options; the diversification of species composition and structure; use of low impact mechanical methods; use of prescribed fire; and the use of longer rotations.

Chemicals and application methods are selected to minimize risk to non-target species and sites under the guidance of cooperating agencies such as Maryland Department of Agriculture and DNR Natural Heritage Program.

Whenever chemicals are used, the Pesticide Use Tracking Form will be used to prepare a written prescription to describe the site-specific hazards and environmental risks, the precautions that workers will employ to avoid or minimize those hazards and risks, and includes a map of the treatment area.

Chemicals are applied only by appropriately trained and licensed workers according to State requirements.

When chemicals are used, the effects are monitored and the results are used to determine the measure of success and if treatment modifications can be employed, such as reduced application rates. Records are kept according to State requirements.

5.9 Practice Scheduling – Annual Work Plans (AWP)

Field surveys, GIS-based forest and habitat maps and associated databases and forest models such as Remsoft Spatial Woodstock will be the working tools used for the long-range management of the forest and in scheduling harvests and thinning that are listed in the annual work plans (**Chapter 10**). Annual Work Plans (AWP) will list all management & restoration activities slated to occur on the Forest during each fiscal year. Annual Work Plans are posted on the DNR website for each state forest.

5.10 Non-Silvicultural Forest Management Activities

A variety of activities beyond silvicultural treatments are required to maintain the health and productive capacity of the forest. External property boundary lines will be marked and maintained either by painting and/or posting using approved procedures. This is required to protect the property from inadvertent trespass and to maintain evidence of ownership and management. Existing roads will be maintained where necessary to provide access to tracts for fire management, management activities, and appropriate recreation. Additional roads may need to be constructed in support of silvicultural operations, but these will be limited and, often, closed after the operation is finished. In many areas of the Forest, ditches will need to be maintained to ensure the successful implementation of both forestry and wildlife management activities. The wildlife management activities will involve both the protection of existing habitat and the creation of new habitat for a variety of endangered species (See **Chapter 7** & **8**).

5.10.1 *Roads*

Roads are important for management and public access. Existing roads and trails will be used and maintained in a manner that minimizes erosion and piled debris along road edges. They should also be maintained to blend with the natural topography and landscape and avoid blockage of drainage systems. While additional permanent roads are not needed on the Pocomoke State Forest, any road construction (even temporary access trails) will follow State BMP guidelines. For logging roads on any harvest site, logging mats should be used to reduce rutting when wet soil conditions warrant and must be removed at the completion of the harvest. Care will be taken in constructing logging entrances along public roads and in using public roads during harvesting operations. Damage to roadbeds, shoulders, ditches, culverts, and buffer strips should be avoided and promptly repaired. Roads within Riparian Forest Buffers or Wildlife Areas should be closed and re-seeded where practical. Other roads should be reviewed from time to time, and those not needed for forest or game management purposes or access should be considered for closure.

5.10.2 *Forest Health*

One of the key aspects for maintaining forest health is to keep the forest actively growing and not let the forest stagnate. This can be accomplished by implementing a thinning program that releases selected

trees for rapid and vigorous growth. This will improve forest health through reducing plant stress and competition for moisture, light, and nutrients. By maintaining actively growing trees, they are less likely to be impacted by forest insect infestations, such as the pine bark beetle. By reducing stand density through thinning and opening up the forest, wildfire intensity will also be reduced and resulting damage to trees will be lessened.

5.11 Financial Returns

The long-term goals for the loblolly pine forest should provide sustainable economic performance as well as contribute to water quality protection and wildlife habitat enhancement. However, if future policy changes are made to the levels of environmental protection and additional acreage is moved from "General Forest Management" to other management prescriptions, then significant impacts on financial returns could result.

Future financial projections will depend on the specific parcels, their stand condition, and the markets. Yearly harvest acreages are determined through forest modeling, deviations larger than 10 percent from these acreage targets should be explained in the Annual Work Plan. This should be accompanied by new model outputs indicating that the target is consistent with the goal of long-term sustainability.

5.12 Forest Modeling

5.12.1 *Modeling Long-term Sustainability*

Achieving the goal of a sustainable and economically self-sufficient forest creates the need for forward projections that illustrate the probable effect of management activities on key forest qualities. This requires the identification of *indicators* that can be tracked over time to determine trends and relationships. Tracking requires that each indicator can be measured, monitored, or modeled in a consistent and feasible manner.

5.12.2 *The Indicators*

At this stage, the forest managers have identified the following indicators (others may be added as the ability to track them becomes available):

- The amount of pine timber available for harvest
- The age and species distribution of the forest trees
- The creation and maintenance of sufficient older, larger trees that create better habitat for species such as the Delmarva Fox Squirrel
- The protection of critical habitat areas such as those adjoining streams, marshes, Delmarva Bays, or special soil conditions
- The maintenance of a generally stable flow of economic opportunities (jobs, timber sales, etc.) from the forest; and,
- The generation & maintenance of stable economic flows back to the state and counties.

5.12.3 *The Forest Planning Model*

The Maryland DNR Forest Service studied available forest modeling systems and ultimately chose the Remsoft Spatial Woodstock model for development of long-term projections on the Chesapeake Forest. Therefore, Remsoft should be adequate for modeling on the Pocomoke State Forest as well, given the two forests close proximity and similar growing conditions. Information on the model is available at www.remsoft.com.

Spatial Woodstock is integrated with the Chesapeake Forest Geographic Information System so that a single master database can be maintained to serve ongoing forest planning, management, and information needs. A similar configuration will be used on Pocomoke State Forest. The model runs 50-year projections within the estimated 250-year life span of the main tree species involved.

Modeling Pocomoke State Forest requires that the forest be divided into discrete areas (called stands) that have similar soils, vegetation, age, and other characteristics. Priority Management Areas (**Chapter 5**) must also be identified. The model also differentiates between natural and planted loblolly stands because they have different treatment needs.

A detailed Forest Model utilizing the current forest database from Pocomoke State Forest was run using a 75-year period. The results from this model run, which contains a number of graphs based on the indicators listed in this section, can be found in **Appendix I**.

5.13 Inventory and Monitoring

A high-quality inventory and monitoring program that is linked to a GIS-based data management system is the key to a successful adaptive management program. It is, however, one of the often neglected or under-funded parts of a land management program. This plan's successful implementation rests on the capacity of the Department to find the resources needed to support the necessary monitoring program across all the areas listed below (**Chapter 10**). An inventory and monitoring program is also one of the important aspects of the Forest Certification program (**Section 5.14**).

The Land Manager is responsible for developing and maintaining an interactive data collection and management system to facilitate field management as well as document activities, results, yields, etc., to provide data input to the planning models. A statistically valid and multi-tiered sampling procedure has been developed to provide data on growth rates, yield response to management practices such as thinning, and associated environmental impacts such as water quality or habitat changes.

Monitoring for forest sustainability will require attention to the parameters listed in **Chapter 1**. *That will require monitoring of:*

- Soil quality – through regular soil testing, particularly on plantations where more intensive forest management is practiced.
- Biodiversity– information is needed that ties species or suites of species to particular areas, soil types, or vegetative structural conditions so that trends can be predicted under various management options and population of species increases or declines can be detected.
- Water quality, particularly as it relates to nutrient and sediment loads that can be attributed to specific forest management practices.
- Ecologically Significant Areas – an updated inventory of special areas, by type, location, and condition should be maintained to assure that none are being adversely affected by forest management activities.
- Economic performance – Data for long-term trend analysis, as well as quarterly reporting, should be developed and maintained.

5.13.1 *Water Quality Monitoring*

Due to the special attention on water quality in the Chesapeake Bay, and the need to document more clearly how commercial forest management affects water quality, Pocomoke State Forest can serve as a living laboratory for those interested in this particular field of study. Independent third-party partners such as Universities and non-profit organizations like the Chesapeake Bay Foundation are welcome to

pursue a monitoring scheme, conduct research, and utilize the management actions on the land as an ongoing scientific experiment.

5.13.2 *Timber Harvests*

For Pocomoke State Forest, the land manager will ensure that a pre-harvest plan is developed and a post-harvest BMP inspection report is prepared and maintained on file for each harvest operation. An important aspect to protect water quality on timber harvest sites is to ensure a certified Master Logger carries out the harvest operation. Pocomoke State Forest was one of seven State Land sites included in a study of BMP implementation conducted in 2004 and 2005 as part of developing a Northeastern Area Regional BMP Assessment Protocol. The study revealed that statewide, sediment movement into watercourses was avoided on 81% of the sites. The study was conducted by an independent contractor, Sustainable Solutions, LLC, and funded by the USDA Forest Service Northeastern Area State and Private Forestry.

5.13.3 *Herbicide Applications*

Herbicide applications are rarely used on Pocomoke State Forest however when management conditions warrant their use, the land manager will maintain records of tree growth, application rates, soil nutrient levels, and vegetative community to track the effectiveness of herbicide applications.

Herbicide Application Study:

On Chesapeake Forest Lands, minimum effective levels of herbicide application have already been evaluated to determine useful rates for managing mixed pine-hardwood stands. The region has abundant regeneration of sweetgum and red maple, species that are native but are being seen in much greater quantities in the presence of wildfire suppression. Oaks were historically more abundant and are favored for their mast-bearing ability and wildlife habitat desired for current wildlife habitat objectives.

The typical application method on both Chesapeake Forest and Pocomoke State Forest for herbicides is aerial spraying of an Arsenal tank mix at low rates, leaving 300 foot or larger spray buffers around waterways.

5.14 Forest Certification

A primary objective of Pocomoke State Forest (and all Maryland State Forests) is to become a national model of certified sustainable forestry. That objective was achieved in the spring of 2009 when Pocomoke State Forest received dual certification under both the Sustainable Forestry Initiative (SFI) standard and the Forest Stewardship Council (FSC) standard. Compliance with certification is monitored through annual audits. See **Appendices B** & **C** for details on the two certification programs.

5.14.1 *Certification Guidelines Premise:*

It is the Department's belief that an independent review and certification of all state forest management plans and practices has the potential to improve the management of the forest and build public confidence in the quality of that management.

The initial thrust of the combined SFI/FSC certification process was begun on the Chesapeake Forest Lands that received dual certification in June 2004, and Pocomoke State Forest received this designation in the spring of 2009. As part of the process of maintaining dual certification, follow-up annual audits/inspections will continue, following the initial granting of certification. An annual Senior Management Review will also be conducted, as per SFI requirements (**Appendix G**). The Maryland DNR Forest Service remains committed to resolve any audit issues that hinder it in obtaining and or maintaining SFI/SFC certification.

5.15 **Forest Stewardship Council (FSC) – Guidelines & Principles**

5.15.1 *Invasive Species Control:*

Invasive species will be controlled aggressively and in a timely fashion when discovered in the field. Site locations will be mapped and incorporated into the GIS database. An Invasive Species Tracking Form (See Policy Handbook) will be filled out by the person discovering the invasion and reviewed by the Forest Manager. Treatment recommendations will be assigned and monitored for effectiveness.

Invasive species that occupy a large area may need to be addressed through the ID Team field review process. However, efforts will be made to treat affected areas before species go to seed, as seeds could remain viable in the soil for many years.

5.15.2 ***High Conservation Value Forest (HCVF) Definition Guidelines***

Four of the six types of High Conservation Value Forests as identified within FSC Principle 9 will constitute the definition for HCVF on Pocomoke State Forest. They are:

- (HCV1) Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endangered species on PSF are ESA Zone 1&2).
- (HCV2) Forest areas containing globally, regionally, or nationally significant large landscape level forests (e.g. Wildlands)
- (HCV3) Forest areas that are in or contain rare, threatened, or endangered ecosystems. (Inland sand dunes, old growth forest, Natural Heritage Areas, & Wetlands of Special State Concern)
- (HCV4) Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, Riparian Forest Buffers, forested areas within a 300-foot stream buffer).

Refer to FSC Principle #9 (HCVF) in ***Appendix B****.*

Pocomoke State Forest Annual Work Plans (AWP) will list all management activities slated to occur within designated High Conservation Value Forest (HCVF). All HCVF areas proposed for management work will have been reviewed and approved by the Department's Inter-disciplinary Team and the PSF citizen advisory committee. A summary of activities completed in HCVF areas can be found on the PSF website under the monitoring tab as "Activity Summary by AWP".

5.15.3 ***Representative Examples of Existing Ecosystems***

Within this chapter, the five identified management areas on Pocomoke State Forest represent examples of existing ecosystems that will be protected through implementation of specific management activities. Four of these areas contain representative samples of fragile and unique ecosystems identified by the Forest Service and the Wildlife and Heritage Service. These sites are designated as High Conservation Value Forest (HCVF). Ecologically Significant Areas (ESA) & Other State Protected Lands are listed in **Chapter 7**, the Core Forest Interior Dwelling Birds are described in **Chapter 8**, and the Riparian Forest sites that are the 300-foot expanded stream buffers are described in **Chapter 6**. The management activities in these four areas emphasize restoring more natural conditions allowing for natural regeneration of stands to occur. In the Riparian Forest areas and the Core FIDS areas, management of the natural forest will focus on creating old growth stands.

CHAPTER 6

Water Quality Areas: Riparian Forest Buffers and Wetlands

(High Conservation Value Forest-HCVF)

6.1 Introduction

Water quality areas are dominated by land-water relationships. They include streamside forests, stream banks, flood plains, wetlands, and other areas that are the contact points between land and water. Their management is critical to not only preventing water pollution, but to cleaning up water through the filtering of sediments, uptake of nutrients, and stabilization of water temperature and flow conditions. In addition, these areas are some of the most biologically rich portions of the landscape, functioning as habitat for the widest variety of plants and animals, both aquatic and terrestrial. It is becoming generally recognized that riparian areas and wetlands are key to many biodiversity issues. It is for these reasons that these areas have been designated as High Conservation Value Forest (HCVF) since they provide connectivity from Pocomoke State Forest through other public and private forestlands to the Chesapeake & Coastal Bays. The identification and maintenance of High Conservation Value Forest fall under Principle 9 of the Forest Stewardship Council (FSC) guidelines see **Appendices B** & **C** for information on this certification program.

There are several hundred acres of riparian forests that extend through all of the existing management areas identified in **Chapter 5**. The riparian acreage is a general estimate and will need to be adjusted as field examination provides additional data and as forested non-operational wetlands are added into the riparian forest buffer totals. Field personnel will identify and establish riparian forest buffers, mark boundaries, and provide GPS coordinates for updating the GIS data system.

Largely, the management of these areas relies primarily on natural processes, such as natural establishment and succession. Management activities within these areas will be designed to maintain or improve the ecological functioning of the forest, wetland, and stream systems. Any timber or fiber production from these lands will be ancillary to other management needs.

6.2 Riparian Forest Buffers: High Conservation Value Forest (HCVF)

The primary goal of HCVF riparian forest buffers is to maintain and improve the quality of water flowing into the streams and rivers and eventually to the Chesapeake Bay from Pocomoke State Forest. Riparian forests also provide critical habitat that is an essential element of the associated aquatic ecosystem and the diversity of wildlife that utilizes riparian areas. Therefore, the management goals for riparian forest buffers are:

1. To remove sediments, nutrients, and other potential pollutants from surface and groundwater flows;
2. To maintain shade cover for streams and aquatic systems to regulate temperature and dissolved oxygen;
3. To provide a source of detritus and woody debris for aquatic systems;
4. To provide riparian habitat and travel corridors for wildlife; and,
5. To maintain or establish native plant communities.
6. To allow these areas to revert into Old Growth Forest.

In order to achieve these goals, the following management objectives will be used as criteria to more specifically evaluate and design potential management activities:

1. Minimize disturbance to soil structure or duff layer;
2. Avoid exposed mineral soils;

3. Prevent all rills, gullies, or ruts that may channel water flow and short circuit surface flow paths;
4. Protect mixed hardwood or mixed hardwood/conifer forest community;
5. Maintain mature forest conditions adjacent to stream; and,
6. Encourage the development of a diverse uneven age forest community in terms of species, canopy levels, and diameter class.

6.2.1 *Stand Composition*

Riparian forests should be managed to encourage a mixed hardwood or mixed hardwood/conifer community with a combination of diverse herbaceous, mid-story, and over story plants. Hardwood species should be encouraged to ensure maximum functions for denitrification, canopy diversity, woody debris, and nutrient uptake. Riparian forests should favor species that have been shown to effectively take up nutrients including red oak, white oak, red maple, quaking aspen, ash, basswood, yellow poplar, dogwood, red cedar, and sweet and black gum. Diversity in species and forest structure should be encouraged as a strategy to maintain forest function and resilience in the event of a major disturbance or new pest or pathogen; many pests or pathogens are limited to certain types of species or tree condition, and disturbances such as windstorms or fire can affect different species to varying extents.

6.2.2 *Vegetation Management*

Any vegetation management must be designed to improve the ecological functioning of the riparian forest and stream system according to management goals and objectives. If a silvicultural treatment or management prescription is conducted, it should be limited to addressing management concerns to improve or ensure the health of the riparian forest or adjacent stands. Such concerns include insects, disease, fire, wind throw, ice damage, threatened and endangered species, critical habitat, native plant communities, invasive/exotic species, hazard fuel reduction, and prescribed burning. There will be no planned clear cuts conducted within a riparian forest area. Any management activities should use the least impacting equipment, follow best management practices (BMPs), and comply with all state and local regulations.

6.2.3 *Roads*

Roads should avoid riparian forests to the maximum extent possible and any existing roads within riparian forests should be evaluated for closure. If road construction is necessary in a riparian forest, all related BMPs for road construction should be followed including:

1. Perpendicular alignment to riparian forest to minimize impact
2. Utilizing temporary stream crossings when possible
3. Adequate sizing of crossing to avoid affecting flow
4. Discarding slash and debris from right-of-way clearing outside of stream area.

6.2.4 *Herbicide Use*

Aerial application of herbicides is not permitted within riparian forests. If aerial spraying is planned for stands adjacent to a riparian forest, the riparian forest must be clearly designated and GPS-established to protect the riparian forest from application or drift. Chemical applications within riparian forests will only be permitted for purposes of improving the ecological functioning of the riparian forest for its management goals and will be limited to spot applications and direct application to the target plant.

6.3 Non-Operational Wetlands

Ecologically, wetlands are defined as areas that are saturated or inundated enough to influence soil characteristics and to support a wetland plant community. Under this definition, most of the Pocomoke State Forest lands are wetlands due to the low relief and high-water tables in the region. Therefore, the

general forest management guidelines address some of the special management consideration required for forested wetlands.

However, some wetland areas are not suitable for timber production and therefore require their own management guidelines. These non-operational wetlands include all areas designated in the stand classification system as non-operable areas and described as marsh (M), bottomland (B), non-productive (NP), or swamps (S), but not included in riparian forest buffers. Additionally, areas within soil management group 5 will be included as wetland areas. (**Appendix D**). Any currently non-designated Delmarva Bays, watershed improvement projects, or other newly identified non-operable wetland areas will also be included. Non-operational wetland management guidelines will also apply to wetland buffers, which extend 100 feet from the edge of freshwater non-operational wetlands to provide upland habitat for amphibians. This buffer will need to be established in the field because some stands designated as wetlands include an adequate buffer but others do not. Many of these wetlands are also designated as HCVF.

The Management Goals of wetland areas will be as follows:

1. Provide high quality wetland systems including associated upland ecotones
2. Maintain or enhance any unique biological communities that may be present
3. Maintain or restore hydrologic and water quality functions of wetlands, including flood storage, groundwater recharge, denitrification, nutrient uptake, and sedimentation
4. Maintain or establish a native wetland plant community

In order to achieve these goals, the following management objectives will be used as criteria to more specifically evaluate and design potential management activities:

1. Minimize disturbance to soil structure or removal of duff layer
2. Encourage development or maintenance of a native wetland plant community
3. Prevent further ditching (to avoid altering the hydrology of the wetland)

6.3.1 *Vegetation Management*

Within non-operational wetland areas, management activities should encourage the establishment of native wetland plant communities. Within the wetland buffer, management activities should encourage a healthy forest with a diversity of species, canopy levels, and diameter classes. Any vegetation management must be designed to improve the ecological functioning of the wetland system according to management goals and objectives. There should be no planned clear cuts conducted within a wetland area unless needed to re-establish or favor native wetland species. (An example of this would be the removal of woody vegetation within a Delmarva Bay.) If a silvicultural treatment or management prescription is conducted, it should be limited to addressing management concerns that threaten the health of the wetland, the wetland buffer, or adjacent stands. Such concerns include insects, disease, fire, wind throw, ice damage, threatened and endangered species, critical habitat, native plant communities, invasive/exotic species, hazard fuel reduction, and prescribed burning. Any management activities should use the least impacting equipment, follow best management practices (BMPs), and comply with all state and local regulations.

6.3.2 *Stand Composition*

Within wetland areas and wetland buffers, emphasis will be placed on maintaining and encouraging a diverse community of native wetland plants. Particular emphasis will be placed on maintaining any unique biological communities present at a site. In forested wetland areas and buffers, emphasis will be

on maintaining or encouraging native species to maximize denitrification and to provide leaf litter and woody debris as food and cover for aquatic wildlife.

6.3.3 *Herbicide Use*

Aerial application of herbicides will not be done within wetlands. If aerial spraying is planned for stands adjacent to a designated wetland, the wetland must be clearly designated and GPS-established to protect the riparian forest from application or drift. Chemical applications within wetlands will only be permitted for purposes of improving the ecological functioning of the wetland to meet management goals and will be limited to spot applications and direct application to the target plant of products approved for aquatic application to the target plant.

6.3.4 *Roads*

Roads should avoid wetland areas and wetland buffers to the maximum extent possible, and any existing roads within wetland areas should be evaluated for closure. If road construction is necessary in a wetland area, all related BMPs for road construction should be followed including:

1. Align to minimize impact;
2. Discard slash and debris from right-of-way clearing outside of wetland areas; and,
3. Avoid impacts to wetland hydrology.

6.4 Riparian Forest Buffer Delineation for High Conservation Value Forest

Riparian forest buffer establishment and layout on Chesapeake Forest Lands will extend 300 feet from the edge of all rivers and streams identified in "Maryland Waterbodies - Rivers and Streams (Detailed)" (https://opendata.maryland.gov/Hydrology/MD-iMAP-Maryland-Waterbodies-Rivers-and-Streams-De/jady-3bxx). Within these 300-foot buffers, minimum 50-foot no cut buffers are determined using the following formula derived from the 2015 Maryland Soil Erosion and Sediment Control Standards and Specifications for Forest Harvest Operations:

*50 ft. + (2 ft. * % slope) = No-cut stream buffer width (maximum of 150 ft.)*

Establishment of additional 300-foot buffers will include other riparian areas that, once examined through field review by a Licensed Forester and/or other trained natural resources professional, are determined based on evidence of stream function to be in need of a buffer. Examples of other riparian areas may include functioning old-field ditches, depressions, or intermittent streams. USGS topographic maps and layers may be used as guidance for determining possible locations of "blue line" streams, but inconsistent resolution and accuracy of those datasets makes using them across the entire Pocomoke State Forest unviable.

These buffers will provide additional nutrient uptake for water quality; increased forest interior habitat for wildlife, including FIDS and DFS; and wildlife travel corridors. They will be managed for the creation and maintenance of mature mixed hardwood-pine forests. These areas have been identified as High Conservation Value Forest (HCVF) and will be managed to protect and maintain their important role in improving water quality as it affects the Chesapeake Bay and Coastal Bays.

Actual buffer layout must be done in the field in response to the soil, topographic, and vegetative conditions encountered in each place. Obviously, where a stream or wetland occurs on the interior of a Pocomoke State Forest parcel, the total riparian forest created would form a 600-foot riparian forest corridor. In cases where the stream forms the property boundary of a Pocomoke State Forest tract, the best that can be done is to establish and manage the one-sided riparian forest and attempt to encourage the adjacent landowners to take similar measures.

6.5 Management and Function of Expanded Riparian Forest Buffers

Expanded riparian buffers will be managed to enhance and maintain the ecological function of the aquatic system, including enhancing the function of the forest in the removal of nutrients from overland flow and shallow underground aquifers. Regardless of current species composition, the first 50 feet from the stream bank is a no-cut area regardless of current species composition, to avoid destabilizing stream banks. Any additional riparian buffer will ultimately be a limited harvest area; however the goal is to create a mixed hardwood/pine stand, and thus management activities will encourage the creation and maintenance of mature mixed forests. Tree removals, through thinning or harvest, will be done only to improve riparian forest function. Once target species composition is reached, these areas will become no-cut zones and allowed to become old-growth areas. Periodic monitoring (e.g., every 5-10 years) of forest health and level and type of tree regeneration should be conducted to assure that riparian forests are being perpetuated and are in a condition to maintain the expected functions of stream shade, woody debris, inputs for aquatic habitat, nutrient assimilation, and protecting litter layer and soil organic matter.

This will have the added benefit of producing increased interior forest habitat for wildlife. No herbicides or fertilizers will be used in any area of the 300-foot riparian buffer, except to control invasive species. Since these buffers will ordinarily be adjacent to pine plantations on the upland side, these areas will need to be clearly marked and identified with GPS coordinates so that aerial operations on adjoining lands do not affect them.

6.6 Pocomoke River and Associated Buffers

Pocomoke State Forest incorporates the lower part of the Pocomoke River within its boundaries. The Pocomoke River flows southward and drains into the lower Chesapeake Bay. The Pocomoke River is tidal in this area.

Owing to the flat terrain there are many swampy areas having either brackish or fresh water. Several streams either originate in or flow through swamps. The streams are rather sluggish and much less flashy than those draining areas having more topographic relief.

Both surface runoff and ground water flow contribute to surface stream flow. During periods of rainfall or rapid snowmelt, direct runoff greatly increases the volume of surface flows. Ground water, however, sustains the flow of surface streams in two ways. First, visible springs, located outside of stream channels, discharge excess ground water at flow rates, which vary with the seasons and precipitation. These discharges are steadier and more dependable than direct runoff. Second, portions of many stream channels are often below the top of the local ground water table. At the times and in the places that the water table is higher than a stream bed, water seeps directly from the ground into the stream channel, supplementing surface flow. The portion of channel flow derived from ground water is known as stream base flow.

The Pocomoke River is tidal for 36 miles and maintains a uniform width ranging from 400 to 600 feet and a depth ranging from seven to 29 feet. Above Porters Crossing, the river essentially loses its free-flowing character as it meanders through bottomland swamp or unnatural man-made drainage ditches. Below Snow Hill, The Pocomoke widens into a beautiful free-flowing river.

Bald Cypress Swamps, the northernmost along the Atlantic Coast, and other wet areas border the entire length of the Pocomoke River. The river and these swamps provide the meeting ground for major southern and northern plant species. The Pocomoke River enjoys high water quality except for areas around Pocomoke City and Snow Hill where minor pollution exists.

There are a number of protection measures in place to ensure that all activities that occur on Pocomoke State Forest will not impact the river system that runs through it. Riparian Buffers as mention in this chapter will be designated on all streams that flow through the Forest and into the River. All tidal areas of the river, which cover the major portions of the Pocomoke that flow through the Forest, are protected under the State's Critical Area Law. This law put in place a 1,000-foot buffer zone landward from the mean high tide mark, all activities within this zone must adhere to regulations, which can be found in the Code of Maryland Regulations under 27.02.05. The Pocomoke River has also received a "State Scenic Rivers" designation, which ensures long-term protection of this valuable resource. This is described in more detail below.

6.7 Pocomoke River Scenic Designation

"The Pocomoke River and its tributaries possess unique natural and scenic resources that are unequaled by those of any other river on the Eastern Shore of Maryland. This uniqueness led to the designation of the river and its tributaries as initial components of the Maryland Scenic and Wild Rivers system in 1971." (Maryland Scenic Rivers: The Pocomoke, Planning for Its Scenic, Wild and Recreational Resources)

6.7.1 *Definition of a Scenic River*

A Scenic River is a "free flowing river whose shoreline and related land are predominantly forested, agricultural, grassland, marshlands, or swampland with minimum of development for at least 2 miles of the river length." [Natural Resources 8-402(d)(2)]

6.7.2 *Designation Process*

The designation process involves four steps: an inventory of the river's resources is conducted to determine its eligibility as a Scenic or Wild River; local governments officially propose or endorse the designation of the river; the Scenic and Wild River Review Board reviews and endorses the proposal; and the Maryland General Assembly officially designates the river. The Scenic and Wild River Act mandates the preservation and protection of natural values associated with the rivers designated as Scenic and/or Wild. Each unit of State and local government, in recognizing the intent of the Act and Scenic and Wild Rivers Program, is required to take whatever action is necessary to protect and enhance the qualities of a designated river.

6.7.3 *The Pocomoke Scenic River Plan*

Maryland Scenic Rivers: The Pocomoke, Planning For Its Scenic Wild and Recreational Resources (1982) is a comprehensive management plan prepared by the Department of Natural Resources (Maryland Scenic and Wild Rivers Program). The study has three major components: an inventory of the river corridor's biological and recreational resources, general management recommendations, and implementation techniques. The recommendations address a number of practices that should be considered in the implementation of the Pocomoke State Forest Ten-Year Resource Management Plan to avoid conditions that may impact the visual landscape and/or water quality.

The resource use recommendations are grouped in eight major categories: water quality and flow, fish and wildlife structures, forestry practices, public access, recreation, dredging, filling and other earth moving activities, and others. In principle, the plan promotes maintaining biodiversity and sensitive habitats; protecting the fish, flora and fauna, and visual quality through conscientious conservation practices; and the provision of opportunities for passive recreation and public access. Implementation of the plan is the responsibility of the Department of Natural Resources, along with the Somerset & Worcester County offices of Planning and Zoning. For more information on the Scenic Rivers program

go to the Department's website at: http://dnr.maryland.gov/land/stewardship/scenicrivers.asp. A copy of the Pocomoke River Scenic Plan can be found on the Pocomoke State Forest Website at: http://dnr.maryland.gov/forests/Pages/publiclands/eastern_pocomokeforest.aspx.

6.8 Significant Vernal Pools

Vernal pools are defined by the MD Nontidal Wetland Protection Act (Annotated Code of Maryland §8-1201) and associated regulations (COMAR 26.23.01.01) as *a nontidal wetland in a confined depression that has surface water for at least 2 consecutive months during the growing season and:*

a) Is free of adult fish populations;
b) Provides habitat for amphibians; and
c) Lacks abundant herbaceous vegetation.

For the above definition, the "growing season" on the Delmarva Peninsula is roughly defined as the March 15-October 15 period, with annual variation.

The Maryland Wildlife Diversity Conservation Plan (MD DNR 2005) defines vernal pools as small, nontidal palustrine forested wetlands with a well-defined, discrete basin and the lack of a permanent, above ground outlet. The basin overlies a clay hardpan or some other impermeable soil or rock layer that impedes drainage. As the water table rises in fall and winter, the basin fills, forming a shallow pool. By spring, the pool typically reaches maximum depth following snowmelt and the onset of spring rains. By mid-late summer, the pool usually dries up completely, although some surface water may persist in relatively deep basins, especially in years with above average precipitation. This periodic, seasonal drying prevents fish populations from becoming established, an important biotic feature of vernal pools. Many species of plants and animals have evolved to use these temporary, fish-free wetlands. Some are obligate vernal pools species, so called because they require a vernal pool to complete all or part of their life cycle. While we typically associate vernal pools with forested habitats, they can also occur in other landscape settings, both vegetated and un-vegetated (Calhoun and deMaynadier 2004), such as meadows, pastures, clearcuts, and agricultural fields.

Vernal pool basin substrate typically consists of dense mats of submerged leaf litter and scattered, coarse woody debris. During dry periods the presence of a vernal pool is often denoted by blackened leaf litter, a sign of seasonally anaerobic conditions, and stained tree trunks. Herbaceous vegetation is usually absent to sparse in and around the basin, although small sphagnum patches may occur along the basin edge. A dense shrub layer may occur along the shoreline or in small patches within the basin (MD DNR 2005).

It should be noted that besides "traditional" vernal pools there is a unique seasonal nontidal wetland on the Delmarva Peninsula called a "Delmarva Bay" or "Carolina Bay". It is also defined by law and regulation and differs from a "vernal pool" mainly in its basin shape (elliptical or oval), presence of a sandy rim, and that it has abundant herbaceous vegetation. This wetland type is described in detail in **Chapter 7**, with accompanying management zones and prescriptions (see Smith and Knapp 2006).

A statewide vernal pool mapping exercise was conducted in GIS during preparation of the Maryland Wildlife Diversity Conservation Plan (MD DNR 2005). All palustrine wetlands (emergent, scrub-shrub, and forested) with NWI water regime modifiers of temporarily flooded, seasonally flooded, seasonally flooded/saturated, saturated, and semi-permanently flooded (beaver) were included (Cowardin et al. 1979). This GIS layer (**Figure 10**) could possibly serve as a starting point for identifying significant vernal pools on Pocomoke State Forest and Chesapeake Forest, however this map was never ground-truthed and NWI maps often overlook smaller wetlands (Calhoun and deMaynadier 2004). Thus, a

concerted effort is still needed to ground truth the existing map and to survey for significant vernal pools that have been missed. The presence of obligate and certain facultative vernal pool species could also be used to help identify these wetlands. Calhoun and deMaynadier (2004) used the following NWI wetland classification codes to initially screen for potential vernal pools: PUB/POW (open water), PSS (scrub shrub), PFO (forested wetland), and PEM (emergent wetland), though the latter were less likely to be vernal pools due abundant herbaceous vegetation. A GIS vernal pool mapping exercise should be conducted that is a combination of methods used by the 2005 DNR effort and those of Calhoun and deMaynadier (2004).

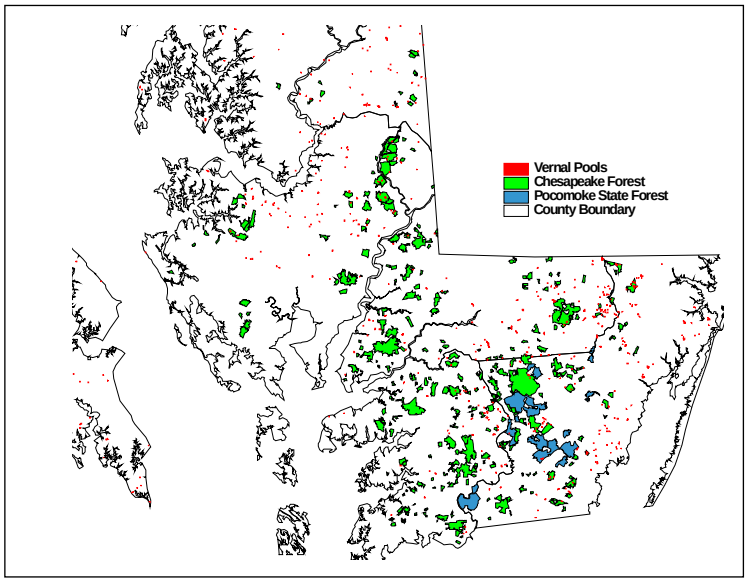

Figure 10: Vernal Pools on Pocomoke State Forest and Chesapeake Forest tracts. (2011)

Many states have developed vernal pool certification programs with criteria for determining "in the field" whether a wetland is truly a vernal pool. Based on these and other sources, it is recommended that the following criteria be adopted for use in determining a significant vernal pool on Pocomoke State Forest and Chesapeake Forest. The first 3 criteria must be met, # 4 must be met if there are no obligate species present, and either criteria 5 or 6:

1. A depression confined to a relatively small area with no permanent above ground outlet (look for blackened leaves and staining on trees);
2. Presence of surface water for ≥ 2 months during the growing season (pond depth is usually at its maximum just prior to tree leaf out);
3. Lack of herbaceous vegetation or it is limited to the basin edges, typically sparse (<50% cover), with or without sphagnum moss;
4. Lack of established and reproducing fish population(s);
5. Evidence of breeding **obligate or indicator vernal pool species** (require a vernal pool to complete all or part of their life cycle). On the lower Delmarva Peninsula, these include 5 amphibians and a crustacean group, the fairy shrimp (at least 4 species in the Order Anostraca; Brown and Jung 2005). Amphibians include marbled salamander (*Ambystoma opacum*), spotted salamander (*A. maculatum*), eastern tiger salamander (*A. t. tigrinum*. state endangered), wood frog (*Lithobates sylvaticus*), and eastern spadefoot (*Scaphiopus holbrookii*). Eggs, egg masses, larvae, transforming individuals, juveniles, and adults all would serve as positive evidence of a significant vernal pool.
6. The presence of rare or state-listed **facultative vernal pool species**. Facultative species are vertebrate and invertebrate species that frequently use vernal pools for all or a portion of their life cycle but are able to successfully complete their life cycle in other types of wetlands. They serve as indirect indicators of vernal pool habitat. On the lower Delmarva Peninsula facultative species include 16 amphibians, 1 reptile, and 17 invertebrates (Brown and Jung 2005), However only 3 of these, all amphibians, are rare or state-listed: barking treefrog (*Hyla gratiosa*; state endangered), eastern narrow-mouthed toad (*Gastrophryne carolinensis*; state endangered), and

carpenter frog (*L. virgatipes*; watchlist). Eggs, egg masses, larvae, transforming individuals, juveniles, and adults all would serve as positive evidence of a significant vernal pool.

Identifying and mapping all significant vernal pools on Pocomoke State Forest and Chesapeake Forest is a daunting task that will require both a concerted well-funded effort for GIS mapping and ground-truthing, plus opportunistic data collection by DNR Forestry staff, consultants, and other DNR staff and partners. Brown and Jung (2005) as well as the Vernal Pool Association's website (www.vernalpool.org) should be used as primary references. A data sheet has been developed for these opportunistic surveys (see Policy Handbook for Pocomoke State Forest & Chesapeake Forest Lands) based on the MD Vernal Pool Task Force draft 2008 datasheets.

6.8.1 *Vernal Pool Conservation and Management Prescriptions*

Due to their complex bi-phasic life history, vernal pool breeding amphibians are biologically linked to both their aquatic breeding habitat and terrestrial habitat in which they forage, aestivate, and hibernate. Their population dynamics also are dependent on landscape connectivity as they operate as metapopulations. Major threats include anthropogenic destruction and alteration of their aquatic and terrestrial habitats. Management strategies require conservation of a diversity of wetland habitats that vary in hydroperiod and their surrounding terrestrial habitats (Semlitsch 2003). Semlitsch (1998) concluded that a buffer zone encompassing 95% of pond-breeding salamander populations would need to extend 534 feet from the wetland edge.

Semlitsch and Bodie (2003) observed that the 50–100-foot buffers used to protect wetlands in most states were inadequate for amphibians and reptiles. They summarized results of 40 papers describing biologically relevant core habitats surrounding wetland breeding sites and recommended that 3 conservation zones be established around amphibian breeding ponds. Zone 1 was the wetland and an Aquatic Buffer that extended 100-200 feet from the wetland edge. Zone 2 was the Core Habitat which extended 465-950 feet from the wetland edge. Zone 3 was a Terrestrial Buffer for Core Habitat and extended 165 feet from Zone 2. At a minimum these 3 zones comprise 630 feet and >1100 feet at the maximum. However, Semlitsch and Bodie (2003) did not make recommendations on what activities could occur in these areas only that managers needed to be aware that these were biologically relevant buffers.

Calhoun and deMaynadier (2004) also recommended 3 conservation zones. Zone 1 was the Vernal Pool Depression in which no disturbance should be allowed. Zone 2 was the Vernal Pool Protection Zone, a 100-foot buffer around the vernal pool in which limited timber harvesting could be allowed but only if >75% canopy cover was maintained, harvest occurred only when the ground was frozen or dry, heavy machinery use was minimized, and abundant coarse woody debris was retained. Zone 3, or the Amphibian Life Zone was a 400-foot-wide buffer from Zone 2 (extends to 500 feet from vernal pool) in which partial timber harvest could occur, but only if >50% of the canopy was maintained, no openings >1 acre were made, harvest occurred only when the ground was frozen or dry, and abundant coarse woody debris was retained.

Semlitsch et al. (2009) concluded that removal of only a portion of the canopy (≤50%) minimized negative impacts to amphibians associated with select harvests and clearcuts. They noted trade-offs between either harvest method and that clearcuts should be small (<5 acres) and only used when remaining habitat was high-quality for amphibians.

Based on these papers and mindful of the need to balance conservation with sustainable forestry, the following conservation and management prescriptions are recommended for mapped significant vernal pools on Pocomoke State Forest and Chesapeake Forest:

Zone 1: includes the significant vernal pool and extends into terrestrial habitat to 100 feet from the high-water mark. This will be called the **Amphibian Protection Zone** (**Figure 11**).

Management: This is a non-operable area with no herbicide or nutrient applications allowed. No new roads. No heavy equipment should traverse this area except for during restoration activities and this should be minimized, only to occur when ground is frozen or very dry. Site-specific restoration plans may be developed by Wildlife & Heritage with possibility of a "one-time only" harvest of some areas by Forestry, but this will be on a case-by-case basis.

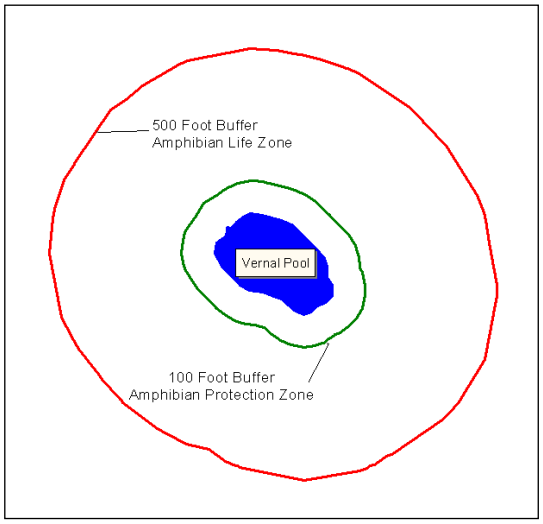

Figure 11: Amphibian buffer zone around a vernal pool

Zone 2 (Forestry responsible for management with input from Wildlife & Heritage): This area will be called **Amphibian Life Zones** (**Figure 11**) – from Zone 1 to 500 feet from the wetland edge.

Management:

1) Saw timber rotations maintaining ≥ 50% canopy closure. A patch clearcut of ≤ 1 acre would be allowed in this area, but select harvests are preferred with retention of coarse woody debris and leaf litter. Natural regeneration is the preferred method; however the planting of native genotype hardwoods where appropriate, may be conducted after consultations between the Forest Manager and Wildlife & Heritage on species selection during the Annual Work Plan review process.
2) Management of Zone 2 will be done in such a way that 75% of the area contains large pole timber and saw timber age classes (10" DBH and greater) which will be managed for longer stand rotations (50+ years). Forest Management activities such as commercial thinning in these stands shall maintain a minimum of 70 sq. ft. of BA with the goal that ≥50% of the stand composition will be comprised of hardwood species. When regeneration harvests occupy 25% of Zone 2, then natural regeneration must reach large pole timber size (10" DBH) before additional regeneration harvesting occurs.
3) There will be no mechanical site preparation. Prescribed burning will be allowed as a management tool. No new roads should be built in this area.
4) Harvests and heavy equipment should be conducted only when the ground is frozen or very dry.

Zone 3 (Forestry responsible for management with input from Wildlife & Heritage): This will be called the **Vernal Pool Connectivity Zone – Special Case** (**Figure 12**): from Zone 2 to 1000 feet from the wetland edge. This area is primarily to ensure that adjacent vernal pools have some habitat connectivity between them, providing microhabitat and allowing movement between breeding ponds. This Zone will only be used when 2 breeding ponds are ≤1000 feet

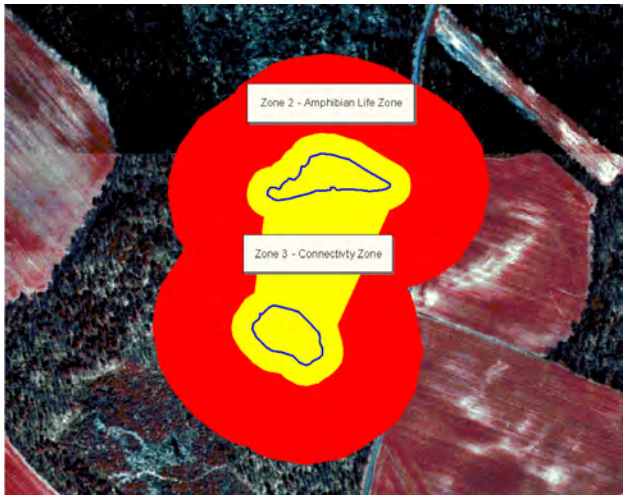

Figure 12: Vernal Pool connectivity zone for amphibian conservation

from each other (and really encompasses the Zone 1 of each pond and connecting area). An inoperable area should be established between the two ponds that is the width of the diameter of the largest of the ponds.

Literature Cited

Brown, L. J. and R. E. Jung. 2005. An introduction to mid-Atlantic seasonal wetlands. EPA/903/B-05/001, U.S. Environ. Protection Agency, Ft. Meade, MD, 92 pp.

Calhoun, A. J. K. and P. deMaynadier. 2004. Forestry habitat management guidelines for vernal pool wildlife. MCA Technical Paper No. 6, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York. 32 pp.

Cowardin, L.M., V. Carter, F. C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats in the United States. FWS/OBS 79/31, Fish Wildl. Serv., USDI, Washington, D.C., 103 pp.

Maryland Department of Natural Resources. 2005. Maryland wildlife diversity conservation plan. DNR Publ. No. 03-5312006-135, Annapolis, MD. 365 pp.

Semlitsch, R. D. 1998. Biological delineation of terrestrial buffer zones for pond-breeding salamanders. Conservation Biology 12:1113-1119.

Semlitsch, R. D. 2003. Conservation of pond-breeding amphibians. Pages 8-23 in Semlitsch, R. D. (ed.) Amphibian conservation. Smithsonian Books, Washington, D.C. 324 pp.

Semlitsch, R. D. and J. R. Bodie. 2003. Biological criteria for buffer zones around wetlands and riparian habitats for amphibians and reptiles. Conservation Biology 17:1219-1228.

Semlitsch, R. D., B. D. Todd, S. M. Blomquist, A. J. K. Calhoun, J. W. Gibbons, J. P. Gibbs, G. J. Graeter, E. B. Harper, D. J. Hocking, M. L. Hunter, Jr., D. A. Patrick, T. A. G. Rittenhouse, and B. B. Rothermel. 2009. Effects of timber harvest on amphibian populations: understanding mechanisms from forest experiments. BioScience 59:853-862.

Smith, S. and W. Knapp. 2006. Chesapeake Forest ecologically significant area (ESA) classification for sustainable forest management: management zone delineations and prescriptions. Unpubl. DNR Report, Wye Mills, MD, 10 pp.

CHAPTER 7

Ecologically Significant Areas & Other State Protected Lands

7.1 Ecologically Significant Areas (ESA) Defined

This plan uses the term "Ecologically Significant Area" to identify unique sites that have special ecological significance. These areas have been specifically delineated and must be given careful management consideration. ESAs are areas that harbor or could potentially harbor rare, threatened, or endangered (RTE) species and/or unique natural community types.

ESAs presently comprise 7,363 acres or about 40.5% of the entire forest. The identification of ESA areas by the Wildlife and Heritage Service was done to aid in the determination of sustainable forest acreage within Pocomoke State Forest and to provide management prescriptions for the ESAs. As part of the overall effort to simplify management designation for each acre of Pocomoke State Forest (PSF) a GIS mapping exercise was conducted to integrate all expanded stream buffers, core Forest Interior Bird (FIDS) management areas, Delmarva Fox Squirrel (DFS) management areas, and High Conservation Value Forests (HCVF). The final result envisioned was that each management category on the entire PSF would have distinct, non-overlapping map units. This gives a clear and unambiguous view of total acreage in each management category, and how much of the entirety of PSF is available to sustainable forestry operations. This provided key information that was needed for computer modeling of economic sustainability of Pocomoke State Forest.

Throughout this document, the term "sustainable forestry" *means the stewardship and use of forests and forest lands in a way, and at a rate, that*:

Maintains their biodiversity, productivity, regeneration, capacity, vitality, and potential to fulfill, now and in the future, relevant ecological, economic, and social functions at local and regional levels; and does not cause damage to other ecosystems (COMAR 08.01.07.01(8)).

The ESAs, Core FIDS management areas, DFS management areas, and Old Growth Management Areas delineated for PSF are all critical to achieve this definition of a sustainable forest. The habitats associated with these areas are ecologically significant not only because of the biological services they provide to rare, threatened and endangered (RTE) species, but also for the valuable role they play in keeping many other species of greatest conservation need from becoming rare in the first place.

On Pocomoke State Forest, portions of these areas are also designated as High Conservation Value Forest (HCVF). Rare threatened or endangered species and or unique natural community types fall under two categories of our HCVF definition, they are: *(HCV1) Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endangered species) and (HCV3) Forest areas that are in or contain rare, threatened or endangered ecosystems.*

7.2 Other State Protected Lands

Most of the land designations listed below fall under some type of state protection through legislation. Most of these areas are overlapped by the ESA layer, however some sections are not and as such are listed here as a separate layer. There are four areas described here: Natural Areas (Heritage Areas); Ecologically Significant Areas; State Designated Wildlands; and Historic and Archaeological Areas. The borders of these layers may overlap with one another.

7.2.1 *Natural Areas*

Mattaponi Natural Heritage Area (NHA-31)

General Description:

More than 75% of the Mattaponi Natural Heritage Area is comprised of Southern Bald Cypress Swamp and the ecotone between Swamp and Upland Forest. As with Hickory Point Cypress Swamp Natural Heritage Area, Mattaponi NHA is part of Pocomoke Swamp, which is an isolated northern extension of the Great Dismal Swamp ecosystem. Centered near the Virginia-North Carolina border, the Great Dismal Swamp ecosystem is now less than one-half of its original size due to anthropogenic activities.

In the 1930s, 159 plant species were documented for Pocomoke Swamp, with about 36% of these species near their northern limit of distribution. One of these species, Dwarf Trillium (*Trillium pusillum var. virginianum*), is Threatened in Maryland, and the population in Mattaponi NHA is the largest in the State. It is most abundant in the ecotone between Swamp and Upland Forest, and it also occurs on hummocks in the Swamp and in portions of Upland Deciduous Forest without dense vernal shade. Being a spring ephemera, Dwarf Trillium is uncommon or absent under evergreens and in areas with a high density of deciduous stems such as recently logged areas. An Endangered bird species, Swainson's Warbler (*Limnothlypis swainsonii*) is also protected by the NHA. Breeding habitat is comprised of drier portions of the Swamp and Upland Border with dense shrub layers and partially open deciduous canopies.

Management Needs:

The Natural Heritage Area must be managed pursuant to the Chesapeake Bay Critical Area Criteria. Protection of Natural Heritage Areas, and other types of Habitat Protection Areas in the Chesapeake Bay Critical Area, is partially dependent upon the location of the Critical Area Buffer. The Buffer along Pocomoke River is considerably wider than 100 feet, since the Criteria require expansion of the Buffer to encompass "contiguous sensitive areas." Contiguous sensitive areas include: the Bald Cypress Swamp, because of its hydric soils and State-listed species habitats; all of the Upland Border, because of steep slopes and State-listed species habitats; and portions of the Upland with hydric soils connected to the Swamp (e.g., streams and associated floodplains) or with rare and endangered species habitat contiguous with the Swamp such as that of Dwarf Trillium.

The following activities are specifically allowed by the Criteria in portions of the NHA inside the Buffer, assuming rare and endangered species are not affected, and the activities do not conflict with other State and Federal regulations:

- Hunting
- Fishing
- Trapping
- Educational pursuits
- Scientific observation
- Non-commercial, passive recreation; e.g., Hiking, Nature
- Photography
- Public beaches, launching and docking facilities, Fishing piers if 5 requirements are met
- Water-dependent research facilities
- Commercial water-dependent fisheries facilities

The following activities are specifically disallowed in portions of the NHA inside the buffer:

- Development activities, including structures, roads, parking areas and other impervious surfaces, mining and related facilities, or septic systems

  EXCEPT: Activities associated with acceptable water-dependent facilities

- Industrial and port-related facilities, and non-public marinas; Bridges and utilities unless no feasible alternative exists

  Exception Activities associated with acceptable water-dependent facilities cont.

Dredged spoil disposal except for:

a. backfill for permitted shore erosion protection structures
b. use in approved vegetated shore erosion projects
c. placement on previously approved channel maintenance spoil disposal areas
d. beach nourishment

Clearing of existing natural vegetation except:

a. to provide access to private piers
b. to install or construct a legally permitted shore protection device or measure
c. to install or construct a legally permitted water dependent facility
d. farming activities, including the grazing of livestock
e. commercial harvesting of trees

Portions of Natural Heritage Areas which fall outside the Buffer are to be protected "...from alteration due to development activities or cutting or clearing so that the structure and species composition of the areas are maintained." A 100-foot, no disturbance buffer around the sandpit area should satisfy short-term management needs. In the long-term, woody plant succession must be controlled since extant rare and endangered species are not shade tolerant. In the ancient dune system, restoration activities may be needed in areas where indigenous vegetation has been significantly impacted. However, landscape history studies will be needed before restoration plans can be formulated.

The Natural Heritage Area boundary is also the Habitat Protection Area boundary for State-listed species protection. Pursuant to the Criteria, State-listed species and habitat must be protected from development activities and disturbances unless it can be shown that these activities or disturbances will not have or cause adverse impacts on these habitats.

Hickory Point Cypress Swamp Natural Heritage Area (NHA-29)

General Description:

Hickory Point Cypress Swamp Natural Heritage Area is part of Pocomoke Swamp, which is an isolated northern extension of the Great Dismal Swamp ecosystem. Centered near the Virginia-North Carolina border, the Great Dismal Swamp ecosystem is now less than one-half of its original size due to anthropogenic activities. In the 1930s, 159 plant species were documented for Pocomoke Swamp, with about 36% of these species near their northern limit of distribution. Five rare plant species and four rare animal species have been documented in the Swamp. The plant species are: Red Bay (*Persea borbonia*), White Spikerush (*Eleocharis albida*), Southern Wildrice (*Zizaniopsis miliacea*), Shoreline Sedge (*Carex hyalinolepis*), and the Gibbous Panic-grass (*Sacciolepis striata*). The animal species are the Swainson's Warbler (*Limnothlypis swainsonii*), a Dytsicid Beetle (*Hoperius planatus*), the Great Purple Hairstreak (*Atlides halesus*), and Palamedes Swallowtail *(Papilio palamedes*). The population of Southern Wild rice is one of only two know in the state.

Management Needs:

The Natural Heritage Area boundary includes Hickory Point Cypress Swamp and a 100-foot upland border. The Natural Heritage Area must be managed pursuant to the Chesapeake Bay Critical Area Criteria, and protection under the Criteria is partially dependent upon the location of the Critical Area Buffer. With the exception of the 100-foot upland buffer, all of this NHA falls inside the Critical Area Buffer since the latter must be expanded to include all contiguous wetlands and rare and endangered species habitat. Activities that are allowed and disallowed by the Criteria are the same as those discussed for Mattaponi Natural Heritage Area. The 100-foot upland forested border was included within the NHA boundary to protect the Swamp from excessive sediment, nutrient, or pesticide runoff and from exotic plant invasion.

The Natural Heritage Area boundary is also the Habitat Protection Area boundary for State-listed species protection. Pursuant to the Criteria, State-listed species and habitat must be protected from development activities and disturbances unless it can be shown that these activities or disturbances will not have or cause adverse impacts on these habitats.

7.2.2 *Ecologically Significant Areas*

Pocomoke River Macrosite

Background:

The Pocomoke River Macrosite ESA was recently created. It was designed to encompass the many already existing and smaller ESAs into a more ecologically functional and defensible unit. Initially the ESA boundaries of many sites, discussed below, were designed based on the state of our current knowledge. As our knowledge grew and new data was gathered it became evident that these ESA boundaries were insufficient, often times confusing, and overlapped or were contiguous each other. The most strategic way to address the ecological needs of these ESAs was to create a new macrosite. The alternative approach would have been to delete and redesign the many ESAs now included in the Pocomoke River Macrosite. If this were done much legacy data would be lost due to changes in names referenced many places (i.e. older reports, field forms, etc.) and would lead to further confusion. This is the largest ESA on Pocomoke it accounts for 82% of all the ESA acreage on Pocomoke State Forest.

General Description:

This macrosite encompasses 13 ESAs and creates a more defensible ecological unit. The macrosite boundary consists of the Pocomoke River, tributaries, and surrounding upland buffers. This macrosite supports 53 populations of RTE species tracked by the Wildlife and Heritage Service and an additional 11 locations of Bald Eagle Nests. Among these species include the best examples of many tidal and freshwater systems. This macrosite includes the following ESA boundaries:

- Blades Sandpits
- Corbin Canyon
- Corkers Creek Canal Marsh
- Cottingham Mill Run
- Furnace
- Hickory Point Cypress Swamp
- Mattaponi
- Pocomoke River – Green Run
- Poorhouse Branch
- Poorhouse Branch - Wesley
- South Snow Hill Wetland
- Tilghman Race
- Whiton’s Crossing
- Pocomoke River Macrosite

Brief descriptions of some of the ESAs included with the Pocomoke River Macrosite are below.

Blades Sandpits ESA

General Description:

An area of artificial sandpits harbors four rare plant species and two rare animal species. These sandpits are on private property directly adjacent to Pocomoke State Forest and the protection area buffers for these habitats fall onto PSF.

Management Needs:

No specific management needs are currently required on the PSF portion of this ESA.

Corkers Creek Canal Marsh ESA

General Description:

This ESA is continuous with the Mattaponi ESA and is composed of Corkers Creek North of Rt 113. This riparian ESA supports three rare plant species and an associated buffer.

Management Needs:

No specific management needs are currently required at this time. The riparian forests that compose this ESA are exceptionally high quality and are entirely located with HCVF.

Whiton's Crossing ESA

General Description:

This ESA is situated along the Pocomoke River and includes areas of riparian and floodplain woods with an associated buffer. These woods support a healthy population of the Catchfly-grass (*Leersia lenticularis*). This species of plant is considered Endangered in Maryland and is only located in swamp forests in the Pocomoke River watershed.

Management Needs:

No specific management needs are currently required at this time. The majority of this ESA is located with HCVF forests.

Poorhouse Branch ESA

General Description:

The Poorhouse Branch ESA supports two distinct but significant habitat types. These are the riparian swamp forests along the Pocomoke River and their associated sand ridge systems. The Pocomoke River at this location supports two species considered globally rare: Sea-side alder (*Alnus maritima*) and Long's bittercress (*Cardamine longii*). The sand ridges to the east of the river support Wild Lupine (*Lupinus perennis*), Hairy Snout-bean (*Rhynchosia tomentosa*), and Spotted Butterfly-pea (*Centrosema virginianum*).

Management Needs:

There are no specific management needs for the habitat associated with the Pocomoke River. The majority of this habitat type is located within HCVF. The species located on the sand ridge habitats will likely need habitat management at some point to combat natural succession. Specific management plans will have to be created for specific areas before management activities occur.

7.2.3 *Non-Pocomoke River Macrosite ESAs on Pocomoke State Forest*

Dividing Creek Ponds

General Description:

Dividing Creek Ponds Protection Area encompasses two seasonal ponds that support populations of 6 rare plant species. Additionally the sandy roadside along Fleming Mill Pond Road supports two additional rare plant species.

Management Needs:

Management may be necessary in the northern pond as the rare species documented from this pond have not been documented for many years. The pond has a shrinking canopy due to plant succession. Management may also be necessary in the Southern pond because the state Endangered Club-headed Cutgrass (*Leersia hexandra*) has not been seen in over a decade. This is the only known population of this plant in Maryland.

The protection area boundary includes much of the forested drainage area to maintain apparently acceptable hydrological conditions and to protect the native pond flora from exotic plant species. Management needs of the forested buffer are unclear, and formulation of a management strategy will be dependent upon completion of a thorough landscape history analysis that focuses on differences between extant and pre-settlement conditions. Until then, timber management activities will be precluded from the protection area.

The sand ridge species located along Fleming Mill Pond Road are restricted to the roadside due to the planted Loblolly Pine occupying habitats on the adjacent sand ridges. Management for these species should be considered.

Furnace ESA

General Description:

This ESA consists of high quality sand ridges supporting 18 rare, threatened, or endangered species (plants and animals) tracked by the Wildlife and Heritage Service. Centered around the Furnace Town area, the PSF stands in the immediate vicinity directly support many of these RTE species. All of these species are sand ridge specialists.

Management Needs:

The sand ridges in the vicinity of many of these RTE species have been planted and converted to Loblolly pine stands. The removal of loblolly to restore a more natural system consisting of oaks and hickories with an open understory should promote the expansion and continuation of these RTE species. Specific management plans will have to be created for specific areas before management activities occur.

Furnace Road Power-line

General Description:

The Furnace Road Power line is kept free of trees and shrubs through active management. This open habitat has emergent wetlands and upland meadows that support nine rare plant species tracked by the Wildlife and Heritage Service. Prior to settlement, natural disturbances such as fire and flood created and maintained habitat for these species. Since these natural forces have been suppressed in much of the landscape since settlement, populations of these species have become dependent upon artificially maintained areas such as power line rights-of-way.

Management Needs:

Current management practices are generally beneficial to the rare and endangered species. However, extra care must continue to be taken to assure that woody plant management activities continue to be conducted on acceptable schedules and with minimal impact from heavy equipment. Expansion of this habitat into adjacent stands should be carefully considered and largely could be largely influenced by adjacent forest stand composition and quality.

Forest Road Dunes ESA

General Description:

Furnace Road Dunes ESA was delineated to include a recent (ca. 6 year) post clear-cut and neighboring Sand Ridges that support a globally rare short-leaf pine forested community type. Located in the clear-cut is a small population of the state-endangered shining nutrush (*Scleria nitida*).

Management Needs:

The clear-cut supporting the state-endangered shining nutrush was planted in loblolly pines and is rapidly succeeding into plantation. Management is needed to combat succession to create and maintain the habitat necessary for this species. Restoration of the natural community formerly found in the now cleared area, which was dominated by pond pine (*Pinus serotina*), is desired. Ideally, prescribed fire would be an integral component of this ESA Management.

Sand Road Woods ESA

General Description

This small ESA is bisected by Sand Road. The disturbance associated with roadside maintenance provides habitat for two state-listed species; the thread-leaved Gerardia (*Agalinis setacea*) and a dystiscid beetle (*Hoperius planatus*).

Management Needs

Though roadside maintenance is the reason habitat is currently available for the state-listed species mentioned above, improper mowing (i.e. at inappropriate times of year) could cause the loss of the species from these locations. Coordination with the maintenance crews is needed to ensure the species long term viability at the site.

Sand Ridge Reference Area ESAs:

The following ESAs consist of Sand Ridge Habitats currently supporting a G3 community type characterized as being located on inland sand dunes of the Pocomoke watershed. The vegetation composition characterizing this community is short-leaf pine (*Pinus echinata*), sand hickory (*Carya pallida*), Southern red oak (*Quercus falcata*), water oak (*Q. nigra*) and hillside blueberry (*Vaccinium pallidum*). These ESAs could be used as reference areas for this community type because detailed community plots were taken on these dunes and these data were used in the classification of this community type. These ESAs are:

- Fishhook Dune
- Millville Dune
- Route 113 Dune

Remaining ESAs:

ESAs are created by examining ecological units (i.e. continuous wetlands, soil types) and are drawn without the bias of property ownership. Sometimes this creates odd areas (i.e. slivers) of ESA overlap. These 4 ESAs are ecologically significant units, but a very small amount of acreage is located on PSF. These ESAs are:

- North Millville Swale
- Pollits Branch
- Spearing Road Powerline Swale
- Whiteburg Road Site

Because these ESAs contain such small acreage of Pocomoke lands they will not be independently discussed in detail.

7.3 ESA Management

The goal of ESA management is not only the maintenance of existing rare species habitat, but also restoration of additional habitat to further enhancing RTE populations and natural communities. In addition, the protection of ecosystem function from a landscape level perspective is also an important objective to pursue. ESAs were classified by major natural community or other landscape category that support RTEs. We consolidated all ESAs into 6 ESA types representing the significant and unique natural communities and landscape features occurring on the mid and lower Eastern Shore that should be the focus of management and restoration activities. These included:

1) **Delmarva** or Carolina **Bays** (Stolt & Rabenhorst 1987), which are elliptical non-tidal depressional wetlands with varying hydro-periods that support RTE plant and amphibian populations.
2) **Sand Ridge** complexes which are post-Pleistocene inland sand dunes within the Parsonsburg sand formation (Denny & Owens 1979). These currently or formerly supported pine-oak barrens and have unique plant and animal assemblages.
3) **Emergent Wetland:** typically seasonally flooded wetlands dominated by herbaceous vegetation that include RTE plants, reptiles and amphibians.
4) **Riverine Swamp Forest:** this is a broad group of forested wetlands which includes Atlantic white cedar swamps, bald cypress swamps and other floodplain forests. It also included forests approaching old growth status.
5) **Sandpit:** man-made basins that due to hydro-period and other factors support RTE plant communities.
6) **Complex**, for those ESAs including >1 major natural community or ESA type.

Management zones (**1, 2 or 3**) within ESAs were delineated in ArcMap following definitions given below. The most appropriate forestry practices, given the ecological objectives, were developed for each ESA category and each zone. Included in this zonation was the DNR unit (Wildlife and Heritage Service, Forest Service or both) responsible for implementation of management. The resulting ESA management zone boundaries and expanded stream buffers within ESAs were clipped in Arc Map so there were distinct, non-overlapping map units. ESAs were then clipped to Pocomoke State Forest (PSF) boundaries, so the GIS product would only display management areas on PSF. Additionally, outside of ESAs all expanded stream buffers, and Core FIDS management areas, were clipped into non-overlapping map units (following hierarchy of Core FIDS >stream buffer) within PSF. Lastly, the entire

multiple layer project was topologically cleaned and merged into a single layer. All acreages reported were derived from Xtools in Arc Map 9.3. Use of other area estimators may yield slightly different results

I. **Zone 1** contains RTE species and high-quality natural communities plus buffer. This area is usually managed by Wildlife and Heritage, with site-specific restoration plans developed and implemented. However, at times Wildlife and Heritage will identify specific areas within Zone 1 where Forestry may be able to conduct an economic harvest, typically on a "one-time only" basis. This zone should not be included in sustainable forestry acres.

II. **Zone 2** was used **solely** to describe a secondary management area for Delmarva Bays, i.e., "life zones" for amphibians (Semlitsch 1998, Semlitsch 2003, Semlitsch and Bodie 2003, Semlitsch et al 2009). This management prescription is only found at one ESA on Pocomoke State Forest. For the sake of this exercise, acreages derived from Zone 2 were not considered in computations of sustainable forestry acreage, as its management is fairly restrictive, though limited sustainable forestry is possible. Forestry will be responsible for the management of this zone with input from Wildlife and Heritage.

III. **Zone 3** was the remainder of the ESA not in Zones 1 or 2, except in some instances when expanded stream buffers (300-foot) were within ESAs. Expanded stream buffers were mapped as a separate distinct management layer. Zone 3 was meant to be areas for rare species populations to expand into, once natural communities are restored. This zone will be managed sustainably and in perpetuity by Forestry with input from Wildlife & Heritage.

Throughout this section the term "native genotype" means source plant material that is indigenous to the coastal plains of Maryland and Delaware, and the eastern Shore of Virginia. However, for species present throughout the state, sources from the state or mid-Atlantic region can be considered for planting stock, after consultation between Wildlife & Heritage, the Forest Manager and the State Nursery Manager.

7.4 Management Zone Definitions & Prescriptions by ESA Category & Zone

I) <u>Delmarva Bay ESAs</u>

Only one Delmarva Bay is present on PSF. This Bay is of exceptional quality and is surrounded by mature forests. At this time no specific management is necessary at this bay but if management is necessary in the future the following guidelines should apply.

a) **Zone 1** (Wildlife and Heritage +/or Forestry responsible for management): extends to the edge of the sandy rim or 100 feet from the high-water mark, whichever is greater (this corresponds to legal protection for Nontidal Wetlands of Special State Concern under MD Nontidal Wetland Protection Act of 1990 (COMAR 08.05.04.01.23).

Management*:* Site-specific restoration plans developed by Wildlife and Heritage. Wildlife and Heritage.

b) **Zone 2**: Amphibian Life Zones – from Zone 1 to 500 feet from the wetland edge (based on Semlitsch 1998). There is only one Bay on Pocomoke State Forest.

Management: Given there is only one Bay on Pocomoke State Forest and the Bay and surrounding forest are of such high quality the management for this area should be no-cut. This no-cut buffer will act to prevent the encroachment of non-native and invasive species from becoming established and will provide an example of what these bay

systems would have looked like. This is probably the highest quality bay on the lower shore and should be managed as such.

c) **Zone 3** (Forestry responsible for management with input from Wildlife and Heritage):

Remainder of ESA.

Management:

1) Saw timber rotations are preferable for this zone. Harvest types of group selection or select cuts retaining large mature trees are the compatible harvest types.

2) Natural regeneration is the preferred method; however the planting of a mixture of native genotype hardwoods and pond, pitch and/or short-leaf pines, where appropriate, is permitted after consultations between the Forest Manager and Wildlife and Heritage on species selection during the Annual Work Plan review process.

3) There will be no mechanical site preparation. Prescribed burning will be allowed as a management tool. There will be no chemical control of hardwoods except as may be deemed necessary after consultation between the Forest Manager and Wildlife and Heritage.

II) Riverine Swamp Forest ESAs

a) **Zone 1** (Forestry responsible for management): extends 300 feet to either side of a stream **or** the entire floodplain plus 50 feet, whichever is greater. This is minimum acreage for FIDS and recommended travel corridors for DFS.

***Management*:**

1) 50-foot no-cut buffer closest to stream/floodplain.

2) Remaining 250 feet managed for minimum of 50% hardwood (or Atlantic White Cedar and/or Bald Cypress). Where Loblolly pine plantation are found, thinning may be heavier than normal (post-thinning basal area of > 70 ft^2 / acre). Planting of native genotype trees may be conducted as recommended by Wildlife and Heritage.

3) Once stand composition reaches ≥ 50% hardwood (or Atlantic White Cedar and/or Bald Cypress), this 300-foot buffer becomes a no-cut buffer in perpetuity. It is expected that most of this buffer is already in the prerequisite composition to qualify as a no-cut zone. Many of the Riverine Swamp Forest ESAs are located along the Pocomoke and are currently in the composition that is desirable, thus they should be managed as a no-cut zone. *There is no Zone 2 or 3 for this ESA Category.*

III) Sand Ridge ESAs

a) **Zone 1** (Wildlife and Heritage +/or Forestry responsible for management): Sand ridge soils plus 100 feet into lowland from base of ridge.

***Management*:**

1) Retain all short-leaf, pitch and pond pine

2) Remove all loblolly & Virginia pine

3) Manage for mixed pine-hardwood sparse woodland

4) Natural regeneration or planting of natural genotype short-leaf pine. No site preparation. No hardwood control except as recommended by Wildlife and Heritage. Planting of native genotype short-leaf, pitch and pond pine, and/or selected hardwoods is possible and encouraged in landscapes dominated by loblolly pine.

5) Clearcuts or heavy thinning (post-thinning basal area of > 70 ft^2 / acre) allowed in loblolly pine plantations to facilitate natural stand establishment.

6) Long-term management, i.e., once mixed pine-hardwood sparse woodland is established: single-tree and/or group selection. It is expected that much of the sand ridge habitat found on Pocomoke Forest is already in the desired condition and therefore most of the harvest taking place within this HCVF will be only single-tree or group selection. *There is no Zone 2 for this ESA Category.*

b) **Zone 3** (Forestry responsible for management with input from Wildlife and Heritage): remainder of ESA.

Management:

1) Saw timber rotations with the preferred regeneration harvest being select or group retention harvests of native pines and hardwoods.

2) Natural regeneration is the preferred method; however the planting of a mixture of native genotype hardwoods and pond, pitch and/or short-leaf pines, where appropriate, is permitted after consultations between the Forest Manager and Wildlife and Heritage on species selection during the Annual Work Plan review process.

3) There will be no mechanical site preparation. Prescribed burning will be allowed as a management tool. There will be no chemical control of hardwoods except as may be deemed necessary after consultation between the Forest Manager and Wildlife and Heritage.

IV) <u>Complex ESAs</u>

a) **Zone 1** (Wildlife and Heritage +/or Forestry responsible for management): a merging of overlapping Zone 1 types from above, typically a series of wetlands or sand ridges with 100-foot buffer except for larger areas in Riverine Swamp Forests such as NHAs and Wildlands.

***Management*:** Site-specific restoration plans developed by Wildlife and Heritage. Wildlife and Heritage may recommend "one-time only" harvest of some areas by Forestry, on a case-by-case basis, and also following prescriptions from above.

b) **Zone 3** (Forestry responsible for management with input from Wildlife and Heritage): Remainder of ESA.

Management:

1) Saw timber rotations with the preferred regeneration harvest being select or group retention harvests of native pines and hardwoods.

2) Natural regeneration is the preferred method for both designated management areas; however the planting of a mixture of native genotype hardwoods and pond, pitch and/or short-leaf pines, where appropriate, is permitted after consultations between the Forest

Manager and Wildlife and Heritage on species selection during the Annual Work Plan review process.

3) There will be no mechanical site preparation, however prescribed burning will be allowed as a management tool. There will be no chemical control of hardwoods except as may be deemed necessary after consultation between the Forest Manager and Wildlife and Heritage.

The resulting ESA management zone boundaries were clipped in ArcView so there were distinct, non-overlapping map units. ESAs were then clipped to PSF boundaries, so the GIS product would only display management areas on PSF. Additionally, outside of ESAs all HCVF management areas were clipped into non-overlapping map units (following a hierarchy of stream buffer>DFS>FIDS) within PSF. Lastly, the entire multiple layer project was topologically cleaned and merged into a single layer project (again, with non-overlapping distinct map units associated with management designations). The resulting product is the ArcView product **PSF_Management_Zones**.

7.4.1 *Results and Discussion*

The majority of the 11 ESAs examined in this project are Complex ESAs (87.1%), 2.6% were Riparian ESAs, and 2.3% were Sand Ridge ESAs. ESAs comprise 7,363 acres or 45.8% of PSF.

ESA Zones 1 and 2 totaled 6,877 acres or 37.8% of PSF. The amount of acreage in Zone 1 and 2 on PSF may seem high at first glance, but upon close examination of this acreage the vast majority is located along the Pocomoke River (6,019 acres or 80%). These areas include NHAs, the Critical Area (CA), and Wildlands that are inoperable for forestry activities. It is expected that the areas of ESA Zone 1 found in the Pocomoke River Macrosite are inoperable. The remaining Zone 1 ESA outside of the Pocomoke River Macrosite (and some small areas of loblolly plantation within) may be operable in some fashion and are included in the total acreage for limited forestry activity. This acreage equals 604.4 acres or 3.8% of the forest.

ESA Zone 3, which is available for sustainable forest management, totals 474 acres or 2.6% of PSF. This Zone was subdivided into pulpwood management areas and saw timber management areas.

The area within the entire PSF that is available for limited forest management (ESA Zones 1 & 2) is 6,877 acres. The remaining ESA acreage (located with the Pocomoke River Marcosite ESA) is inoperable for Forestry activities and consists of 5,889 acres.

On Pocomoke State Forest, areas that are available for sustainable forestry, though with varying management prescriptions, include the following: ESA Zone 3 (474 acres or 2.6% of PSF), ESA Zone 1 Sand Ridge Community (13 acres or 0.1%, Core FIDS management (87.9 acres or 0.5%), and DFS management (10,079 acres or 55.4%). Thus, a total of 10,941 acres or 60.1% of PSF is available for sustainable forestry.

These results should allow DNR Forest Service to successfully model the economic sustainability of the PSF. Following the management zones and prescriptions described here and in the PSF Sustainable Plan (MDNR 2010) should also result in the ecological sustainability of the PSF project. Implementation of the management prescriptions for each Zone and ESA categories will require close coordination between Wildlife and Heritage and Forestry. Wildlife and Heritage will still need to produce restoration and management plans for Zone 1 within most ESAs, however all the acreage within ESAs except for some of Zone 1 now has management prescriptions. The Forest Service will follow the prescriptions for Zones 2 and 3 (and Zone 1 where appropriate) when formulating Annual Work Plans (AWPs) for areas within ESAs. Management prescriptions for Core FIDS management areas, DFS

management areas, and expanded stream buffers will follow those within the Sustainable Management Plan. The AWP review process will allow Wildlife and Heritage as well as the entire PSF Interdisciplinary Team the opportunity to refine proposed forest management activities to fulfill these prescriptions.

7.5 Prescribed Burning within ESAs

Some mechanical fire line construction may be necessary within Zones 1, 2, or 3 in order to conduct prescribed burns within fire safety guidelines and according to state burning regulations. All fire lines that are proposed by Forestry within an ESA will be reviewed by Wildlife & Heritage for recommendation as to type and location of fire lines The Wildlife and Heritage Restoration Ecologist must sign off on all burn plans that occur within ESAs. Forestry will contact Wildlife and Heritage within 48 hours preceding a prescribed burn on an ESA.

7.6 Use of Herbicides/Pesticides within ESAs

As a policy, chemicals will not be used in Zones 1, 2 or 3 to control hardwoods; exceptions to this policy will be made only after consultation between the Forest Manager and Wildlife and Heritage. The use of chemicals to control other invasive species within each Zone would be allowed after consultation between Wildlife and Heritage and the Forest Manager. This also includes control of invasive animal species, particularly potentially damaging insects, such as the Asian Long-horned Beetle. The expected damage from the pest outbreak to the ESA and surrounding habitat should be greater than the potential negative effects on rare species populations if the areas are cut or sprayed. In the latter case, consultations would also include the MDA Forest Pest Specialist. These would constitute the only potential exceptions to the no-cut policy for riparian and wetland buffers.

7.7 Annual Work Plans

Concerns for ESAs will also be addressed during Annual Work Plan (AWP) reviews by the full ID Team. This will often be done at the time another silviculture operation (thinning or harvest) is planned. During the AWP reviews, all actions necessary to protect, restore or enhance affected ESAs will be considered.

7.8 Wildlands

7.8.1 *The Maryland Wildlands Preservation System*

The Maryland Wildlands Preservation System is Maryland's counterpart to the federal Wilderness Preservation System and consists of all those properties owned and managed by the Maryland Department of Natural Resources, which were designated as State Wildlands by the Maryland General Assembly.

Statutory Definition

"Wildlands are limited areas of land or water which have retained their wilderness character, although not necessarily completely natural and undisturbed, or have rare or vanishing species of plant or animal life or similar features of interest worthy of preservation for use of present and future residents of the State. This may include unique ecological, geological, scenic, and contemplative recreational areas on State lands" (Natural Resources Article, §5-1201).

Background and History

The Maryland Wildlands Act established the State Wildlands Preservation System in 1971. The first official Wildland in Maryland, the Big Savage Mountain Wildland in Savage River State Forest, was

officially designated by an act of the General Assembly in 1973. As of 2009, twenty-nine separate Wildlands have been designated on over 43,773 acres of State Park, State, Wildlife Management Areas, and State Forest.

Wildlands at Pocomoke

There are presently two designated Wildlands within Pocomoke State Forest: the 3,109-acre Pocomoke River Wildland and the 1,784-acre Cypress Swamp Wildland. The Wildland boundaries overlap most of the above-described Heritage Areas.

The Pocomoke River Wildland, which extends from Pocomoke River Wildlife Management Area to the Shad Landing area of Pocomoke River State Park, contains a combination of cypress swamp and mixed upland hardwood forest. The area also contains a portion of the Mattaponi Natural Heritage Area.

The Cypress Swamp Wildland is located southwest of Pocomoke City north and east of Hickory Point Road. The Cypress Swamp Wildland contains a substantial portion of the Hickory Point Natural Heritage Area.

Both Pocomoke River Wildland and the Cypress Swamp Wildland contain portions of Pocomoke Swamp, which is an isolated northern extension of the Great Dismal Swamp ecosystem. Historical occurrences of State endangered species occur at both, locations.

7.9 Historic and Archaeological Areas

This category features areas in which historical or archaeological artifacts or sites are known or suspected to exist. There is presently one known archeological site adjacent to the Forest boundary, which is the Furnace Town Historic Site the key unit being the Nassawango Iron Furnace. Forest lands adjoining this site may contain artifacts of 19th century buildings, farms and support activities of the Nassawango Iron Furnace, including charcoal-making locations. The management goals within this area include protection of the integrity of the site. Education or display of artifacts may or may not be featured within this site or other potential archeological sites as the promotion of access to such sites may not be desirable.

CHAPTER 8

Wildlife Habitat - Protection and Management

8.1 Introduction

The rich diversity of wildlife species located within the Pocomoke State Forest requires the use of a wide array of adaptive management techniques. The objective is to utilize adaptive management to address the ecological needs of this diversity of wildlife species and habitat types, including different successional stages of forest, (e.g., distribution, size, composition, and juxtaposition of forest patches), riparian buffers, corridors, and interior forest habitat. This approach requires management prescriptions that are anchored in the ecological principle that all of the habitats function in relationship to each other. This is not a definitive prescription, rather an adaptive attempt to best serve the species located on these lands. Using this approach, this part of the plan is broken into three sections: Riparian Forest Buffers; Rare, Threatened and Endangered Species; and Wildlife Management Opportunities.

8.2 Riparian Forest Buffers – High Conservation Value Forest

These areas are intended to provide additional water quality protection as well as provide riparian forest habitat that is important for many wildlife species (see **Chapter 6**). All blue-line streams on Pocomoke State Forest will have stream buffers that extend at least 50 feet from the stream bank on either side and expanded forested riparian buffers 300 feet from the stream bank on each side. This will include other riparian and forested wetland areas that once examined through field review are determined to be in need of a buffer. These buffers will provide additional nutrient uptake for water quality, increased forest interior habitat for wildlife including FIDS, and travel corridors for DFS and other wildlife. They will be managed for the creation and maintenance of mature mixed hardwood-pine forests as described in **Chapter 6**.

8.3 Rare, Threatened, and Endangered Species

8.3.1 *Delmarva Fox Squirrel (DFS)*

(Pocomoke State Forest contains 305 acres of DFS Core & 12,799 acres of Future Core areas)

Almost all of Pocomoke State Forest contains habitat that would be suitable to populations of the Delmarva Fox Squirrel. However, currently there is only one small tract of Pocomoke State Forest located in Somerset County that is part of a larger Core DFS area that extends from a nearby Chesapeake Forest Lands tract. Even though there have been no recent sightings of DFS on Pocomoke State Forest within Worcester County, there are populations present on other state lands both to the southwest and southeast of the State Forest. For this reason, several Future Core areas have been designated on Pocomoke State Forest to serve as future translocation sites for DFS. (**Figure 13**)

8.3.2 *Forest Management for Delmarva Fox Squirrel (DFS)*

Most of the DFS management areas on Pocomoke State Forest are dominated by older loblolly pine and mixed hardwood stands. On lower wet sites, in addition to a mix of pine species there is sweet gum, red maple and a mix of wetland varieties of oaks, in some areas these stands will also contain Bald Cypress. On the higher dry sites in addition to the pines, gum and maple there will be a variety of the upland oaks, American Beech and few other upland hardwood species.

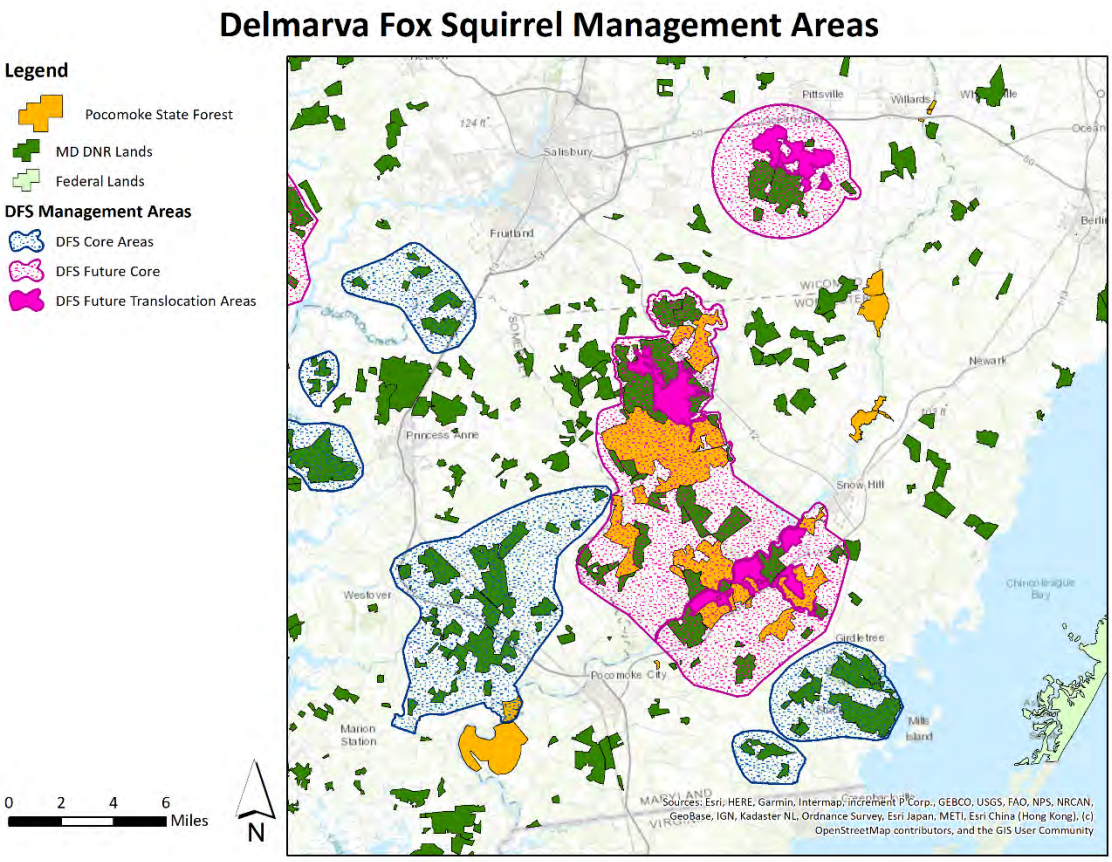

Figure 13: Delmarva Fox Squirrel Areas on Chesapeake Forest Lands & Pocomoke State Forest (2021)

Longer rotations between harvests will be used to achieve and sustain suitable DFS habitat. Intermediate thinning which retains 70 to 80 square feet of basal area and prescribed burning are just a few of the techniques that will be used to achieve the desired habitat type in the shortest amount of time. Natural regeneration will also be used as loblolly pine plantations are thinned and harvested in order to develop a mixed pine hardwood forest type. All hardwood stands will be managed in a way that does not convert the stand to a pine dominated forest type. Stands that are dominated heavily by pine will be thinned in a way that promotes and maintains mast producing hardwoods in both the mid-story and over story canopy.

Based on forest modeling and field analysis, loblolly pine stands and mixed pine/hardwood stands begin to achieve suitable habitat when they reach 40 years of age. In managing for DFS, once this minimum age has been achieved it will be maintained as DFS habitat for at least 20 years. This will result in a minimum rotation length of 60 years for the designated areas of suitable habitat in both Core and Future Core areas. For hardwood dominated forest, site specific field analysis will be used to determine the age that suitable habitat is achieved and minimum rotation lengths of 80 years or longer will be the rule on these sites. For DFS CORE management areas a minimum of 50% of the area must be maintained in suitable DFS habitat. In DFS Future Core Areas, potential translocation sites will maintain a minimum of 800 acres of suitable DFS habitat within an approximate 1,600-acre area at all times for future translocations. The designated areas of suitable habitat within each Future Core area must follow the same management requirements as DFS Core areas. For each DFS management area, the designated acreages of suitable habitat will be identified and tracked via the GIS database for Pocomoke State Forest.

Intermediate Thinning & Regeneration Harvest within DFS Areas

In the development cycle of a new forest, intermediate thinning such as pre-commercial, first, and second thinning operations along with prescribed burning are a few of the techniques that will be used to achieve the desired DFS habitat of a mixed pine hardwood forest. Pre-commercial thinning and first thinning will generally focus on opening up the stand for in-growth of hardwood species and improved growth for residuals. Second thinning will generally focus on improving growth of dominant and co-dominant trees within the canopy while further improving stand composition. When a final regeneration harvest is scheduled to occur, efforts will be made to maintain and create forest corridors, which link suitable habitats across the landscape. Corridor dimensions and characteristics will change with the landscape and site conditions but should generally be at least 300 feet wide and be composed of suitable habitat when possible.

For a regeneration harvest in DFS Management areas, a combination of various harvest methods such as variable retention, shelterwood, deferment, seed tree, etc. may be used to help ensure successful regeneration of the site. A common recommendation for a regeneration harvest is to retain most of the hardwoods and then allow for a mix of pine & hardwood natural regeneration. However, in many cases, the predominant residual hardwood stand is composed of sweet gum and red maple with a few scattered oaks. If left unchecked the residual sweet gum/red maple will tend to dominate the site and interfere with the natural regeneration of the pine and other mast producing hardwood species such as oak. To ensure successful regeneration some limited use of herbicides may be required to reduce but not eliminate the component of gum and maple in the stand. All herbicides used on Pocomoke State Forest would be applied at reduced rates based on results achieved from previous trails carried out on the forest. An alternative to the use of herbicides on some sites would be to implement prescribed fires to control residual vegetation. However, the ability to use fire is greatly limited by site location, weather conditions, and access to local crews skilled in the application of a prescribed fire program. So fire will be one tool used strictly for those sites that would benefit most from its use. In addition, the use of artificial regeneration that involves the planting of native pines and hardwoods may be used to help reestablish the desired mixed pine/hardwood stand. Regeneration harvests on Pocomoke State Forest are limited to a maximum of 40 acres in size based on the Forest Stewardship Council (FSC) standards. When regeneration harvests are implemented, forested corridors will be used as linkages between designated areas of suitable DFS habitat. All proposed harvesting operations along with practices to regenerate the stand will be outlined in the Annual Work Plan (AWP) that is reviewed by an interdisciplinary team of resource professionals from the Department.

8.3.3 ***Bald Eagle***

There are several eagle nests located in or near Pocomoke State Forest. These will change over time as the birds move or populations continue to expand. Guidelines established by the Department will be followed around all eagle nest trees. These guidelines currently require:

Establishment of a protection area around each nest tree, within this area, there are two zones of protection: Zone 1 extends from the nest tree to a radius of 330 feet; Zone 2 extends from 330 feet to 660 feet in radius.

The management guidelines are:

a. No land use changes, including development or timber harvesting, in Zone 1;
b. No construction activities such as clearing, grading, building, etc., within Zones 1 or 2, and ideally should occur to closer than 750 feet from the nest;

c. Selective timber harvesting may be done in Zone 2, but clear cutting should be avoided; and,
d. No construction or timber harvesting activities should occur within either protection zone during the eagle-nesting season, which is from December 15 through June 15.

8.4 Management Opportunities for Other Wildlife Species

8.4.1 *Forest Interior Dwelling Bird Species (FIDS)*

Core areas are designated as High Conservation Value Forest (HCVF).

General Objectives for Forest Interior Dwelling Birds (FIDS)

In general FIDS bird habitat is defined as contiguous forested blocks with interior forest habitat (forest at least 300' from nearest edge) comprising 25% of the forest area. These blocks can range from 100 to 500+ acres and ideally contain a perennial stream or river with a 600' wide riparian forest buffer. Conservation recommendations for FIDS habitat have been developed for Hardwood & Mixed Hardwood Pine Forests and Loblolly Pine Forests. Maryland Wildlife and Heritage Service published a set of guidelines entitled "FIDS Timber Harvest Guidelines" and dated (**Appendix E**). These guidelines will be utilized within the DFS and Core FIDS areas on Pocomoke State Forest.

8.4.2 *Amphibians*

Locations and special management prescriptions for some amphibian habitats are included within the Ecologically Significant Areas land classification (**Chapter 7**). Other amphibian habitat will be protected through expanded riparian forest buffer areas. Forest managers with assistance from a Wildlife and Heritage Biologist will need to identify any important amphibian habitat and adjust forest harvest operations to protect these habitats. Seasonal wetlands and vernal pools are nearly impossible to adequately survey and map from GIS data. Therefore, these critical habitats will need to be identified, GPS-located and protected during field examinations.

8.4.3 *Aquatic Furbearers*

Aquatic furbearers on the state forest include beaver, mink, muskrat, and river otter. This group, though taxonomically diverse, are commonly dependent upon aquatic habitats. Historical management schemes have centered on habitat protection and regulated trapping for recreational and economic opportunity.

Beaver

Beavers are found throughout Maryland and are common in the Pocomoke River State Forest. They are dependent upon plentiful, constant sources of water with nearby woody vegetation. They quickly modify their environment using rocks, sticks, and mud to build dams and protective lodges. Entirely vegetarian, they prefer soft plant foods including grasses, ferns, stems and leaves of aquatic and terrestrial plants. They also eat the bark, twigs, and buds of aspen, maple, willow, birch, alder, and cherry trees.

Currently, beavers are considered common throughout the Pocomoke River State Forest. Regulated trapping and mandatory tagging provide useful data on beaver harvests and subsequent populations.

Muskrat

Muskrats live on or near the still or slow-moving water of ponds, marshes, streams, and rivers. They build lodges of vegetation or burrow into stream banks and dams. Both lodges and burrows have underwater entrances. Muskrats feed primarily on the roots and stems of aquatic plants, such as cattails and bulrushes, as well as a small amount of animal protein, such as crayfish, fish, and mussels. Highly

reproductive, mature females may produce two to four litters per year. Muskrat habitat in the forest appears to be good and subsequent population levels range from moderate to high.

Mink

The mink is a semi-aquatic member of the weasel family. They live at the edge of lakes, streams, and rivers in forested areas. As an opportunist, they hunt along the stream banks of rivers and dive to locate aquatic animals. Prey includes muskrats, mice, rabbits, shrews, fish, frogs, crayfish, insects, snakes, waterfowl, and other birds. Due to the shy, secretive nature of minks, little is known about mink populations at the Pocomoke River State Forest. Studies indicate an individual mink requires approximately three miles of stream on the riverbank.

River Otter

The river otter is an elusive aquatic member of the weasel family. Otters were once found in watershed areas across the State. At present, breeding populations are limited to Maryland's Eastern Shore. The Pocomoke River State Forest contains a watershed that is considered extremely valuable habitat.

8.5 Management Opportunities for Game Species

Personnel with MD DNR Wildlife and Heritage Service were consulted on game species of concern, hunting programs and special habitat considerations. Several sites were visited in the field and recommendations discussed.

Most game species are thriving on Pocomoke State Forest but woodcock and northern bobwhite quail are declining throughout the region. These two species were identified as priorities for habitat management on the forest.

Within the hierarchy of land classifications on the forest, opportunities for quail and woodcock habitat management were sought on the acres that remained in the general timber management category.

Northern Bobwhite Quail Management

Within the hierarchy of land classifications of Pocomoke State Forest, opportunities for quail habitat management should be identified and prescribed within the General Timber Management land classification. In addition, where applicable, quail habitat management practices should be included in the management category designations where these practices are in concert with the management recommendations for ESA areas, FIDS areas and DFS areas.

The general goal for quail management in commercial pine forest is to provide quality permanent herbaceous habitat, not less than 10 acres in size, adjacent to a mosaic of older pine stands with open under stories and regenerating pine/hardwood stands. The permanent herbaceous area should be managed for native herbaceous plants by allowing natural regeneration or planting some native warm season grasses. These permanent herbaceous areas should be located on the edge of the site so as not to fragment the forest stands on the tract, or on some of the larger old wildlife field plots scattered throughout the forest. The herbaceous condition can be maintained by periodic controlled burns and/or disking. Quail benefit from periodic disturbances to their habitat. Some of the smaller wildlife field plots can be planted to hardwood species to provide diversity and increase wildlife habitat value to the surrounding pine stands. The older pine stands should be managed for diverse herbaceous understory vegetation by thinning to allow sunlight to reach 40-70% of the forest floor. Ideally, controlled burns should follow thinning every 2–5 years depending on site conditions and available resources. Timber harvests adjacent to the permanent herbaceous habitat site should be in the 10 to 50 acre size providing a greater diversity in timber age classes and habitats around the core quail site. Regenerating mixed

pine/hardwood stands should be thinned heavily during the first thinning by removing two adjacent rows instead of one.

Although individual quail coveys (groups of birds) only require approximately 40 acres of land to meet all their needs, research shows that several thousand acres of connected habitat is needed to support a viable bobwhite population. Therefore, scattered, isolated patches of habitat are not sufficient to hold populations of bobwhites with current low densities. The goal of bobwhite management on CFL should be to create a mosaic of early successional/regenerating/thinned pine, pine/hardwood stands with nearby herbaceous areas, and older age timber stands.

Woodcock Management

Woodcock management opportunities will be highest on poorly drained loamy soils like those found in soil management groups 1 and 2 on stands within the General Timber Management land classification.

The general goal for woodcock habitat is to provide a mosaic of regenerating hardwood seedling/sapling stands with herbaceous openings in close proximity.

Woodcock need rich humus layers (that support earthworms) covered by dense sapling growth (to provide protection from aerial predators) and little to no under story (to allow detection of terrestrial predators). Short rotation timber management with frequent re-entry cycles would be complementary to woodcock management. Final harvest sites should be 10 to 50 acres in size.

Mechanical site prep followed by bedding damages humus layers and woodcock habitat and so should be avoided where possible. On final harvest areas that are site prepared, consideration will be given to leaving some areas (up to 10%) with no site prep and no planting. These sites would be managed to regenerate naturally to hardwood saplings. Site prep operations that avoid some areas and or site prep by fire, followed by spot planting will likely be complementary to woodcock management.

Deer Management

Deer thrive in the mixed-structure situation common on Pocomoke State Forest and their numbers can become a serious ecological problem, particularly when they over-browse vegetation and alter biological diversity. In order to maintain a productive forest, deer populations need to be managed at socially and ecologically acceptable levels through hunting. The goals for deer management include maintaining population levels that allow natural tree growth and regeneration; limiting browsing impacts on rare, threatened, and endangered plants; and limiting deer impacts on neighboring agricultural lands. These goals will be achieved through public hunting (**Chapter 9**).

Wild Turkey Management

Although wild turkeys are thriving on the lower Eastern Shore of Maryland, PSF should be managed to provide the high-quality habitat required to continue supporting high turkey population densities. Many practices implemented to benefit bobwhite quail will also benefit wild turkeys. Thinning and controlled burning of pine stands, maintenance of permanent herbaceous openings, and seeding of logging roads and landings to a cool season grass/legume mix will encourage optimal turkey brood habitat that is thought to be the most critical and limiting factor affecting wild turkeys in Maryland. Additionally, hard mast producing tree and shrub species are an important component of wild turkey habitat and should be retained and their establishment encouraged during forest management operations.

Squirrel Management

Squirrels generally prefer hardwood forests. In the Pocomoke State Forest, as the percentage of hardwoods increase in forest stands, squirrel population numbers should be more abundant. Squirrel

management is relatively passive since these creatures are highly adaptable and greatly influenced by natural circumstances; however, some of the more important management considerations involve regulated hunting, increasing available nesting sites, promoting mast production, and encouraging vertical diversity of forest stands. The vertical structure of the forest is more critical to flying squirrels than to any other squirrel species. Gray squirrels generally live in forest interiors and are found predominantly in more mature forest stands. A suitable number of den sites, mast producing trees, and a multistory, unevenly aged forest stand are critical for maintaining preferred squirrel habitat. Leaving mast producing trees, over mature trees, snags, and downed logs during forest management operations will promote squirrels.

8.6 Waterfowl

Aquatic habitats located within and surrounding the Pocomoke River State Forest, support several species of waterfowl. Open water areas include the Pocomoke River, its tributaries, and several swamps. Waterfowl use these habitats for nesting, foraging and resting areas.

Wood ducks and mallards are the most common resident species. Wood ducks nest in tree cavities and man-made structures along wooded shorelines and upland areas. Young birds feed exclusively on animal matter, such as aquatic and terrestrial insects. As the birds mature, their diet shifts to vegetable matter, primarily acorn, and other forms of hard and soft mast.

Mallards nest in marshy areas and along protected shorelines using cattails, grassy areas, and fallen logs for cover. Mallards are highly adaptive feeders that use numerous native and agricultural foods. Native plant materials include wild millets, grasses, smartweeds, and rushes. Agricultural foods consist of numerous types of waste grain including com, wheat, barley, and oats.

Black ducks and hooded mergansers may occasionally nest in the Pocomoke River State Forest (Wm. Harvey, per comm.). Black ducks nest in a variety of habitats, but are dependent on dense ground cover. Hooded mergansers, like wood ducks, are cavity nesters and utilize similar habitats.

Numerous species of waterfowl use the aquatic habitat of the Pocomoke River State Forest as stopovers or resting areas during migration. Ducks, geese, and swans have been observed periodically throughout these habitats.

Current management of waterfowl in the Pocomoke River State Forest is limited to erection and maintenance of wood duck nesting boxes. Management commensurate with watershed protection should adequately address this group’s needs.

CHAPTER 9

Public Use & Education

9.1 Background

Pocomoke State Forest is an integral component of a larger greenway system that connects other public and private forest, state and local county parks and state wildlife management areas. These sites in addition to their natural, cultural, and historic values provide a variety of recreational opportunities. Decisions affecting public uses (recreational opportunities) on Pocomoke State Forest are integrated into management decisions that are consistent with the following resource goal as stated in **Chapter 1**: *"Provide opportunities for the enjoyment of the natural resources on the Forest by making appropriate areas available for resource-based, low impact recreational activities and environmental education programs that are consistent with the resource values of the Forest."*

9.2 Current and Future Public Uses

The demand both nationwide and locally indicate that outdoor recreational activities such as hiking, horseback riding, wildlife viewing, hunting, fishing, off-road vehicle use, canoeing and kayaking continue to be popular. The public's pursuit of these activities continues to play a major role in Maryland's economic growth and tourism industry. Therefore, all future public use proposals will be evaluated based on the resource goal stated above to determine their compatibility with:

- The implementation of sustainable forest management;
- The conservation of wildlife;
- The conservation of plant and animal habitats and other sensitive areas;
- The maintenance of water quality;
- And the protection of cultural resources.

The primary types of public use to be encouraged on the Pocomoke State Forest include activities such as hiking, hunting, fishing, birding, horseback riding, nature/wildlife observation, environmental education, trapping, and access for canoeing and kayaking. In select cases, minimal development may be undertaken to provide and maintain off-road vehicle trails, mountain bike trails, hiking trails and disabled hunter access trails.

9.2.1 *Hunting*

Wildlife populations must be managed to ensure a healthy forest. Therefore, public hunting opportunities will be provided to limit the population growth of game species and ensure the protection of the forest and other habitat areas. This plan attempts to identify the proper combination of hunting as well as other appropriate recreational uses. The forest is open to hunting and fishing in season. The important forest game birds and mammals include the following species: wild turkey, white-tailed deer, and gray squirrels. Due to the fact that 96% of the forest is classified as forestland, this group of wildlife species is common throughout the forest. Trapping on portions of the PSF for furbearers is permitted through the issuance of a trapping lease.

Upland game birds and mammals are not as common on the forest but do provide for hunting opportunities. Low populations of eastern cottontail rabbit, bobwhite quail, mourning dove, and American woodcock can be found in recently cutover areas, open land habitats that exist on the forest, or near private agricultural lands adjacent to the forest.

Aquatic habitats located within and surrounding the forest support several species of waterfowl. Open waters include the Pocomoke River, its tributaries, and several swamps/marshes. Wood ducks and mallards are the most common species.

Hunting with rifles, handguns, shotguns, bows and muzzleloaders are permitted in all designated areas in accordance with state and federal laws. Possession or use of weapons is prohibited in State Forests outside of the regular open hunting season. Target shooting is prohibited. All game birds and game mammals may be hunted. Game shooting stands are limited to those of a temporary nature, which must be removed or dismantled at the end of each day. The hunting season in State Forests conforms to standard hunting seasons adopted by state and federal regulations.

9.2.2 *Hiking, Biking Horseback Riding, Nature Observation and Off-Road Vehicles*

Although hunting is the most popular activity, there is an extensive forest road system on the Pocomoke State Forest that offers many opportunities for hiking, biking, horseback riding and nature observation. These activities will be encouraged on all tracts provided there are no other user conflicts.

9.2.3 *Pocomoke State Forest Trail System*

The Pusey Branch Nature Trail is a ½ mile self-guided Nature Trail and is complimented by informational signs and exhibits. The trail leads you through pine plantations, mixed pine/hardwoods stands and along bottomland hardwoods. The Milburn Landing Hiking Trail is a 4.5-mile trail that winds along narrow fire trails and wooded roads. Managed woodlands and a wide variety of plant and animal life can be observed. The Hudson-Tarr Tract Bike Trail system is approximately 4 miles of wooded roads that take you through various forest types. Managed woodlands as well as protected Wildlands can be observed along this trail. Parts of the nearly 13-mile Algonquin Cross County Trail go through Pocomoke State Forest. This multi-use trail gets substantial use from hikers, runners, horseback riders, and mountain bikers. The Furnace Loop trails are three interconnected trails of varying length and difficulty that link the historic Furnace Town site to the Algonquin Cross County Trail. Trail Grants will be utilized to improve the existing network of trails throughout the Pocomoke Forest trail system. All new trial system proposals as well as maintenance work will be submitted and reviewed through the Annual Work Plan process.

9.2.4 *Pocomoke State Forest Off Road Vehicle (ORV) Trail*

The 6.5-mile PSF Chandler Tract ORV Trail along with the other ORV trails on state forest property, were established in 1976 under MD Annotated Code 5-209 and DNR Regulation 08.01.03. The Chandler Trail listed under regulation 08.01.03.11.F has operated strictly as a recreational site for use by ATVs and motorcycles. Originally, four-wheel drive vehicles were permitted but were banned due to safety and environmental reasons. The establishment and location of this trail in the 1970s met the criteria under section .10 of the regulation as known by local field staff at that time.

Over recent years, the importance and management of certain natural communities on our State Forest have become more clearly defined on the landscape. The Department is mandated under both the ORV regulation and the Annotated Code to protect any known “unique” natural areas.

Title 5-209 states: *no off-road vehicle may be permitted where its operation will damage the wildland character of the property,*

Regulation 08.01.03.10.C, states:

(1) The Department shall locate ORV trails to minimize:
(b) Damage to soil, watershed, vegetation, or other resources;

(2) The Department may not locate ORV trails in:
(e) Areas possessing unique natural, wildlife, historic, or recreational values as determined by the Department.

Evaluations by DNR staff of the Chandler ORV trail has determined that significant environmental impacts are occurring along two specific sections of this trail from the repeated use of motorized vehicles. The first area is an inland sand dune complex, and the second area is a long riparian corridor along Corkers Creek. The portion of the trail along Corkers Creek was closed in the spring of 2009 and temporary measures were installed to protect the sand dune complex along the other portion of the trail. The Forest Service in conjunction with the Wildlife & Heritage Service also determined that more than half of the area covered by the ORV trail falls into an old growth management area as identified by a recent survey based on the Old Growth guidelines in **Appendix H**. This determination led to the temporary closure of the entire trail in January of 2010.

The Department of Natural Resources (DNR) completed a series of statewide assessments and studies in the summer of 2010 to evaluate the impacts of ORV Trails on sensitive environmental features on DNR lands. The ORV Trail at Pocomoke State Forest was identified early in the assessment process as having significant environmental conflicts with continued ORV use. With the completion of the assessments, DNR held a public meeting on March 23, 2011, to discuss the findings and recommendations of the assessments. The DNR recommendation for the Pocomoke ORV Trail is to permanently close the Trail, which was accomplished in the fall of 201l. Since that time, the trail has been stabilized and has been converted into a hiking and biking trail.

9.2.5 *Water Access for Canoeing, Kayaking and Fishing*

The Pocomoke River and its tributaries offer opportunities for canoeing, kayaking, and fishing. The Forest tracts at Porters Crossing and Whiton Crossing along the Pocomoke River offer access/take out points. Pocomoke State Park located adjacent to the Pocomoke State Forest also provides access to the Pocomoke River. The Corkers Creek-Blackwater Canoe Trail located at Shad Landing State Park is a 2-mile self-guided canoe trail along Corker's Creek and the Pocomoke River. A kayak and canoe soft launch was established at the terminus of Blades Road at the former site of the Mattaponi crossing, which is located about halfway in between Shad Landing and Milburn Landing State Parks on the Pocomoke River. The Nature Conservancy maintains portage opportunities on Nassawango Creek. Dividing Creek can be accessed off Dividing Creek Road. All these waters offer flat-water boating for the novice or experienced canoeist. Improvement of these areas or development of additional water access opportunities will be submitted and reviewed during the Annual Work Plan process.

9.3 Education and Public Outreach

The Department's goal for Pocomoke State Forest is that it will be a national model of sustainable forest management, in addition to increasing the public's awareness concerning the importance of sustainable forest management and its connection to the health of the Chesapeake Bay. The Forest is seen as a "living laboratory" or "outdoor classroom" where resource professionals and the public can learn. Therefore, education and the development of forest management demonstration areas will be very important. This goal will be achieved by:

- The continuation and constant update of the Pocomoke State Forest website;
- The development of brochures and other written material about the Forest;
- And the provision of tours and other public forums for educating the public about the Forest.

9.3.1 *Pocomoke State Forest Website*

The website (http://dnr.maryland.gov/forests/Pages/publiclands/eastern_pocomokeforest.aspx) has been and will continue to be an invaluable mechanism for communicating with the public. It has been used to share general information and annual work plan (AWP) projects. However, its future value is dependent on the Department's ability to continually update the information.

9.3.2 *Educational Material*

The Department should consider the placement of interpretive markers or informational kiosks at the public use areas experiencing the highest visitation. These kiosks would include a map and information on the Forest and sustainable forest management. One example of this approach is found at the self-guided hiking trail on the Milburn Landing Tract. The Department annually updates its educational trail guide by developing information emphasizing sustainable forest management. The Department should also consider the development of a CD-ROM that contains information about the forest, its resources, and the connection to the Bay. This could be a cooperative effort between the Forest Service, the Wildlife and Heritage Service, and the Park Service.

9.3.3 *Tours and Forums*

The Department should sponsor forest management field days that educate the public in the values of sustainable forest management and working landscapes. These field days could be targeted to the public that are using the Forest as a way for them to be educated and understand the Department's approach to forest management and the relationship of their use to this management. The Department will continue to sponsor cooperative research projects as part of the implementation of the Monitoring Plan (**Chapter 10**). Possible partners could include universities such as Salisbury University and the University of Maryland Eastern Shore, private non-profit organizations like the Chesapeake Bay Foundation and local community service organizations. In addition, the Department should involve the Maryland Conservation Corps, local school groups, scouting organizations and local environmental groups in the implementation of projects identified in the Annual Work Plan (AWP).

9.4 Implementation

As with the other management activities, recreational and educational activities will be included as proposals within the Annual Work Plan (AWP). These activities will be reviewed by the Pocomoke State Forest interdisciplinary team and once reviewed and approved will be implemented as part of the AWP process. Public use activities will also be monitored to ensure there is not conflict with the other management goals or degradation of the sensitive resources found on the forest. Limits of Acceptable Change procedures and protocols will be used to monitor these public use activities (see **Chapter 10**).

CHAPTER 10

Pocomoke State Forest Monitoring Plan

10.1 Introduction

The primary goal of the Pocomoke State Forest Project is to provide sustainable natural resources, from water, fisheries, and wildlife habitat to timber, education, and recreation contributing to the local environment and economy. The Pocomoke State Forest and Chesapeake Forest are being managed for sustainable forestry using similar strategies and combined efforts. Concepts of sustainability are based on the international standards of sustainable forestry represented by the Montreal Process Criteria and Indicators http://www.rinya.maff.go.jp/mpci/whatis_e.html. MD DNR participates in the National Roundtable for Sustainable Forests to further improve coordination and use of sustainable forestry practices http://www.sustainableforests.net/. Critical sustainability standards for this Forest includes no soil deterioration or nutrient loss, no decline in water quality from activities, no loss or decline of species, the protection of special areas, an acceptable flow of jobs and revenue, and stakeholder satisfaction with results.

Monitoring is crucial to the ability of the Pocomoke State Forest (PSF) to supply its intended sustained yield of a variety of forest resource benefits. At a minimum, the monitoring activities must meet current requirements for certification and reporting. Monitoring is necessary to document sustainable practices, provide information to adapt management, and carry out elements required for certification as a sustainable forest by the Sustainable Forestry Initiative (SFI) and Forest Stewardship Council (FSC). The FSC specifically identifies monitoring and assessment as one of its ten Principles, and monitoring data are needed to meet a number of SFI Core Indicators. Evaluation of the range of elements being sustained relies on an interdisciplinary plan that monitors a wide range of aquatic and terrestrial features. A monitoring project on this scale provides opportunities for scientific study, collaboration, and external funding. It also provides challenges, such as the need for an efficient, coordinating structure for the monitoring program and how to overcome limits to the involvement of current staff in the project. This critical component of the Pocomoke State Forest Plan will not be successful unless support continues to be adequate, whether financed by Forest income or other sources.

On Pocomoke State Forest (PSF), the process has just begun to implement the detailed layers of monitoring described within this chapter. A re-sampling of CFI plots within the generally managed areas of PSF was just completed in the fall of 2009. Additional sampling of plots within Wildland/Heritage areas will begin in the spring of 2010 this will be followed by sampling within other strata as detailed in this plan.

10.2 Monitoring Plan

The monitoring plan supports the needs of the Pocomoke State Forest Project using a multi-tiered approach:

- Tier I: a landscape-scale inventory
- Tier II: a stand/complex-level inventory, and
- Tier III: project-specific assessment and research.

In order to more efficiently use resources data collection is coordinated as much as possible among the different units' staff and with similarly managed land holdings like Chesapeake Forest. The exact number of points to be sampled will depend on the number of points falling within multiple strata, and

potentially on the cost/effort for sampling. Power analysis and community dynamics models will be used to help determine the appropriate number of samples to allow trends in population changes to be detected. At the beginning of each section, the SFI Objectives and FSC Principles that are addressed by these elements of the monitoring plan are listed, with text descriptions supplied in **Appendices B** & **C**.

Data obtained from the monitoring will be used to update the Pocomoke State Forest Geographic Information System, and spatially integrated with the base ownership layer. DNR units and personnel have been assigned to manage the layers of information based on data source and unit expertise, including Forest Service, Wildlife & Heritage Service, Land Acquisition & Planning Ecosystem Restoration Services, and Information Technology. New data is added to the GIS system through the data manager assigned for the respective layers.

10.3 Tier I: Landscape-scale, Long-term Monitoring

10.3.1 *Objectives*

The focus of Tier I monitoring is overall biodiversity and ecosystem health. It provides the basic inventory data for forest management, sensitive resources, and water quality over terrestrial and hydrogeomorphic regions. Tier I monitoring provides the information base for Sustainable Forestry Initiative certification Objectives 1, 3, 4, 5, and 6, and for Forest Stewardship Council certification Principles 5, 6, 7, 8, 9, 10 (Objectives and Principles listed in **Appendices B** & **C**). The first round of data collection was started in 1999 and completed in 2002 a resample on a portion of PSF was completed in the fall of 2009 with additional sampling of plots to occur within designated Wildland/Heritage areas to be done in the spring of 2010. Data layers inventoried include:

1) Forest overstory condition, including stand inventory, tree growth rates, and regeneration status, yielding information needed to determine sustainable levels of harvesting;
2) Forest understory condition, including height of canopy layers, species, diversity, and presence of invasive species;
3) Wildlife and habitat information, habitat features like snags, woody debris, stand size class, percent canopy, vertical diversity, and suitability for endangered Delmarva Fox Squirrel habitat; and
4) Water quality surveys of nutrient status, macroinvertebrate populations, and aquatic habitat condition that supplement the Maryland Biological Stream Survey data, supplying water quality status and aquatic invertebrate species presence and diversity.

The inventory sampling approach assures representation of sensitive resource areas like forest interior habitat, cypress wetlands, xeric sand ridge habitats, Delmarva fox squirrel habitat, ecologically significant areas, and riparian areas. Special area boundaries including sensitive species protection and restoration areas and cultural resources such as ruins, graveyards, research plots, or wells have been added to the GIS system as encountered or sought out. Inventories are scheduled for update every 10 years.

The definition of sustainability given above for the publicly owned Pocomoke State Forest included stakeholder satisfaction with results. Existing processes, including public meetings on annual work plans, interdisciplinary team for management review, and the Citizens Advisory Committee, all provide outlets for expression of stakeholder views. Information is provided on the DNR website, (http://dnr.maryland.gov/forests/Pages/publiclands/eastern_pocomokeforest.aspx) including the current management plan and annual work plans. These information sources will be used at a minimum to

estimate stakeholder satisfaction. Independent survey of known stakeholders may be undertaken if outside funding and partners are secured.

10.3.2 *Methods Overview*

Strata for sampling were chosen for major factors of interest and to control for known variation. Stream and water quality sampling are organized around geomorphic region and the stream network, while terrestrial sampling uses strata based on forest type and habitat for sensitive resources (**Table 17**). Geomorphic regions split out areas based on underlying geology and topographic characteristics, which usually control major differences in stream chemistry (e.g., acid or alkaline, base levels of nutrients). The stream network is stratified on position relative to State ownership and will correspond partially to stream order; streams originating entirely in State land are likely to be smaller (first, second, or third order), while streams passing through or bordering State lands are likely to be larger (third order or higher). Terrestrial strata focus on major stand types and areas with rare species and natural communities, most of which are already defined and available in digital form, since these two criteria have the greatest effect on management actions undertaken. The information base for the sampling is the Pocomoke State Forest GIS system.

Table 18: Strata for Long-term Monitoring on PSF

Stream and Water Quality Sampling		**Terrestrial Vegetation and Species Sampling**	
Geomorphic Region	***Stream Location***	***Forest Composition***	***Sensitive Resources***
Surficial Confined	Originates in State Forest	Pine	Forest Interior Dwelling Species (FIDS) Core
Fine-grained Lowland	Passes through CF	Upland Hardwood	Delmarva Fox Squirrel (Management Areas)
Well-drained Upland	Borders CF	Bottomland Hardwood	Ecologically Significant Areas (e.g., xeric sand ridges) & High Conservation Value Forest
Poorly Drained Upland		Mixed Pine-Hardwood	Riparian/Wetland Areas,
Poorly Drained Lowland		Bald-cypress	

10.3.3 *Terrestrial Vegetation and Species Sampling*

Vegetation structure and composition will be quantified using methods similar to those of the Continuous Forest Inventory, based on USDA Forest Service inventory sampling and analysis methods. Plots randomly sampled from a grid overlaying the management unit. In addition, percent ground cover, canopy cover, vertical layer presence and height, tree regeneration, coarse woody debris, depth of organic layer, forest health indicators, and data for invasive species, shrubs, and herbaceous plants will be collected. Data summaries for forest overstory include tree volume, basal area, density, and growth rates. All permanent sample points are expected to be sampled at least once every 10 years. In order to ensure that there are adequate samples to examine trends in the data, a minimum of 20 plots were assured for the less common strata like Ecologically Significant Areas.

To gather detailed data on bird and reptile/amphibian abundance and habitat features, a subset of sensitive resource plots will be selected for additional data collection using multiple visits from spring to late summer to adequately sample seasonally available populations. Calculations for wildlife information will include diversity indices, relative frequency, and relative abundance. Multivariate analyses are used to determine relationships between stand types, age classes, and stand history and observed population characteristics. Vegetation information from the detailed wildlife habitat subset of

plots may be analyzed using detrended correspondence analysis techniques to identify community types and other associations.

Living organisms will be monitored with emphasis on sensitive species or indicators of ecosystem functions, including forest interior dwelling and other birds, reptiles, and amphibians. Standard methods include constrained time searches, pitfall traps, and call counts, tailored to the habits of target species.

10.3.4 *Stream and Water Quality Sampling, Procedures, and Progress*

For aquatic samples, points are chosen using stratified random sampling from mapped ("blue-line") stream sections that are 150 m in length. Streams must traverse a minimum of 1000 feet on a PSF parcel. These stream sampling points are re-randomized for each sampling event (at least every 5 years) in order to more accurately capture the general condition of the aquatic resources.

Water quality monitoring will use procedures outlined in Boward and Friedman (2000) or current Maryland Biological Stream Survey sampling methods. Water samples are collected during base flow at all sites with water, standing or free flowing in a defined channel, avoiding the 24-hour period following a minimum of 0.5" of rain. Sampling includes flow (L/s), water temperature (^{o}C), dissolved oxygen (mg/L), pH, and conductivity measurements at each site using field instruments (e.g., Hydrolab Surveyor II). Grab samples of whole water are collected just below the water surface at mid-stream and filtered in the field (0.45: pore size Gelman GF/C filter). To allow for analysis of nitrogen species, the samples are stored on ice and frozen the day of collection for later lab analysis. Analysis includes dissolved inorganic nitrogen (mg N/L of NO^3, NO^2, NH^4) and dissolved inorganic phosphorus (mg P/L PO^4). All analyses are conducted in accordance with US EPA protocols.

Aquatic benthic macroinvertebrates are collected using methods developed for mid-Atlantic coastal plain streams that are compatible with and comparable to Maryland Biological Stream Survey (MBSS) sampling protocols (Kayzak, 2001). Samples are collected only from free-flowing streams, avoiding inaccuracies associated with evaluating standing pools. Sample processing is done according to MBSS guidelines (Boward and Friedman, 2000). Habitat assessments based on US EPA methods for low gradient streams (Barbour et al., 1999) are completed at all macroinvertebrate stations. Summary measures include the Benthic Macroinvertebrate Index of Biotic Integrity, Habitat score, and percent of suitable habitat.

10.4 Tier II: Stand/Complex-level Medium-term Monitoring

10.4.1 *Objectives*

This level of monitoring is used to give more specific information on:

1) Occurrence and management needs for rare, threatened, or endangered species, or natural communities,
2) Areas where invasive species threaten populations of rare species,
3) Stands or complexes where more information is needed to support high production of wood fiber or other marketable product, or
4) Other species or areas of interest that occurs across several stands.

Emphasis will be placed on sites that need to be protected, enhanced, or restored to maintain healthy native communities. Factors assessed at this scale include water quality and sensitive resources, including species presence, richness, and diversity. In areas identified for high production of wood fiber or other marketable forest products, more frequent and more intensive forest stand data may be needed to inform management options. These monitoring activities will occur more frequently and in focused

areas compared to Tier I monitoring. Tier II monitoring supplies information needed to carry out or document SFI Objectives 1, 3, 4, 6, and 8, and FSC Principles 5, 6, 7, 8, 9, 10.

Forest communities of interest on the Pocomoke State Forest include shortleaf pine (*Pinus echinata*) and pond pine (*Pinus serotina*). Overstory and regeneration will be monitored to determine that these less abundant pine types are being maintained in the current stands or other areas with suitable habitat. Monitoring of regeneration will be based on needle characteristics like length, flexibility, and diameter since cones would not be present. Monitoring of regeneration is designed to allow diagnosis of threats to maintaining these pine forest communities, and to allow management actions to be taken to increase abundance prior to loss of parent trees. Other natural communities of interest with monitoring needs related to management and protection include sand ridges, old growth and nearly old growth forests, and other High Conservation Value Forest.

10.4.2 *Methods Overview*

Sample points for sensitive resources will be selected using random sampling or, when necessary, stratified random sampling. Cluster sampling may be used for rare plants. For forest stand condition, systematic grid sampling will be used for greatest efficiency, avoiding lining up the grid with obvious landscape patterns (streams or ridges) to preclude bias in sampling. Data collection will occur more frequently than in Tier I monitoring, with the timing dependent on the organisms/habitat features to be monitored. This monitoring may be ongoing or of limited duration.

Standard methods available in federal or state manuals or published peer-reviewed research will be used to collect data for:

- Water quality indicators such as stream nutrient export, wetland condition, fish and aquatic macroinvertebrate assemblages;
- Forest stand condition indicators such as vegetation structure and composition, invasive species, natural plant communities, insect and disease impacts, fuel loading, and stand density;
- Rare, threatened, and endangered species presence, diversity, and abundance; and
- Presence of invasive species that threaten the survival of rare, threatened, or endangered species;
- Natural community diversity metrics;
- Other indicators of ecosystem recovery and function.

Impacts from trails including both hiking and All-Terrain Vehicle (ATV) routes, can be monitored in specific areas of concern using standard limits of acceptable change (LAC) procedures (Stankey et al., 1985; McCool and Cole, 1998) and procedures developed specifically to assess trail impacts (Marion and Leung, 2001). Methods to monitor populations of rare, threatened, and endangered species in Ecologically Significant Areas and other areas of interest will depend on the organisms of interest. Protocols will generally follow standardized methods presented in Tier I. Power analyses will be used to help determine the appropriate number of samples to allow a trend to be detected. Unique natural communities will be monitored using standard plot methods for community classification. Forest stand information may include data for stand-level growth and yield modeling, soil sampling, and overstory and understory composition.

10.4.3 *Invasive Species*

Information on general occurrence of invasive plants will be captured in the Tier I inventory, and updated on the same cycle as that inventory. Previous inventory of invasive species found a predominance of Japanese stiltgrass (*Microstegium vimineum*) on Pocomoke State Forest, especially along roadsides. More intensive monitoring and control will be targeted to those areas where they might

compromise the health and survival of rare, threatened, or endangered species or natural communities. Invasive species control plans will be developed in conjunction with rare species protection and restoration plans. Control plans will include actions to prevent or minimize re-infestation of problem species, such as when management operations are in adjacent areas. Control options will be tailored to the situation and species, and may include physical, chemical, or biological controls. Stiltgrass populations on roadsides can be controlled through targeted broadcast spraying, which often helps control further movement into the forest. The spread of invasive plant species will also be minimized as much as possible through Best Management Practices for timber harvest and other management activities.

Problematic invasive species are sometimes identified in routine field operations, outside of rare species habitat. In these cases, staff will determine the potential to interfere with the survival, health, or regeneration of native forest stands. Where the invasive species is a significant detriment, a management strategy for control will be developed and included in the annual work plan review. Chemical control is anticipated in many settings because of the general effectiveness and cost-efficiency, although any effective option including physical or biological control will be considered. Species that have potential to interfere greatly with forest health and regeneration include multi-flora rose, mile-a-minute, and Japanese wisteria.

10.5 Tier III: Management Activity-based Short-term Monitoring

10.5.1 *Objectives*

Monitoring at the Tier III level measures responses to management activities at a finer scale, including silvicultural treatments, restoration projects, and public uses that may affect a portion of a stand or the whole stand. This level of monitoring includes updates of stand-level information to reflect recent management actions and some focused scientific studies, with monitoring occurring on both control and experimental areas before and after the manipulation. Measurement and monitoring of soil quality, water quality, and species presence, richness, and diversity allow us to monitor these indicators of sustainability from the Sustainable Forest Management Plan for the Pocomoke State Forest Project over the long term. Tier III monitoring is needed to document compliance with SFI Objectives 1, 2, 3, 4, and 6 and FSC Principles 5, 6, 7, 8, 9, and 10 (**Appendices B** & **C**).

10.5.2 *Methods Overview*

Sample plots are chosen randomly or systematically within appropriate control (reference) and experimental areas (areas to be manipulated). Where possible, at least 3 replicates are sampled for each type, with more than one sample taken in each plot. Potential experimental area treatments include prescribed burns, herbicide applications, harvest systems and practices, watershed restoration and improvement projects, and ESA restoration activities. Measurements of stand health, biodiversity, productivity, soil fertility, water quality, and species-specific responses are most appropriate for this level of monitoring.

10.6 Procedures by Forest Management Actions

Harvesting (For SFI Objectives 2, 3, 4, 5, 6):

All thinning and regeneration harvest operations are checked for compliance with Best Management Practices (BMP). Harvest Site Review checklist items include Haul Roads\skid trails & Landings, Merchandizing & Selection, Streamside Management Zones (SMZ) & Stream Crossings, Safety BMPs, and Aesthetics.

The harvest area selection process occurs through Interdisciplinary Team review, based on an Annual Work Plan recommended activity list generated by the forest manager. Stands are selected based on age, stocking levels and species composition. Consideration is given to size of the area to be harvested and its proximity to stands less than seven years of age. Currently, most silvicultural prescriptions have been for final harvest however a transition over commercial first and second thinning will occur over the next several years. Silvicultural prescriptions may be modified based on the following:

- Presence of rare species, and Forest Interior Dwelling Species, Wetlands of Special State Concern, Threatened and Endangered species (state and federal) (existing database and some field checks);
- Stream/ditch buffers (later identified and flagged in the field);
- Cultural sites (e.g., graveyards, ruins);
- Presence or absence of advanced regeneration (i.e., whether suitable for natural regeneration, planting, or direct seeding).

10.6.1 *Site Preparation*

Natural regeneration is considered as the first option, so advanced regeneration is evaluated (plot counts to estimate seedlings/acre, with attention to distribution over harvest area). Site preparation methods considered by the Interdisciplinary Team for the Annual Work Plan review include but are not limited to prescribed burning, herbicide application, and mechanical treatment.

10.6.2 *Prescribed Burning*

Prescribed burning is recommended for site preparation or after thinning to control understory vegetation and encourage regeneration of native fire-adapted plants. Procedures for establishing the prescription for a burn include evaluating the site for fuel load, ability to carry a burn, locations of fire breaks, and potential hazards of smoke to surrounding locations (e.g., well-traveled roads, confined livestock, neighbors). Prescribed burn plans are prepared by MD DNR fire staff, using guidance from "A Guide to Prescribed Fire in Southern Forests" (1989, USDA FS National Wildfire Coordinating Group publication PMS 431-2). MD DNR fire personnel evaluate all sites after burning to determine if the burn met the stated objectives. MD DNR Wildlife and Heritage staff specialists evaluate selected sites with high potential for rare species for presence and abundance of target species following burn treatment. On the Pocomoke State Forest, understory burning to enhance shortleaf pine regeneration is planned. Regeneration monitoring will be used to evaluate the level of success of this practice and identify factors to improve regeneration.

10.6.3 *Herbicide Application*

The use of herbicides is being minimized on Pocomoke State Forest, but there are instances where their use is appropriate to effectively shape the stand to its desired condition for forest products and/or habitat with minimal impact to soils. Herbicides are applied according to label restrictions, with spray buffers around flowing streams or open water. Application is most commonly by air (helicopter), with backpack application used where spot spraying is the only need. Management on Pocomoke State Forest in many areas seeks to establish a mixed stand that includes pine and hardwoods, particularly oak species valuable for rare species such as Delmarva Fox Squirrel and many other wildlife species. Oak species tend to be more resistant than other hardwoods such as sweetgum and red maple to a commonly used herbicide such as Arsenal AC (imazypyr) at reduced rates. While gum and maple are native species, the lack of wildfire has allowed their density and frequency to greatly increase at the expense of other hardwoods, and they lack the mast that is a winter staple for wildlife. Monitoring of regeneration density and type will allow evaluation of current practices in developing the desired mix of stand types.

Results of trials of reduced herbicide rates applied on Chesapeake Forest lands will also be considered for management on Pocomoke State Forest since many stand and soil types are shared.

10.6.4 *Mechanical Treatment*

Mechanical site preparation usually involves heavy equipment such as a bulldozer, which may be augmented by lighter equipment such as chain saws or brush saws. A drum chopper may be used to condense slash and allow the site to be burned and planted. If slash is too dense to permit regeneration or planting, root raking and piling is considered. Root raking may also be used in restoration efforts to remove invasive species from unique habitats (i.e. windrows in Carolina Bays). Riparian buffers are flagged in the field to assure that machinery does not affect water bodies and no delivery routes for sediment are established during the operation. Excessive rutting and soil compaction are avoided as required in Maryland Forest Harvesting BMPs and are monitored using the Harvest Site Review form.

10.6.5 *Intermediate Operations*

Commercial and pre-commercial thinning is planned for the Pocomoke State Forest. The same procedures as outlined for harvesting are followed, regarding site review, modification of operation for rare or sensitive species, and BMP compliance. Fertilization is not typically practiced, but soil tests for nitrogen, phosphorus, and pH before and after application will be used if application is needed.

10.6.6 *Special Area Projects for Water Quality*

Some additional restoration projects may be undertaken for water quality and wildlife objectives. Watershed improvement projects will be chosen in locations where slowing water could improve nutrient and sediment levels in water leaving Pocomoke State Forest. Projects require at least two critical elements: 1) waterway and topography where water can be slowed and backed up to increase residence time without adversely affecting neighboring lands, and 2) source of nutrients or sediment, such as from agricultural lands (rates from forest lands are already low). Monitoring includes pre-project baseline information and post-project assessment of water quality and vegetation.

Habitat Improvement Projects are chosen in areas with great potential to support rare species or natural community types. MD Wildlife and Heritage Service is developing management plans for selected areas, and restoration projects will be implemented as part of the annual work plan. Projects include clearing trees in areas where rare species depend on more open conditions, disturbance to mimic natural process, prescribed burning and restoring hydrology where past drainage has reduced extent of wetland habitat. Presence and extent of rare species or appropriate indicators will be recorded before and after projects.

10.6.7 *Special Area Projects for Wildlife & Heritage*

Portions of Pocomoke State Forest lands are being surveyed annually for bird presence through statewide and regional count programs. These bird counts are added to other regional and national data. A detailed study of bird use, including forest interior dwelling species, was completed in the early 1990s by principal investigators at Frostburg State University, and found extensive use even in some pine-dominated regions. Follow-up study of this result is anticipated in partnership with Frostburg State or another university.

10.6.8 *Public Use and Recreational Activity*

Hunting is permitted on Pocomoke State Forest lands. For lands open to public hunting, monitoring consists of periodic roadside vehicle counts during hunting season. The annual harvest report includes estimates for harvest by species: white-tailed deer, sika deer, turkey, dove, quail, squirrel, and rabbit.

Public use data will be collected via checklist surveys, permit applications, and other quantitative methods comparable to those used by the USDA Forest Service, US Fish and Wildlife National Refuge System, and Maryland DNR Wildlife and Heritage Service.

Other recreational activities (such as trail use for horseback riding, bird watching, or hiking) are monitored through use agreements outlining terms and conditions of use for organized for-profit groups. Ongoing survey efforts such as the national surveys for fishing and hunting and county recreational surveys will be used as additional information sources and for context to allow comparisons of patterns of use on Pocomoke State Forest. Other methods such as online user forms and honor system use survey boxes will be used as time, resources, and departmental approval permit. As stated earlier, impacts to use areas may be monitored using limits of acceptable change (LAC) protocols, provided funding is available (Stankey et al., 1985; McCool and Cole, 1998).

CHAPTER 11

Pocomoke State Forest Annual Work Plan - Process

11.1 Annual Work Plan

The Annual Work Plan (AWP) will be the controlling document to assure that the Land Manager is effectively carrying out the sustainable management plan for the land, and that the Department is fully informed and supportive of the management actions planned and taken. The Pocomoke State Forest Manager is responsible for the preparation of the Annual Work Plan. **Figure 14** depicts the process used in the development of the Annual Work Plan.

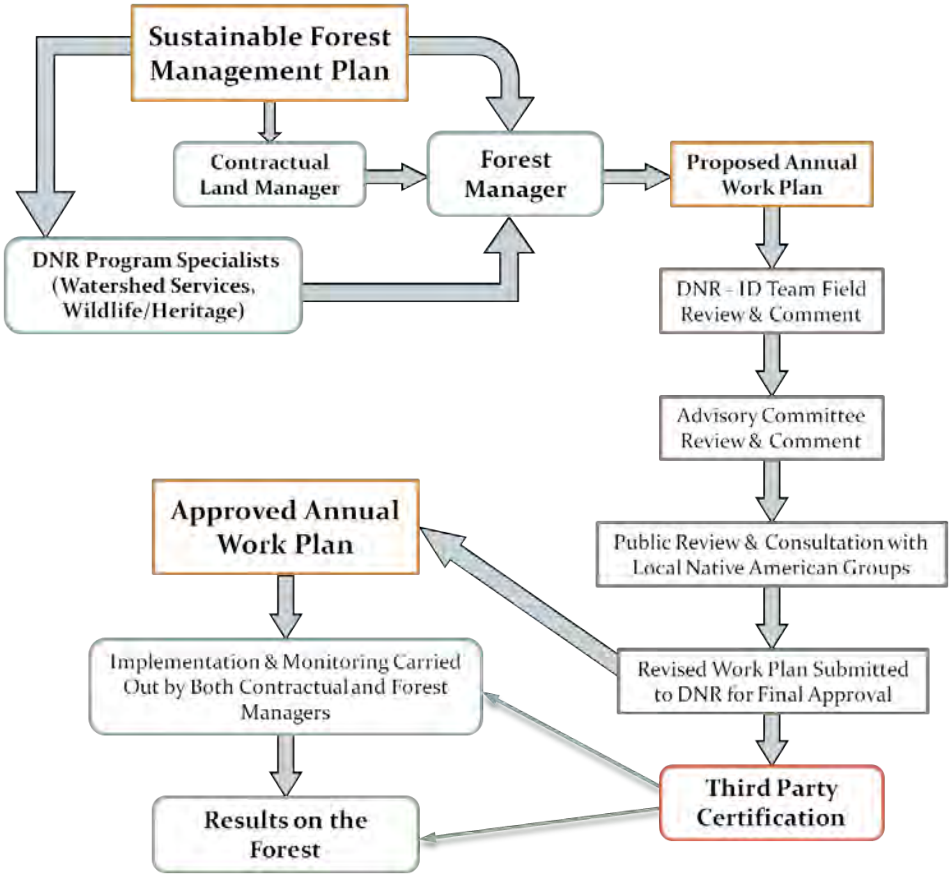

Figure 14: Annual Work Plan development process

The concept of an annual work plan that establishes the land management program for an entire year is an important key to successful implementation of sustainable forest management on Pocomoke State Forest. A land management contract that covers both Chesapeake Forest Lands and Pocomoke State Forest was implemented via a contract process called an RFP (Request for Proposals) beginning in July 2011. It will be the job of the Contract Land Manager to implement the silvicultural practices outlined in each Annual Work Plan. It will be the responsibility of the DNR State Forest Manager to oversee day to day operations on Pocomoke Forest and the implementation of each Annual Work Plan. The amount of work that needs to be done, coupled with the tendency of Eastern Shore soils to be too wet at times to support equipment without soil or water damage, means that the both the State Land Manager and the private contract manager must be able to plan and schedule work well ahead of time, arrange for sub-

contractors, and be ready to move rapidly when weather and soil conditions are favorable. This will be accomplished through a well-defined and detailed annual work plan that will plan out forest management and restoration projects over a year in advance of the actual work.

Figure 14 shows how achieving desirable on-the-ground results, which are the key outcomes of the annual work plans, requires the cooperation of a variety of players. Several parties are involved in the process all with key roles, but the persons central to all implementation, monitoring and reporting are the Land Managers. In this process, the lines of responsibility essential for success are clearly defined. The Land Managers are responsible for implementing the Annual Work Plan in a manner that is both environmentally and fiscally responsible. Quarterly reports submitted by the contractual Land Manager to DNR maintain a constant flow of information so that problems can be quickly identified and addressed.

Once implementation is underway, the ongoing process of carrying out forest management activities will result in changes in on-the-land conditions, as well as new information gathered. The on-ground results will be verified by a third-party certification process, which will be conducted every 3-5 years. Certification is done to compare the achieved results with the planned outcomes of the management prescriptions contained in this plan and the Annual Work Plans. The independent 3rd party auditors will report their findings to the Land Managers. Where field or operational deficiencies are noted, it will be the responsibility of the Land Managers to correct them. Any deficiencies identified in the management plan or its goals will be addressed by Maryland DNR. The audit report, and any subsequent actions taken, will be available to the public.

Implementing the Pocomoke State Forest plan involves adaptive management, where research and monitoring are given a high priority, and new information is constantly gathered to feed back into the basic data management system and all future plans. The Land Managers are responsible for reporting key findings as well as maintaining a constantly updated data management system that is always available for making forecasts, guiding management decisions, and providing a current information base that can support plan reviews or amendments in the future.

11.2 Annual Work Plan Timetable

Annual Work plan development along with the necessary environmental and regulatory reviews will strive to follow the following process/timelines:

1. The Contractual and DNR Land Managers begin fieldwork to review sites to be included in the next annual work plan from November through March;
2. The DNR Land Manager drafts a proposed work plan and sends it for ID Team review by July 1.
3. The DNR – ID Team reviews the proposed plan, a field review of proposed activities in the work plan is scheduled and comments returned to the DNR Land Manager at least two weeks before the scheduled ID Team field review;
4. The DNR Land Manager presents the proposed work plan to the Forest Citizens Advisory Committee for comment and review by December 1.
5. This above process includes consultation/review with local Native American Groups and the Maryland Commission on Indian Affairs concerning potential sites of special cultural, ecological, economic, or religious significance.
6. The DNR Land Manager reacts to needed changes and submits a revised plan to DNR Headquarters by January 1.
7. The final step is the AWP will be posted on the DNR webpage for a 30-day public comment period, to be completed no later than March 1.

8. The DNR Headquarters obtains final official approval of the Annual Work Plan, as revised, by June 1.
9. The Land Managers begin implementing the approved Work Plan July 1.
10. Independent Third-Party Auditing for forest certification begins after the year ends and is repeated every 3-5 years, depending on certification requirements.

11.3 Contents of the Annual Work Plan

- Identification of proposed silvicultural activity for the year, including stands to be thinned or harvested, sprayed, burned, or otherwise treated;
- Identification of areas to be planted or treated to achieve reforestation;
- Identification of special areas to be treated for improvement of watershed or wildlife habitat conditions, establishment or improvement of water quality zones or wildlife buffers, or other special areas; and,
- Identification of recreational, maintenance, monitoring, and any other special projects that are proposed.

The Annual Work Plan will contain a proposed budget for the year, including revenue and cost estimates for all proposed activities. The Land Managers will be responsible for overseeing all activities to ensure the desired environmental and silvicultural result, while maintaining cost effectiveness and targeted economic returns.

CHAPTER 12

Operational Management

12.1 Introduction

This section of the plan is designed to cover the annual cost and revenues associated with the operational management of Pocomoke State Forest. It is the Department's intent that most of the revenues generated from the PSF will be used to pay for the management and operation of the Forest. As stated in **Chapter 1** of this plan, "*The primary goal of the Pocomoke State Forest Sustainable Management Plan is to demonstrate that an environmentally sound, sustainably managed forest can contribute to local and regional economies while at the same time protecting significant or unique natural communities and elements of biological diversity.*"

The numbers expressed in this section are only estimates and averages of annual expenses and revenues. These numbers will fluctuate each year based on management prescriptions, economic conditions, and public use of the forest.

The following information is a breakdown on Revenues and Operational costs associated with the Pocomoke State Forest. Yearly changes in the timber markets and weather conditions can severely affect revenues. Operational expenses will vary from year to year mainly based on costs associated with proposed restoration projects. For many watershed restoration projects, other sources of revenues such as matching grants will be sought to help offset the cost to the Department.

12.2 Pocomoke Forest Revenue

Revenues that are generated from the Pocomoke State Forest are deposited into the Department's Forest Reserve Fund. In order to cover expenses out of this Fund, a Pocomoke Forest Budget must be developed a year in advance as part of the larger DNR budget. It then goes through the legislative approval/review process along with all other state operating budgets. Once adopted, the budget goes into effect the first day of the fiscal year (July 1st).

Forest Product Sale Revenue: This revenue is generated from the sale of forest products, which are identified in the Annual Work Plan. Traditional forest products include pulpwood and sawtimber from first and second thinning and regeneration harvests. This revenue is tied to forest harvest activities identified in the annual work plan and will vary each year. With the current age class distribution of the forest, most revenue will be from "thinning" operations.

12.3 Operational Cost

Operational expenses are those costs paid directly out of Chesapeake Forest revenues either by the State Forest Manager and or by the private contractual land manager. These costs are only estimates and will vary each year, some of these costs are tied directly to the amount of revenues generated each year.

12.3.1 *Staffing Cost*

This cost is associated with Departmental contractual staffing and State Personnel classified salaries. This staff is responsible for developing annual work plans, managing the daily activities on the forest, including boundary line work, road and gate repairs, recreational activities such as the public hunting programs and implementing all restoration projects.

12.3.2 *Land Operation Cost*

This includes expenses for office and field equipment, vehicles, gates, gravel, signs, boundary paint, roadwork contracts and construction, trash removal from illegal dumping, boundary line work & surveying, tree planting, site preparation, control of invasive species, pre-commercial thinning, and other forest management practices. Some of these costs will vary greatly from year to year based on the activities identified in the Annual Work Plan.

12.3.3 *Forest Certification, Inventory & Monitoring Program*

This estimate reflects the annual cost of various on-going research projects on the forest. Expenses are directly tied to the Chesapeake Forest Monitoring Plan and Forest Certification. The purpose of forest monitoring is to accurately evaluate forest health and the effects of specific management activities. Resource managers will use the information to make informed future management decisions (i.e., adaptive management). Cost would cover both forest resource and sensitive habitat inventories and monitoring the effects of various restoration projects.

Expenses for forest certification will vary from year to year and will be at their highest at the initial certification and then every three or five years when the re-certification is done. Routine audits are used to verify compliance with the various certification programs. The goal is to certify Pocomoke Forest under both the Sustainable Forest Initiative (SFI) and the Forest Stewardship Council (FSC). Each certifying agency takes a slightly different look at what is needed for sustainable forest management. Expenses will include fees for audits and annual monitoring programs for compliance with the certification requirements.

12.3.4 *County Payments*

These are revenue payments to the Worcester County government that will vary every year. Payments are made on an annual basis based on 25% of the timber revenue generated from the forest. These payments are used to help the counties offset the loss in property tax revenues that are not paid on state owned lands.

12.4 Other Revenue/Funding Sources

Other budgetary funding that is utilized on an annual basis in the management of Pocomoke State Forest comes from a variety of sources. There are General Funds which are state tax revenues provided annually to cover a small portion of the operational budget. Most of these funds are used to pay Chesapeake Forest staff salaries. At this point, there are two full-time state personnel working on the Pocomoke State Forest, a forest manager, and one forest technician. Future plans include hiring additional staffing to cover wildlife management activities, restoration projects and additional forestry related activities.

Other funding comes in the form of grants through state and federal sources and primarily are utilized in habitat and watershed restoration projects. These funds are project specific some funding will be obtained through partnerships and grants, such as State Highway SAFETEA funds. Expenses include the installation of ditch plugs and water control structures, removing invasive species and re-establishing native plant communities and habitat. Additional funding comes through submitting applications for trail grants for forest trail maintenance and construction.

12.5 Summary

This is the general breakdown in the Revenues and Operational Cost associated with the Pocomoke State Forest. As described, these figures will vary from year to year. A more detailed picture on

revenues and operational cost will be provided within each Annual Work Plan and an annual report prepared by the Land Manager. This generalization of the operating budget suggests the importance of maintaining income levels in order to achieve the goals set forth in the other portions of this plan (i.e., sustainability).

APPENDIX A

Pocomoke State Forest - Citizens Advisory Committee

Appointments to the citizen advisory committee are recommended by existing committee members and the Forest Manager. While the Secretary of Natural Resources makes all appointments, consideration will emphasize retention of a diverse committee make-up representing the variety of advocacy groups, user groups, and professional disciplines interested in the management of the forest.

Primary Objectives of the Advisory Committee include the following:

1. Ensure that work plan proposals meet the needs of as many interest areas as possible and contains provisions that make the plan sensitive to the concerns of all user groups.
2. Follow-up review of all interdisciplinary reviews to eliminate any oversights, or clarify misunderstandings.

Interest areas represented on the committee include the following:

Recreation

(Hiking, horseback riding, bird watching, etc.)

Sportsman

(Fishing, hunting)

Wildlife Interest

(Audubon, National Wildlife Federation, TNC, Ducks Unlimited, etc.)

Conservation Interest

(TNC, Trout Unlimited, National Wild Turkey Federation, U.S. F&WS, etc.)

Forest Industry

(Mill representative or logger)

Socioeconomic Interest

(Local business or community/governmental representative)

Forest Conservation District Board Member

(Representative from County Board in the area of State Forest)

Indigenous Peoples

(Representative from a local indigenous tribe)

APPENDIX B

FSC-US Forest Management Standard (v1.0)

(w/o FF Indicators and Guidance)

Recommended by FSC-US Board, May 25, 2010
Approved by FSC-IC, July 8, 2010

PRINCIPLE 1: COMPLIANCE WITH LAWS AND FSC PRINCIPLES
Forest management shall respect all applicable laws of the country in which they occur, and international treaties and agreements to which the country is a signatory, and comply with all FSC Principles and Criteria.

PRINCIPLE 2: TENURE AND USE RIGHTS AND RESPONSIBILITIES
Long-term tenure and use rights to the land and forest resources shall be clearly defined, documented and legally established.

PRINCIPLE 3: INDIGENOUS PEOPLES' RIGHTS
The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognized and respected.

PRINCIPLE 4: COMMUNITY RELATIONS AND WORKER'S RIGHTS
Forest management operations shall maintain or enhance the long-term social and economic well-being of forest workers and local communities.

PRINCIPLE 5: BENEFITS FROM THE FOREST
Forest management operations shall encourage the efficient use of the forest's multiple products and services to ensure economic viability and a wide range of environmental and social benefits.

PRINCIPLE 6: ENVIRONMENTAL IMPACT
Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and the integrity of the forest.

PRINCIPLE 7: MANAGEMENT PLAN
A management plan -- appropriate to the scale and intensity of the operations -- shall be written, implemented, and kept up to date. The long term objectives of management, and the means of achieving them, shall be clearly stated.

PRINCIPLE 8: MONITORING AND ASSESSMENT
Monitoring shall be conducted -- appropriate to the scale and intensity of forest management -- to assess the condition of the forest, yields of forest products, chain of custody, management activities and their social and environmental impacts.

PRINCIPLE 9: MAINTENANCE OF HIGH CONSERVATION VALUE FORESTS
Management activities in high conservation value forests shall maintain or enhance the attributes which define such forests. Decisions regarding high conservation value forests shall always be considered in the context of a precautionary approach.

PRINCIPLE 10: PLANTATION MANAGEMENT
Plantations shall be planned and managed in accordance with Principles and Criteria 1- 9, and Principle 10 and its Criteria. While plantations can provide an array of social and economic benefits, and can contribute to satisfying the world's needs for forest products, they should complement the management of, reduce pressures on, and promote the restoration and conservation of natural forests.

REGIONAL LIMITS AND OTHER GUIDELINES ON OPENING SIZES

SOUTHEAST REGION

The guidelines describe below are not binding to the certification of forest management in the Southeastern United States. They have been retained in order to provide certification bodies and other stakeholders in forest certification with the spirit of the original, SE Regional Standard position on the use and size of clear-cuts.

Indicator 6.3.g.1.a

- Primary and natural forests: clear-cutting is not allowed. Harvesting is not allowed at all in ***primary forests***.
- Semi-natural forests: stands with trees greater than 100 years old: clear-cutting is not allowed; even-aged stands of hardwood and cypress: clear-cutting is allowed; the size of openings should be conservative.
- Even-aged stands of pine and pine/hardwood: clear-cutting is allowed; the size of openings should not be higher than the limit for plantations and should be justified by natural regeneration requirements.

Clear-cuts up to 80 acres are allowed in cases where a 40-acre stand would not provide enough timber volume to secure an economically operable timber sale, meaning that the sale would not attract a buyer and/or the landowner would not make a profit from the sale. Examples of such cases include stands that have been high graded and the most valuable species of trees have already been removed, or where a site has been planted with inappropriate, poorly growing species and the landowner/manager wants to clear and restore the site. This exception cannot be used when a 40-acre clearcut would be economically operable and a landowner wants to cut 80 acres simply to make a greater profit.

Clearcuts up to 80 acres are allowed in cases where harvesting a stand in 40 acre blocks would cause unnecessary environmental disturbance to the area surrounding the stand.

An exception to all of the limits on the use and size of clearcuts can be made in cases of ecologic necessity. Clearcutting may be used in natural forest stands--where appropriate and necessary--as a tool for maintaining ecosystems that are dependent on large, contiguous openings. An example is the sand pine scrub ecosystem, which supports the ecologically significant Florida scrub jay and is currently being managed with large, contiguous clear-cuts. Ecologists urge the use of large clearcuts in the sand pine scrub ecosystem to mimic the stand-replacing, catastrophic fires that historically maintained the ecosystem. This exception may only be used when supported by scientific literature.

STREAMSIDE MANAGEMENT ZONE (SMZ) REGIONAL REQUIREMENTS

SOUTHEAST REGION

6.5.e.1 (SE only) Streamside or special management zones (SMZs) are specifically described and/or referenced in the management plan, included in a map of the forest management area, and designed to protect and/or restore water quality and aquatic and riparian populations and their habitats (including river and stream corridors, steep slopes, fragile soils, wetlands, vernal pools, seeps and springs, lake and pond shorelines, and other hydrologically sensitive areas).

At a minimum, management of SMZs has the following characteristics:

- Management meets or exceeds state BMPs.
- SMZ width reflects changes in forest condition, stream width, slope, erodibility of soil, and potential hazard from windthrow along the length of the watercourse.
- SMZs provide sufficient vegetation and canopy cover to filter sediment, limit nutrient inputs and chemical pollution, moderate fluctuations in water temperature, stabilize stream banks, and provide habitat for riparian and aquatic flora and fauna.

- Characteristic diameter-class distributions, species composition, and structures are adequately maintained within the SMZs.

For additional information go to the Forest Stewardship Council – United States homepage at: https://us.fsc.org/en-us

APPENDIX C

Sustainable Forestry Initiative® (SFI) 2022 Standard

Note: This following information is an excerpt from Section 2 of the SFI 2022 Forest Management Standard. For additional details go to http://www.sfiprogram.org/sfi-standard/.

Forest Management Standard Principles

1. **Sustainable Forestry**
To practice *sustainable forestry* means meeting the needs of the present while promoting the ability of future generations to meet their own needs by practicing a land stewardship ethic that integrates *reforestation* and the managing, growing, nurturing and harvesting of trees for useful products, and for the provision of *ecosystem services* such as the *conservation* of soil, air and water quality and quantity, *climate change adaptation and mitigation, biological diversity, wildlife* and *aquatic habitats,* recreation and aesthetics.

2. **Forest Productivity and Health**
To provide for regeneration after harvest, maintain the health and productive capacity of the forest land base, and to *protect* and maintain *long-term* soil health and *productivity.* In addition, to *protect* forests from economically, environmentally or socially undesirable impacts of wildfire, pests, diseases, *invasive species* and other damaging agents and thus maintain and improve *long-term forest health* and *productivity.*

3. ***Protection*** **of Water Resources**
To *protect* and maintain the water quality and quantity of water bodies and *riparian areas,* and to conform with forestry *best management practices* to *protect* water quality, to meet the needs of both human communities and ecological systems.

4. **Protection of Biological Diversity**
To manage forests in ways that *protect* and promote *biological diversity*, including animal and plant species, *wildlife habitats, ecologically and culturally important* species, *threatened and endangered* species (i.e., *Forest with Exceptional Conservation Values*) and native *forest cover types* at multiple scales.

5. **Aesthetics and Recreation**
To manage the visual impacts of forest operations, and to provide recreational opportunities for the public.

6. **Protection of Special Sites**
To manage lands that are geologically or *culturally important* in a manner that takes into account their unique qualities.

7. **Legal Compliance**
To comply with applicable federal, provincial, state, and *local forestry* and related environmental laws, statutes, and regulations.

8. **Research**
To support advances in sustainable forest management through research, science, and technology.

9. **Training and Education**
To improve the practice of *sustainable forestry* through training and education *programs.*

10. **Community Involvement and Social Responsibility, and Respect for Indigenous Rights**
To broaden the practice of *sustainable forestry* on all lands through community involvement, socially responsible practices, and through recognition and respect of *Indigenous Peoples'* rights and *traditional forest-related knowledge*.

11. **Transparency**
To broaden the understanding of forest certification to the *Forest Management Standard* by documenting certification audits and making the findings publicly available.

12. **Continual Improvement**
To continually improve the practice of forest management, and to monitor, measure and report performance in achieving the commitment to
sustainable forestry.

13. **Responsible Fiber Sourcing**
To use and promote *sustainable forestry* across a diversity of ownership and management types in the United States and Canada that is both scientifically credible and socially, environmentally, and economically responsible and to avoid sourcing from *controversial sources* both domestically and internationally.

SFI 2022 Forest Management Standard Objectives

A Summary of the *SFI 2022 Forest Management Standard Objectives* follows:

Objective 1. Forest Management Planning
To ensure forest management plans include *long-term* sustainable harvest levels and measures to avoid forest conversion or *afforestation* of *ecologically important* areas.

Objective 2. *Forest Health* and *Productivity*
To ensure *long-term* forest *productivity* and *conservation* of forest resources through prompt *reforestation, afforestation,* deploying *integrated pest management* strategies, *minimized* chemical use, soil *conservation*, and protecting forests from damaging agents.

Objective 3. *Protection* and Maintenance of Water Resources
To *protect* the water quality and water quantity of rivers, streams, lakes, *wetlands*, and other water bodies.

Objective 4. *Conservation* of *Biological Diversity*
To maintain or advance the *conservation* of *biological diversity* at the *stand*- and *landscape*-level and across a diversity of forest and vegetation cover types and successional stages including the *conservation* of forest plants and animals, *aquatic species, threatened and endangered* species, *Forests with Exceptional Conservation Value, old-growth forests* and *ecologically important* sites.

Objective 5. *Management* of *Visual Quality* and Recreational Benefits
To manage the visual impact of forest operations and provide recreational opportunities for the public.

Objective 6. *Protection* of *Special Sites*
To manage lands that are geologically or *culturally important* in a manner that takes into account their unique qualities.

Objective 7. Efficient Use of Fiber Resources
To *minimize* waste and ensure the efficient use of fiber resources.

Objective 8. Recognize and Respect *Indigenous Peoples'* Rights
To recognize and respect *Indigenous Peoples'* rights and traditional knowledge.

Objective 9: Climate Smart Forestry
To ensure forest management activities address *climate change adaptation* and *mitigation* measures.

Objective 10. Fire Resilience and Awareness
To limit susceptibility of forests to undesirable impacts of wildfire and to raise community awareness of fire benefits, risks, and minimization measures.

Objective 11. Legal and Regulatory Compliance
To comply with all applicable laws and regulations including, international, federal, provincial, state, and *local.*

Objective 12. *Forestry* Research, Science and Technology
To invest in research, science and technology, upon which sustainable forest management decisions are based.

Objective 13. Training and Education
To improve the implementation of *sustainable forestry* through appropriate training and education *programs.*

Objective 14. Community Involvement and Landowner Outreach
To broaden the practice of *sustainable forestry* through public outreach, education, and involvement, and to support the efforts of *SFI Implementation Committees.*

Objective 15. *Public Land* Management Responsibilities
To participate and implement sustainable forest management on *public lands.*

Objective 16. Communications and Public Reporting
To increase transparency and to annually report progress on conformance with the *SFI Forest Management Standard.*

Objective 17. Management Review and Continual Improvement
To promote continual improvement in the practice of *sustainable forestry* by conducting a management review and monitoring performance.

For additional information on the Sustainable Forestry Initiative go their website at: http://www.sfiprogram.org/.

APPENDIX D

Pocomoke State Forest: Soil Management Groups

This is a forest management grouping designed specifically for the Pocomoke State Forest plan, based on the soil series descriptions contained in the three county surveys.

Management Group 1 – Poorly and very poorly drained medium textured soils with heavy subsoils.

Soils:
- Askecksy loamy sand
- Elkton sandy loam
- Elkton silt loam
- Othello silt loam

Description: These are poor and very poorly drained, medium textured soils that have a fine-extured subsoil. They are generally found in broad upland flats, depressions, and swales. Slopes are 0 to 2%. Ponding may occur after heavy rains, and high water table may limit access from December through May. These soils may have seasonal limitations for wetness, but the firm subsoils may allow mechanical operations, particularly with low-impact equipment, that allows them to be managed with intensive forestry methods.

Management Group 2 – Poorly and very poorly drained loam and sandy loam soils with sandy and medium textured subsoils.

Soils:
- Berryland mucky loamy sand
- Fallsington-Glassboro complex
- Hurlock loamy sand
- Klej loamy sand
- Klej-Galloway complex
- Mullica-Berryland complex

Description: Medium and sandy-textured, poorly and very poorly drained soils on upland flats. Small areas in depressions will be ponded in very wet periods. Many of these soils lack firm subsoils, and when saturated may be very subject to soil rutting by equipment. This leads to shorter-season access, which may limit their use. With appropriate seasonal scheduling, these soils are suited for intensive forest management.

Management Group 3 – Well drained and moderately well drained sandy and loamy soils that formed in sandy materials and have sandy loam to silty or sandy clay subsoils.

Soils:
- Downer sandy loam
- Fort Mott loamy sand
- Hambrook sandy loam
- Hammonton loamy sand and sandy loam
- Hammonton-Glassboro complex
- Ingleside and sandy loam
- Ingleside-Runclint complex
- Matapeake fine sandy loam and silt loam
- Mattapex fine sandy loam and silt loam
- Nassawango fine sandy loam and silt loam
- Sassafras sandy loam
- Woodstown sandy loam

Description: Well drained soils that are generally better-suited to pine than to hardwoods. These may occur on slopes of 0 to 10 percent. On the steeper slopes erosion potential needs to be addressed. Rutting and soil damage by machine operations are minor problems and most sites will have good access and operability most of the year. These are the best suited soils for intensive forest management.

Management Group 4 – Deep, sandy soils that are well to excessively well drained.

Soils: Cedartown loamy sand
Evesboro loamy sand
Evesboro-Galestown complex
Galestown loamy sand
Rosedale loamy sand
Runclint loamy sand
Udorthents

Description: These sandy soils have few operating limitations due to soil wetness, and can provide sites for mechanical activities during wet seasons. Productivity is low, and some sites may be occupied by Virginia or shortleaf pine. Some may occur in a landscape pattern of sand ridges interspersed with low wet soils or Delmarva Bays, and provide an important habitat type, particularly for herpivores and invertebrates. Some may have slopes of up to 10-15%, which may limit management. Udorthents are soils that have been mechanically altered and may occur mainly as borrow pits, landfills, or other re-worked areas. Intensive forest management is probably limited on many of these soils.

Management Group 5 – Low-elevation, poorly and very poorly drained soils that formed in organic materials. They may lie in flood plains, freshwater wetlands, or areas that can be affected by tidal flooding.

Soils: Chicone mucky silt loam
Indiantown silt loam
Kentuck mucky silt loam
Manahawkin muck
Nanticoke and Mannington soils
Puckum mucky peat
Transquaking and Mispillion soils
Zekiah silt loam

Description: These poorly drained soils occupy flood plains and both fresh and brackish marshes. Some lie at elevations where flooding by salt water during high tides or storms is a possibility and trees may be affected by salt spray. The sites are marginal in terms of timber or pulpwood productivity, and access is often very restricted. Many of these areas will be riparian forests and other water-related areas that should be managed primarily for water quality and wildlife purposes.

Other types without Management Groups – Other map units that are too small, are comprised of minor soil types, or are not suitable for forest management.

Soils: Water

Table 19: Map Symbols used in County Soil Survey

Highlighted soil series indicate presence on Pocomoke State Forest.

Soil Series	MG	Wicomico	Worcester	Somerset
Acquango sand	4		AcB, AcC	
Annemessex-Manokin complex	1			AoA, AoB
Askecksy loamy sand	1	AsA	As	
Beaches	-	Be	Be	Be
Berryland mucky loamy sand	2	BhA	Bh	
Boxiron	1		BX	
Boxiron and Broadkill soils	1			BX
Broadkill mucky silt loam	1		Br	
Brockatonorton sand	3		BkA, BkB	
Cedartown loamy sand	4	CdA	CeA, CeB	
Chicone mucky silt loam	5		Ch	
Corsica and Fallsington soils	2			CRA
Corsica mucky loam	1	CoA		
Downer sandy loam	3			DoA, DoB
Elkton sandy loam	1		Ek	
Elkton silt loam	1		Em	EmA
Endoaquepts and Sulfaquepts	5	EQB		EQB
Evesboro loamy sand	4	EwA, EwB, EwC	EvA, EvB, EvC	
Evesboro-Galestown complex	4			EzB
Fallsington loam	2	FgA		FgA
Fallsington sandy loam	2	FaA	Fa	FaA
Fallsinston-Glassboro complex	2			FhA
Fort Mott loamy sand	3	FmA, FmB	FmA, FmB	
Galestown loamy sand	4	GaA, GaB	GaA, GaB, GaC	GaB
Glassboro loam	2			GlA
Hambrook loam	3			HcA
Hambrook sandy loam	3	HbA, HbB	HbA, HbB	HbB
Hammonton loamy sand	3		HmA, HmB	HmA
Hammonton sandy loam	3	HnA		HnA
Hammonton-Glassboro complex	3			HgB
Honga peat	5	Ho		Ho
Hurlock loamy sand	2		Hu	HuA
Hurlock sandy loam	2	HvA		HvA
Indiantown silt loam	5		In	
Ingleside loamy sand	3	IeA, IeB		
Ingleside sandy loam	3			IgA, IgB
Ingleside-Runclint complex	3			IkC
Kentuck mucky silt loam	5		Ke	
Keyport fine sandy loam	3	KfA, KfB		
Keyport silt loam	3			KpA
Klej loamy sand	2		KsA, KsB	
Klej-Galloway complex	2	KgB		KgB
Lenni loam	2	LgA		
Lenni sandy loam	2	LfA		
Longmarsh and Indiantown soils	5	LO		LO

Soil Series	MG	Wicomico	Worcester	Somerset
Manahawkin muck	5	Ma	Ma	Ma
Mannington and Nanticoke soils	5		MC	
Manokin silt loam	3			MdA. MdB
Matapeake fine sandy loam	3		MeA, MeB	
Matapeake silt loam	3		MkA, MkB	
Mattapex fine sandy loam	3	MpA	MpA, MpB	
Mattapex silt loam	3	MtA, MtB	MqA, MqB	
Miscellaneous water	-	M-W		M-W
Mullica-Berryland complex	2	MuA	Mu	MuA
Nanticoke and Mannigton soils	5	NM		NM
Nassawango fine sandy loam	3	NnA, NnB	NnA, NnB	
Nassawango silt loam	3	NsA, NsB	NsA, NsB	
Othello and Kentuck soils	1	OKA		OKA
Othello silt loam	1	OtA	Ot	OoA, OtA
Othello-Fallsington complex	2			OvA
Pepperbox-Rockawalkin complex	3	PrA, PrB		
Puckum mucky peat	5	Pk	Pk	Pk
Purnell peat	5		Pu	
Queponco loam	3			QbB
Queponco silt loam	3			QeA, QeB
Quindocqua silt loam	1			QuA
Rockawalkin loamy sand	3	RkA, RkB		
Rosedale loamy sand	4	RoA	RoA, RoB	
Runclint loamy sand	4	RuA, RuB	RuA, RuB	
Runclint sand	4	RsA, RsB		RsB
Runclint-Cedartown complex	4	RwA, RwB		RwB, RwC
Runclint-Evesboro complex	4			RxB
Sassafras sandy loam	3		SaA, SaB, SaC	
Sunken mucky silt loam	5	SuA	Su	SuA
Tangier mucky peat	5			Ta
Transquaking and Mispillion soils	5	TP	TP	TP
Transquaking mucky peat	5		Tk	
Udorthents	4	UbB, UfB, UoB	Uz	UbB, UfB, UfF, UgB, UoB, UwB
Water	-	W	W	W
Woodstown loam	3			WoA
Woodstown sandy loam	3	WdA	WdA, WdB	WdA, WdB
Woodstown-Glassboro complex	3			WpA
Zekiah silt loam	5	Zk	Zk	

APPENDIX E

FIDS/Forestry Task Force

17.1 Chesapeake Bay Critical Area –Timber Harvest Plan Guidelines

17.1.1 *Introduction*

The Chesapeake Bay Critical Area Criteria require the conservation of Forest Interior Dwelling Bird (FIDS) habitat within 1,000 feet of the mean high tide line of the Maryland portion of the Chesapeake Bay. Generally, FIDS habitat consists of large forest tracts. FIDS are a diverse group comprising 25 species, each of which requires relatively large, contiguous blocks of forest in order to successfully breed and maintain viable populations. Many of these species are now rare to uncommon in the Chesapeake Bay Critical Area and elsewhere on the Maryland coastal plain. Some are experiencing statewide, regional or national declines. A combination of factors are likely responsible for these trends. In Maryland, the greatest threat is development, resulting in the permanent loss and fragmentation of large contiguous forest tracts into increasingly smaller, more isolated patches.

Timber harvesting can also significantly impact FIDS habitat. The effects of timber harvesting, their severity and the length of time they persist depend, to a large degree, on the pre-harvest conditions of the forest, surrounding landscape conditions and the type of logging or silvicultural treatment that is applied. Many of these effects can persist until the regenerating forest has reached its pre-harvest age (e.g., 30-80 years). Other impacts such as those that are related to forest ditching, roads and the conversion of native hardwood-dominated forest to loblolly pine may persist much longer. Timber harvesting in relatively undisturbed, old natural forest communities, especially those that have attained old growth conditions, may cause permanent habitat loss or require an exceptionally long period (at least 200-300 years) to recover.

In an effort to resolve issues involving timber harvesting in FIDS habitat in the Critical Area, the Maryland Department of Natural Resources (DNR) convened a group of individuals to address these issues and develop solutions. The group, referred to as the FIDS/Forestry Task Force, was represented by individuals from the Chesapeake Bay Critical Area Commission, DNR-Forest Service, DNR-Wildlife and Heritage Service, Association of Forest Industries, Maryland Forests Association, Maryland Partners In Flight, Maryland Forestry Board Association and The Nature Conservancy. The group's task was to develop a set of practical, user-friendly guidelines for conserving FIDS habitat at timber harvest sites in the Critical Area. The guidelines were designed to provide effective FIDS habitat conservation, as required by the Critical Area Criteria, while minimizing regulatory constraints on landowners who are interested in managing and harvesting timber on their property.

The guidelines, if followed, will provide a virtually automatic regulatory approval of timber harvest plans (as it relates to FIDS conservation requirements). The guidelines are intended to be straightforward and easily applied to timber harvest areas in the Critical Area. Occasionally, exceptions may arise. In these cases, or if the landowner would like to deviate from the guidelines, an on-site review involving the landowner, private forestry consultant, DNR ecologist and forester may take place to consider the landowner's request or other options. It is the intent of the Critical Area Commission that DNR staff who are involved in the timber harvest plan review will work closely with the landowner to achieve reasonable agreement on FIDS conservation measures and timber harvest activities.

Although these guidelines were written specifically for the Critical Area, they are generally applicable to other regions in Maryland. It is hoped that, wherever possible, the guidelines will be used voluntarily

outside the Critical Area by landowners, foresters and other natural resource professionals in an effort to help conserve FIDS habitat and the forest ecosystems on which they depend.

17.1.2 *How to Use These Guidelines*

The guidelines were written with the professional forester, ecologist and land planner in mind. It is assumed that the reader is familiar with the silvicultural (e.g., even-aged management, single-tree selection, etc.), ecological (e.g., snags, microhabitat) and regulatory terms (e.g., Critical Area Buffer) that are used throughout the document. A list of definitions is provided in **Section 17.1.3** for those terms that were created specifically for these guidelines.

The use of these guidelines can be described as consisting of three steps:

1. Determine if *potential FIDS habitat* is present, as defined in **Section 17.1.3**, in the proposed timber harvest area. If not present, no FIDS conservation measures are required.
2. If *potential FIDS habitat* is present, identify and map which of the seven *forest types*, defined in **Section 17.1.3**, are present in the proposed timber harvest area.
3. For each *forest type* present, determine which conservation measures are required and, whenever possible, which of the voluntary conservation measures can be implemented.

The conservation measures are organized by forest type. Those measures that must be applied are shown in italics. At the top of each set of conservation measures is an overview. For some forest types, there are relatively few (Virginia pine forest, mixed hardwood-pine forest) or no (loblolly pine forest) required FIDS conservation measures. For other forest types that tend to contain relatively high quality FIDS habitat (e.g., upland hardwoods, riparian forest), additional conservation measures must be incorporated into the Timber Harvest Plan. The guidelines also include examples of voluntary forest restoration practices that would benefit FIDS in **Section 17.1.4**.

Depending on the forest type, certain parameters may need to be measured or identified in order to determine which conservation measures are applicable. These parameters include total forest tract size, riparian forest width, the percentage of forest cover within 3 miles of the proposed timber harvest area, and the presence of a perennial (or "blue line") vs. intermittent stream. This information is readily available at most MD DNR Forest Service offices. The information also can be obtained using recent aerial photos, U.S. Geological Survey 7.5 minute topographic maps and other remote sensing data that are usually available at state and federal Department of Agriculture offices located in each county.

17.1.3 *Definitions*

Potential FIDS Habitat

A forest tract that meets either of the following conditions:

a. Greater than 50 acres in size and containing at least 10 acres of forest interior habitat (forest greater than 300 feet from the nearest forest edge).
b. Riparian forests that are, on average, at least 300 feet in total width and greater than 50 acres in total forest area. The stream within the riparian forest must be perennial, as indicated on the most recent U.S. Geological Survey 7.5 minute topographic maps or as determined by a site visit.

NOTE: Forest tract size is based on the total contiguous forest area regardless of property and Critical Area boundaries. Two forest tracts are considered noncontiguous or disjunctive if separated by at least 30 feet of non-forested habitat (e.g., road, transmission line right-of-way, cropland, etc.), about the typical width of a 2-lane, paved county road.

When determining which FIDS conservation measures apply to a given area, property lines and the size of the property or parcel are considered.

High Quality FIDS Habitat

Predominantly mature hardwood or mixed hardwood-pine forest tract at least 100 acres in size, of which forest interior habitat (forest at least 300 feet from the nearest forest edge) comprises at least 25% of the total forest area, and contains one or more of the following:

a. at least one highly area-sensitive species (see Critical Area Guidance Paper No. 1) or Black-and-white Warbler, as a probable or confirmed breeder;
b. riparian forest bordering a perennial stream or river and, on average, at least 600 feet in width;
c. mature river terrace, ravine, or cove hardwoods, located at least 300 feet from the nearest forest edge;
d. at least 5 contiguous acres of old growth forest (as defined in the 1989 MD Department of Natural Resources report "Old Growth Forest Ecosystems") located at least 300 feet from the nearest forest edge;
e. contiguous forest acreage of greater than 500 acres.

Forest Interior Habitat

Forest that is at least 300 feet from the nearest forest edge.

Coastal Plain Forest Types

a. **Loblolly Pine** - A forest stand in which loblolly (*Pinus taeda*), shortleaf (*Pinus echinata*) and/or pond pine (*Pinus serotina*) represent at least 60% of the total basal area.
b. **Virginia Pine** - A forest stand in which Virginia pine (*Pinus virginiana*) represents at least 60% of the total basal area and loblolly pine comprises less than 25%.
c. **Mixed Hardwood-Pine** - A forest stand in which loblolly, shortleaf and/or pond pine represents 25-60% of the total basal area.
d. **Upland Hardwoods** - A non-riparian forest stand, exclusive of 4e-g below, in which Virginia, loblolly, shortleaf and/or pond pine represent less than 25% of the total basal area and hardwoods represent at least 60% of the total basal area.
e. **Riparian Forest** - A forest stand located adjacent to a perennial stream, river or expansive forested wetland and usually dominated by hardwoods but may include mixed hardwood-pine forests.
f. **River Terrace/Ravine/Cove Hardwoods** - A forest stand located near or adjacent to intermittent and perennial streams, rivers and forested wetlands and exhibits the following characteristics: (1) steep (typically greater than 15% slope), short dissected slopes above stream and river courses; (2) usually dominated by hardwoods but may include may include some mixed hardwood-pine forests; (3) usually limited to a relatively thin 50-300 foot wide band of forest located along slopes bordering floodplain forests or stream valleys; (4) relatively high horizontal and vertical structural vegetative diversity; and (5) often containing microhabitats (e.g., seepage wetlands, mountain laurel thickets) that are important to certain FIDS.
g. **Regionally Rare or Uncommon Coastal Plain Forest Types** - Forests in which, for example, Bald Cypress (*Taxodium distichum*), Atlantic White-cedar (*Chamaecyparis thyoides*) or Eastern hemlock (*Tsuga canadensis*) occur "naturally" (i.e., not planted) as an associate or plurality of the stocking. Also considered here is old growth forest, as defined in the 1989 MD DNR report "Old Growth Forest Ecosystems". The extent of old growth must exceed 5 contiguous acres.

The identification and minimum size of other rare or uncommon forest types will be determined by the MD Wildlife and Heritage Service on a case by case basis.

h. **New Permanent Forest Openings** - Any opening, including roads, created during timber harvest operations that is not allowed to return to canopy closure.

LOBLOLLY PINE FORESTS

Definition

A forest stand in which loblolly (*Pinus taeda*), shortleaf (*Pinus echinata*) and/or pond pine (*Pinus serotina*) represent at least 60% of the total basal area.

Conservation Measures

Overview: No FIDS conservation measures are required in this forest type; i.e., the use of these conservation measures is voluntary but encouraged whenever possible. Examples of forest restoration which provide benefits to FIDS are shown in **Section 17.1.4**.

1. Avoid establishing new permanent forest openings during timber harvest operations, especially in forest interior areas (i.e., areas greater than 300 feet from the nearest forest edge). For example:
    a. focus traditional wildlife management practices, such as wildlife food plots, near existing forest edges
    b. minimize the number, length and width of forest roads
    c. avoid mowing forest roads during April-July to help minimize cowbird use of the forest area.
2. Retain some hardwoods in the understory, midstory and overstory.
3. Retain a no-cut buffer of at least 100 feet along each side of perennial streams, rivers and extensive forested wetlands.
4. Plan timber harvests in such a way that maximizes the amount of contiguous forest that is pole-stage or older.
5. Retain snags in timber harvest areas. Select the largest snags available and, where possible, arrange in groups of 3 or more. The recommended density and size of snags is $\geq$ 8 snags per acre that are 8 inches or more in dbh.
6. During harvest operations, retain dead and downed woody debris on the forest floor.
7. Encourage timing of timber harvesting to occur outside the period of April 1-July 31, the breeding season for most FIDS.

MIXED HARDWOOD-PINE FORESTS

Definition

A forest in which loblolly, shortleaf and/or pond pine represents 25-60% of the total basal area.

Conservation Measures

Overview: There are no restrictions on the types of silvicultural methods (e.g., clearcutting, shelterwood, group selection, etc.) that may be used to harvest mixed hardwood-pine forests. However, conservation measures 1-3 (in italics) must be applied. The use of conservation measures 2a-c and 4-7 is voluntary and encouraged whenever possible. Single-tree selection which retains at least 70% canopy closure throughout a stand is usually the recommended or preferred, but not required, timber harvest method. The use of **Table 19** is voluntary. Additional silvicultural options are possible if forest restoration

is part of the overall forest management plan. Examples of forest restoration which provide benefits to FIDS are shown on **Section 17.1.4**.

1. *New permanent forest openings are not permitted in the forest interior portions of a forest tract, which is defined as forested areas greater than 300 feet from the nearest forest edge. In non-interior forested areas, new permanent openings will be considered on a case by case basis by the Wildlife and Heritage Service Regional Ecologist and only for forest tracts greater than 200 acres in landscapes with 30-60% forest cover and forest tracts greater than 100 acres in landscapes with > 60% forest cover. Forest openings should be small (< 1 acre), located adjacent to an existing forest edge, and otherwise avoid deleterious "edge" effects.*
2. *Conversion to loblolly pine forest (e.g., forests in which loblolly pine comprises 60% or more of the total basal area) is permitted south of Rt. 50 on the Western Shore and south of the Chester River on the Eastern Shore. Elsewhere, natural regeneration is required and hardwood control is prohibited.* The following should be considered when planning conversion:
    a. Within a forest tract, avoid converting very large areas (e.g., > 30 acres) of mixed hardwood-pine forest, especially those containing relatively old forest conditions (e.g., > 60-70 year old stands). Maintain as large and as contiguous an area as possible in mixed hardwood-pine and hardwood-dominated forest.
    b. Focus conversion in the following areas:
        i. Forest tracts with relatively low FIDS habitat suitability. For example, small (< 100 acres) forest tracts lacking mature mixed hardwood-pine stands, with a relatively small proportion of forest interior habitat and located in predominantly nonforested landscapes (i.e., < 30% forest within 3 miles).
        ii. Along and within 300-600 feet of existing permanent forest edges (e.g., along forest-field edges, forest-roadside edges). Avoid conversion in forest interior areas.
        iii. Adjacent to existing loblolly pine stands.
        iv. In narrow (< 600 feet wide) peninsulas of forest that extend out into a nonforested area.
    c. Arrange converted stands in such a way that maximizes the amount of remaining contiguous, hardwood-dominated forest interior habitat. Avoid a "checkerboard" design of alternating stands of loblolly pine and hardwood-dominated stands.
3. Plan timber harvests in such a way that maximizes the amount of contiguous forest that is pole-stage or older. Avoid "checkerboard" management.
4. The silvicultural methods listed in **Table 19** are strongly encouraged. Generally, the recommended harvest strategy is single-tree selection. Alternatively, consider the following options:
    a. Focus even-aged management with a long rotation cycle near the periphery of the forest tract and use single-tree selection in the more interior portions. Plan harvests so that older successional stages are adjacent to each other.
    b. Use even-aged management with a long rotation cycle and plan harvests so that older successional stages are adjacent to each other.

5. Encourage the retention of snags in timber harvest areas. Select the largest snags available and, where possible, arrange in groups of 3 or more. The recommended density and size of snags is $\geq$ 8 snags per acre that are 8 inches or more in dbh.
6. Encourage the retention of dead and downed woody debris on the forest floor.
7. Encourage timing of timber harvesting to occur outside the period of April 1-July 31, the breeding season for most FIDS.

UPLAND HARDWOOD FORESTS

Definition

A non-riparian forest stand, exclusive of the **Loblolly Pine Virginia Pine** and **Mixed Hardwood-Pine** types, in which Virginia, loblolly, shortleaf and/or pond pine represent less than 25% of the total basal area and hardwoods represent at least 60% of the total basal area.

Conservation Measures

Overview: Conservation measures 1-4 (in italics) must be applied. This requires the use of Table 19 to determine which silvicultural methods are allowable. The table provides greater flexibility within increasing forest tract size and the percentage of forest cover within 3 miles of the proposed timber harvest area. Single tree selection which retains at least 70% canopy closure throughout the stand is usually the recommended but not necessarily required timber harvest method. The use of conservation measures 3a-b and 5-8 is voluntary and encouraged whenever possible. Additional silvicultural options are possible if forest restoration is part of the overall forest management plan. Examples of forest restoration which provide benefits to FIDS are shown in **Section 17.1.4**.

1. *Use **Table 19** to determine which silvicultural methods are allowable. To use this table, measure the total forest tract size and percent forest cover within 3 miles of the proposed timber harvest area. The total forest tract size categories are 50-100 acres, 100-200 acres, 200-500 acres, and > 500 acres. The categories for percent forest cover within 3 miles of the proposed timber harvest area are < 30% forest cover, 30-60% and > 60%.*
2. *New permanent forest openings are not permitted in the forest interior portions of a forest tract, which is defined as forested areas greater than 300 feet from the nearest forest edge. In non-interior forested areas, new permanent openings will be considered on a case by case basis by the Wildlife and Heritage Service Regional Ecologist and only for forest tracts greater than 200 acres in landscapes with 30-60% forest cover and forest tracts greater than 100 acres in landscapes with > 60% forest cover. Forest openings should be small (< 1 acre), located adjacent to an existing forest edge, and otherwise avoid deleterious "edge" effects.*
3. *Conversion to loblolly pine forest (e.g., forests in which loblolly pine comprises 60% or more of the total basal area) is permitted south of Rt. 50 on the Western Shore and south of the Chester River on the Eastern Shore. Converted stands must be managed so that some hardwoods are maintained in the understory, midstory and canopy, and arranged in such a way that maximizes the amount of contiguous, hardwood-dominated and mixed hardwood-pine forest interior habitat.* The following should be considered when planning conversion:
    a. Within a forest tract, avoid converting very large areas (e.g., > 30 acres) of mixed hardwood-pine forest, especially those containing relatively old forest conditions (e.g., > 60-70 year old stands). Maintain as large and as contiguous an area as possible in mixed hardwood-pine and hardwood-dominated forest.
    b. Focus conversion in the following areas:

i. Forest tracts with relatively low FIDS habitat suitability. For example, small (< 100 acres) forest tracts lacking mature mixed hardwood-pine stands, with a relatively small proportion of forest interior habitat and located in predominantly non-forested landscapes (i.e., < 30% forest within 3 miles).
ii. Along and within 300-600 feet of existing permanent forest edges (e.g., along forest-field edges, forest-roadside edges). Avoid conversion in forest interior areas.
iii. Adjacent to existing loblolly pine stands.
iv. In narrow (< 600 feet wide) peninsulas of forest that extend out into a non-forested area.
v. Arrange converted stands in such a way that maximizes the amount of remaining contiguous, hardwood-dominated forest interior habitat. Avoid a "checkerboard" design of alternating stands of loblolly pine and hardwood-dominated stands.

4. *Plan timber harvests in such a way that maximizes the amount of contiguous forest that is pole-stage or older. Avoid "checkerboard" management.*
5. Single-tree selection is the recommended harvest strategy. Below are other options:
    a. Focus even-aged management with a long rotation cycle near the periphery of the forest tract and use single-tree selection in the more interior portions. Plan harvests so that older successional stages are adjacent to each other.
    b. Use even-aged management with a long rotation cycle and plan harvests so that older successional stages are adjacent to each other.
6. Encourage the retention of snags in timber harvest areas. Select the largest snags available and, where possible, arrange in groups of 3 or more. The recommended density and size of snags is $\geq$ 8 snags per acre that are 8 inches or more in dbh.
7. Encourage the retention of dead and downed woody debris on the forest floor.
8. Encourage timing of timber harvesting to occur outside the period of April 1-July 31, the breeding season for most FIDS.

Table 20: Silvicultural methods that are allowable in upland hardwood forest

% forest within 3 miles	Forest Tract Size			
	50-100 acres	**100-200 acres**	**200-500 acres**	**> 500 acres**
< 30%	Single-tree selection Group selection and patch clearcutting within 300' of forest edge	Single-tree selection. Group selection and patch clearcutting within 300' of forest edge. Small (<15 acres) clearcuts adjacent to a forest edge and arranged in a manner which maximizes the amount of contiguous, mature forest interior habitat.	Single-tree selection Group selection and patch clearcutting within 300' of forest edge. Small (<15 acres) to medium-sized (15-30 acres) clearcuts adjacent to a forest edge and arranged in a manner which maximizes the amount of contiguous, mature forest interior habitat.	Single-tree selection Group selection and patch clearcutting within 300' of forest edge. Small (<15 acres) to medium-sized (15-30 acres) clearcuts adjacent to a forest edge and arranged in a manner which maximizes the amount of contiguous, mature forest interior habitat. Some conversion to loblolly pine possible: - within 300' of an existing forest edge - within 300' of an existing pine stand
30-60%	Single-tree selection Group selection and patch clearcutting within 300'of forest edge. Small (<15 acres) clearcuts adjacent to a forest edge and arranged in a manner which maximizes the amount of contiguous, mature forest interior habitat.	Single-tree selection Group selection and patch clearcutting within 300' of forest edge. Small (<15 acres) to medium-sized (15-30 acres) clearcuts adjacent to a forest edge and arranged in a manner which maximizes the amount of contiguous, mature forest interior habitat.	Single-tree selection Single-tree selection with limited group selection. Group selection and patch clearcutting within 300' of forest edge. Small (<15 acres) to medium-sized (15-30 acres) clearcuts adjacent to a forest edge and arranged in a manner which maximizes the amount of contiguous, mature forest interior habitat. Some conversion to loblolly pine possible: - within 300' of an existing forest edge - within 300' of an existing pine stand	Single-tree selection Single-tree selection with limited group selection. Group selection and patch clearcutting within 300' of forest edge. Small (<15 acres) to medium-sized (15-30 acres) clearcuts adjacent to a forest edge and arranged in a manner which maximizes the amount of contiguous, mature forest interior habitat. Some conversion to loblolly pine possible: - within 300' of an existing forest edge - within 300' of an existing pine stand - in blocks of 10 acres or less and located adjacent to an existing forest edge or pine stand
> 60%	Single-tree selection. Single-tree selection with limited group selection. Some patch clearcutting within 300' of forest edge. Small (<15 acres) clearcuts arranged in a manner which maximizes the amount of contiguous, mature forest interior habitat.	Single-tree selection Single-tree selection with limited group selection. Group selection and patch clearcutting within 300' of forest edge. Small (<15 acres) to medium-sized (15-30 acres) clearcuts adjacent to a forest edge and arranged in a manner which maximizes the amount of contiguous, mature forest interior habitat. Some conversion to loblolly pine possible: - within 300' of an existing forest edge - within 300' of an existing pine stand	Single-tree selection Single-tree selection with limited group selection. Group selection and patch clearcutting within 300' of forest edge. Small (<15 acres), medium (15-30 acres) and large (30-50 acres) clearcuts adjacent to a forest edge and arranged in a manner which maximizes the amount of contiguous, mature forest interior habitat. Some conversion to loblolly pine possible: - within 300' of an existing forest edge - within 300' of an existing pine stand - in blocks of 10 acres or less and located adjacent to an existing forest edge or pine stand	Single-tree selection Single-tree selection with limited group selection. Group selection and patch clearcutting within 300' of forest edge. Small (<15 acres), medium (15-30 acres) and large (30-50 acres) clearcuts arranged in a manner which maximizes the amount of contiguous, mature forest interior habitat. Some conversion to loblolly pine possible: - within 300' of an existing forest edge - within 300' of an existing pine stand - in blocks of 20 acres or less and located adjacent to an existing forest edge or pine stand

*** Single-tree selection harvests must retain at least 70% canopy closure throughout the harvest area.**

RIPARIAN FORESTS

Definition

A forest stand located adjacent to a perennial stream, river or expansive forested wetland and usually dominated by hardwoods but may include mixed hardwood-pine forests. This definition does not apply to forests located adjacent to intermittent streams.

Conservation Measures

Overview: Conservation measures 1-4 (in italics) must be applied. This requires the use of **Table 20** to determine which silvicultural methods are allowable. The use of conservation measures 5-7 is voluntary and encouraged whenever possible. Additional silvicultural options are possible if forest restoration is part of the overall forest management plan. Examples of forest restoration which provide benefits to FIDS are shown in **Section 17.1.4**.

1. *Use **Table 20** to determine which silvicultural methods are allowable. To use this table, measure the following: (a) total forest tract size, (b) percent forest cover within 3 miles of the proposed timber harvest area, and (c) riparian forest width. For each of the riparian forest width categories, the length of riparian forest must extend for a distance of at least 1,000 feet. For example, a riparian forest determined to be > 1,000 feet wide must be this wide for a distance of at least 1,000 feet. This distance should be measured as the length of unbroken forest, measured as a straight line, along the mean high tide line and nontidal perennial streams and rivers.*
2. *New permanent forest openings are not permitted.*
3. *Conversion of riparian hardwood or mixed hardwood-pine forest to loblolly pine forest (i.e., forests in which loblolly pine comprises 60% or more of the total basal area) is not permitted.*
4. *Plan timber harvests in such a way that maximizes the amount of contiguous forest that is pole-stage or older.*
5. Encourage the retention of snags in timber harvest areas. Select the largest snags available and, where possible, arrange in groups of 3 or more. The recommended density and size of snags is ≥ 8 snags per acre that are 8 inches or more in dbh.
6. Encourage the retention of dead and downed woody debris on the forest floor.
7. Encourage timing of timber harvesting to occur outside the period of April 1-July 31, the breeding season for most FIDS.

Table 21: Silvicultural methods that are allowable in riparian forest

Based on riparian forest width (feet), forest tract size (acres), and the percent forest cover within a 3-mile radius.

Riparian Forest Width[1]	<30% Forest Cover Within 3 Miles			30-60% Forest Cover Within 3 Miles			>60% Forest Cover Within 3 Miles		
	< 200 ac	200-500 ac.	>500 ac.	<200 ac.	200-500 ac.	>500 ac.	<200 ac.	200-500 ac.	>500 ac.
300-600 ft	STS[2]	NC-100[3]	NC-100	STS	STS	STS	STS	STS	STS
600-1,000 ft	NC-100	NC-100	NC150[4]	STS	NC-100	NC-100	STS	STS	NC-100
> 1,000 ft	NC-100	NC150	NC150	STS	NC-100	NC150	STS	NC-100	NC150

[1] For each of the riparian forest width categories below, the length of riparian forest must extend for a distance of at least 1,000 feet. This distance should be measured as the length of unbroken forest, measured as a straight line, along the mean high tide line, nontidal perennial streams and rivers.
[2] STS = Single-tree selection may occur within the landward 50 feet of the Buffer. Single-tree selection harvests must retain at least 70% canopy closure throughout the harvest area.
[3] NC-100 = No cutting may occur within the Buffer.
[4] NC-150 = No cutting may occur within the Buffer, within 150 feet of the mean high tide line or nontidal perennial streams, whichever width is greatest.

RIVER TERRACE/RAVINE HARDWOOD FORESTS

Definition

A forest stand located near or adjacent to intermittent and perennial streams, rivers and forested wetlands and exhibits the following characteristics: (1) steep (typically greater than 15% slope), short dissected slopes above stream and river courses; (2) usually dominated by hardwoods but may include may include some mixed hardwood-pine forests; (3) usually limited to a relatively thin 50-300 foot wide band of forest located along slopes bordering floodplain forests or stream valleys; (4) relatively high horizontal and vertical structural vegetative diversity; and (5) often containing microhabitats (e.g., seepage wetlands, mountain laurel thickets) that are important to certain FIDS.

Conservation Measures

Overview: Conservation measures 1-4 (in italics) must be applied. Single-tree selection only is permitted if *high quality FIDS habitat is present; elsewhere, limited group selection also may be used.* Although not required, no harvesting is encouraged in this forest type. The use of conservation measures 5-7 is voluntary and encouraged whenever possible. Additional silvicultural options are possible if forest restoration is part of the overall forest management plan. Examples of forest restoration which provide benefits to FIDS are shown on page 144.

1. *Single-tree selection only is permitted if this forest type occurs within high quality FIDS habitat; elsewhere, limited group selection may be used. No harvesting is encouraged whenever possible.*
2. *New permanent forest openings are not permitted.*
3. *Conversion to loblolly pine forest (i.e., forests in which loblolly pine comprises 60% or more of the total basal area) is not permitted.*
4. *Plan timber harvests in such a way that maximizes the amount of contiguous forest that is pole-stage or older.*
5. Encourage the retention of snags in timber harvest areas. Select the largest snags available and, where possible, arrange in groups of 3 or more. The recommended density and size of snags is ≥ 8 snags per acre that are 8 inches or more in dbh.
6. Encourage the retention of dead and downed woody debris on the forest floor.
7. Encourage timing of timber harvesting to occur outside the period of April 1-July 31, the breeding season for most FIDS.

REGIONALLY RARE OR UNCOMMON COASTAL PLAIN FOREST TYPES

Definition

Forests in which, for example, Bald Cypress, Atlantic White-cedar or Eastern Hemlock occur "naturally" (i.e., not planted) as an associate or plurality of the stocking. Also considered here is old growth forest, as defined in the 1989 DNR report "Old Growth Forest Ecosystems". The extent of old growth must exceed 5 contiguous acres. The identification and minimum size of other rare or uncommon forest types will be determined by the Wildlife and Heritage Service Regional Ecologist on a case by case basis.

Conservation Measures

No harvesting in these forest types is permitted if they occur within *high quality FIDS habitat.* Elsewhere, conservation measures will be prescribed on a case by case basis by the MD Wildlife and Heritage Service. These measures could include no harvesting.

17.1.4 *Forest Restoration for FIDS*

The following are examples of forest restoration that would create or enhance the extent and quality of FIDS habitat:

1. Increase the width of riparian forest corridors to at least 300 feet and, ideally, to 600 feet or more.
2. Reforest existing forest openings, especially those located in forest interior areas.
3. Reforest existing non-forested areas (e.g., a field) along the edge of a forest tract. Select areas which will maximize the forest area: edge ratio and total forest tract size.
4. Allow existing woods roads to reforest or reduce their width so that canopy closure is maintained over the road.
5. Establish core areas within forest tracts where little or no harvesting will occur so that, over time, these areas will be restored to old growth conditions. Select areas that are at least 5 acres in size and locate them, if possible, in the most interior part of the forest and adjacent to other areas where little or no harvesting will occur (e.g., Critical Area Buffer, steep slopes).

In reforestation efforts, allow natural regeneration to occur (vs. planting). If planting is used, use tree species that are locally native and use seed or planting stock from local or nearby areas.

APPENDIX F

The Historical and Ecological Role of Fire in the Forests of Maryland's Eastern Shore

Allen R. Carter

18.1 Fire History

18.1.1 *Importance of Lightning Fire*

Although it is certain that on rare occasions wildland fires were initiated by lightning strikes on the Eastern Shore, particularly in the summer during abnormal drought conditions, it is doubtful if lightning-caused fire ever played a significant role in forest dynamics. Unlike certain areas of the western United States or the Florida coastal plain where lightning was and still is a frequent and important ecological component, lightning was neither common enough nor did the required fuel conditions exist for it to be a major factor in forming the forest communities of Maryland.

18.1.2 *Use of Fire by Native Americans*

Frost (1988), in his Pre-settlement Fire Frequency Regimes map of the United States, depicted an average pre- (European) settlement fire frequency of 7-12 years for forests of the Eastern Shore of Maryland, with higher frequencies of 4-6 years in the southeastern Maryland counties of Wicomico, Worcester, Somerset, and Dorchester. These frequencies are high compared to most areas of the Northeast. If lightning was not a significant contributor to these fires, then Native American populations must have been. Pyne (1982) concluded that fire in the Northeast was predominantly a phenomenon associated with human activity.

The forest that covered the Eastern Shore in Indian times was predominantly a hardwood one, though increasingly mixed with pine to the southward (Rountree and Davidson 1997). There are large patches of pine-dominated woods today, but at least in Maryland they are largely second-growth woods, the result of extensive clearing in historic times. In aboriginal times, the woods of the Eastern Shore were likely to be oak-hickory, oak-gum, or oak-pine types, all of which still exist in second-growth form. Rountree and Davidson use the Choptank River as the dividing line, with oak-hickory forests growing on the higher grounds north of the Choptank and oak-pine on the lower ground south of the river.

Captain John Smith said in the early seventeenth century, "A man may gallop a horse amongst these woods any waie, but where the creekes or Rivers shall hinder". Father Andrew White wrote that the woods around St. Mary's were so free of underbrush that a "coach and fower horses" could be driven through them (Rountree and Davidson). The open conditions could be partly attributed to the closed canopies of these mature forests, which shaded out undergrowth, but it is also likely that periodic fire helped to maintain the park-like conditions.

Dr. William Patterson of the University of Massachusetts Department of Forestry and Wildlife Management (1997) stated that pre-European fire occurrence in the Northeast was probably highest near sites of major Indian settlements or seasonal fire activity. Rountree and Davidson suggested Indian use of fire to attract game and create conditions suitable for sustenance: "*Open woods* is a mixture of woodland and small clearings, made by streams or humans or forest fires. Aside from the useful field and thicket plants growing at the edges, the young saplings at those edges were a major source of materials for the Indians' house frameworks. Another tree hugging the forest's perimeter is witch hazel

(*Hamamelis virginiana*), whose wood served for bows and whose bark makes an herbal medicine even today. The bigger trees' fallen branches, of a size to drag easily, became fuel for Indian cooking. Open woods, when containing large stands of deciduous, nut-bearing trees, must have been the most desirable ecological zone to have near an Indian town. Aside from all the food and other things it has for people, this zone is extremely attractive for browsers like deer and elk (extinct in eastern Virginia and Maryland by about the eighteenth century). These cervids not only eat nuts and acorns but also like the reachable leaves and twigs at the woodland's edges and the cover that the underbrush there provides. The native people had good reason, then, to hunt deer by the fire-surround method in the fall: It not only brought in plenty of venison for the winter, but it also preserved clearings and made new ones that would attract deer to the vicinity the next year". Potter (1993) also referred to Indian use of fire both to clear vegetation and hunt game: "Algonquin prepared their fields by girdling the trees near the roots and then scorching the trunks with fire to prevent any further growth. Drivers and fire surrounds were the most common techniques employed" in deer hunting.

It is reasonable to assume that Eastern Shore tribes also used fire to periodically burn the marshes, which were important sources of mollusks, fish, furbearers, waterfowl, edible tubers, and reeds for housing. Fire would have been useful for herding game, enhancing visibility or access, or retarding invasion of woody growth. More often than not, these fires would have spread into adjacent woodlands and, if of sufficient intensity, created the open seedbed conditions conducive to establishment of loblolly pine. Even today the pattern of loblolly pine "islands" and "stringers" in and adjacent to marshes of the lower Eastern Shore is common.

If, as Rountree and Davidson suggest, oaks were the most prevalent species in pre-settlement times, then the possible role of fire in maintaining these forest types must also be considered. Frost stated, "Light, understory fires may have been the norm for millions of hectares of eastern hardwood forest..." Most oak species are midtolerant to intolerant of shade, indicating that disturbance is desirable to promote regeneration and growth. Furthermore, acorn germination and initial seedling establishment are most successful where light understory burns have scarified the seedbed and reduced competition. The extensive presence of oaks on the Shore was an indicator that low-intensity understory fires were common, either intentionally set by Indians to create "open woods" or drive game, or the incidental result of land-clearing.

18.1.3 *Role of Fire in the Colonial Era*

The displacement of Native American populations by European settlers in the seventeenth and eighteenth centuries may have had surprisingly little effect on the use of fire or the frequency of occurrence. Like the Indians, the settlers used fire to clear land for farming and houses, though the technique might have been felling and burning rather than girdling and scorching, and more area would have been cleared; in any event, the inevitable result was that some fires escaped and burned into adjacent woodlands. The concept of aggressive fire suppression would not take hold for another two centuries. At that time there was little suppression capability, and the woodlands were regarded as an impediment to agriculture rather than a resource to be protected - by the time of the Revolution, only Maryland, Virginia, South Carolina, and Georgia had failed to enact statutes regulating open burning (Pyne). Accounts from the colonial period indicate that fire was also used to drive game, facilitate trapping, clear undergrowth for horse travel, enhance foraging opportunities for free-ranging hogs, and even clear the woods of ticks.

18.1.4 *Fire in the Nineteenth and Early Twentieth Century*

Natural stands of loblolly pine (*Pinus taeda)* became much more widespread during this period, particularly in the counties south of the Choptank, largely due to the influence of economic factors. First was the abandonment of agricultural fields as farmers moved to more lucrative jobs in the towns and cities. Loblolly pine is an opportunistic species, which found the recently abandoned fields prime sites for reproduction by natural seeding. The second factor was the rise of large-scale commercial lumbering. Steam locomotives, often used to haul logs from the woods, were notorious for throwing sparks along the tracks and starting fires. As early as 1833 Maryland deemed railroads legally liable for damages caused by locomotive fires (Pyne). Other human activities in the woods associated with logging also contributed to the risk. Large amounts of residual slash left on the ground following logging provided the fuel bed, and the result was a period of intense wildfire activity in the late 1800s and early 1900s, not only on the Eastern Shore but also throughout the country. This served as the eye-opener, which persuaded the federal and state governments, including Maryland, to develop aggressive fire suppression organizations.

Both the clearing of the forests by large-scale logging and the subsequent fires resulted in large areas of open, scarified land suitable for pine regeneration. By the middle of the twentieth century, loblolly pine had become the predominant forest cover type in the lower counties of the Eastern Shore.

18.2 The Ecological Role of Fire

18.2.1 *Pines*

If maintenance of existing pine stands is a management objective, then the value of prescribed fire as a tool must be considered. Baker and Langdon (1990), in their discussion of the silvics of loblolly pine, provide a good overview. Loblolly pine is well adapted to the Atlantic coastal plain of Maryland's Eastern Shore, and grows well on soils with imperfect to poor surface drainage. Seedbed preparation by scarification or burning greatly increases seed germination and seedling survival. Loblolly pine is shade intolerant, so some form of disturbance is necessary to maintain the species. Most view the "climax" forest for the loblolly pine type as several possible combinations of hardwood species and loblolly pine. There is evidence that within the range of loblolly pine, several different tree species could potentially occupy a given area for an indefinite period of time and that disturbance is a naturally occurring phenomenon. If this is so, then the climax for this forest might best be termed the "southern mixed hardwood-pine forest". Loblolly pine seems to thrive when foresters utilize prescribed burning as a management tool. In the Atlantic coastal plain, a series of prescribed burns, such as a winter burn followed by three annual summer burns before a harvest cut, has been more effective than disking for control of competing hardwood vegetation and improvement of pine seedling growth after establishment of natural regeneration.

Walker (1980) stated, "The occurrence of the major southern pines relates to fire history. In the absence of fire, hardwoods encroach and rapidly crowd out pine seedlings. Wildfire, of course, eliminates many pines, but on the whole has favored continuance of coniferous types. Today, prescribed burning is widely practiced for the following reasons:

a. Hazard reduction, as insurance against lethal wildfires
b. 'Rough' reduction, to prepare seedbeds for natural regeneration
c. Control of undesirable hardwoods in pine stands
d. Grazing improvement
e. Exposing seed in quail and turkey management"

Wright and Bailey (1982) maintained that loblolly and shortleaf pine (shortleaf also occurred historically on the Eastern Shore but is much less common than loblolly) thrive where fires occur about every 10 years. Fire plays an important role in favoring natural loblolly pine regeneration over hardwoods, although it cannot be tolerated for the first 10 years or so when the trees are getting established; otherwise young pines will not have had enough time to develop the heat resistance in bark or the height of crown, which enables them to survive winter fires. The authors recommend a prescribed burn interval of 3 years, which is close to the 4-6 year average pre-settlement fire frequency mentioned by Frost.

To quote the authors, "Without fire the Southeast would not have pure stands of pine trees…the Upper Coastal Plains and Piedmont would be dominated by an oak-hickory-pine forest...pine would be only a small portion of the climax. Thus a long history of lightning fires, as well as those set by aboriginal and European men and the intensive prescribed burning programs of today have enabled land managers to maintain productive stands of pine in the Southeast".

18.2.2 *Oaks*

While the scientific community has long recognized the ecological role of fire in establishing and maintaining loblolly and other southern pine types, the importance of fire in maintaining oak forests is only beginning to be acknowledged. Given that oak-dominated forests were once predominant on the Eastern Shore, foresters have been frustrated in their attempts to regenerate and maintain oaks in the face of aggressive competition from red maple, blackgum, poplar, sweetgum, and other deciduous species that are usually considered less desirable both from a commercial and wildlife habitat standpoint. Oaks are often replaced by other species when mature stands are harvested, especially on better quality sites. This phenomenon of declining oak forests is evident not only on the Shore but throughout the Eastern U.S.

It is interesting that oaks have lower mortality rates than competing species in regimes of frequent fire. Van Lear (1992) reported that oak mortality rates after 26 years of biennial summer burning in mature pine stands in the South Carolina coastal plain were still below 50 percent, whereas mortality rates of other woody species ranged from 60 to 80 percent. This tenacious ability of small oak rootstocks to re-sprout repeatedly following frequent top-kill is an important adaptation of oak to frequent fire regimes. This characteristic should enable oak to dominate the advance regeneration pool in areas where fire occurs at frequent intervals. In addition, continued top-killing results in a more favorable root/shoot ratio and faster growth after release.

Van Lear goes on to list several other ways in which fire benefits oak regeneration. Fire removes excessive litter buildup from the forest floor, thereby preparing a favorable seedbed. Squirrels and blue jays for acorn burial prefer areas of thin litter. Jays collect and disperse only sound acorns, which implies that if these acorns escape predation they will result in well-established first-year seedlings. Seedlings from freshly germinated acorns are unable to emerge through a heavy litter cover.

Fire helps control insect predators of acorns and new seedlings. Many of these insects spend all or part of their lives on the forest floor. Infestations, which can vary from year to year and even from tree to tree in some areas, are a major contributor to the oak regeneration problem. Burning may also reduce rodent habitat, eliminating another source of acorn predation.

A regime of frequent burning over long periods of time creates an open stand. In hardwoods, long-term burning tends to eliminate small understory stems outright and gradually reduces the midstory and overstory canopy through mortality resulting from fire wounds. Increased light reaching the forest floor in these open stands will maintain the vigor of oak regeneration.

Severe or frequent fires xerify (dry) the surface of forest sites by consuming much of the forest floor and exposing the site to greater solar radiation through canopy reduction. Adequate advanced oak regeneration in the East is generally found more often on xeric sites than on mesic ones. Conversion of mesic sites to more xeric conditions by intense fires or by long regimes of low intensity fires could explain in large part the ability of oaks to dominate sites where more mesic species normally occur. The absence of fire since the turn of the century has allowed species that are intolerant to fire to become established and grow to a size where they, because of thicker bark associated with age can now resist fire. Yellow poplar, mockernut and pignut hickories, red maple, and blackgum are examples of species that are often found on sites where fire has long been absent.

Frequent fires in oak stands may also increase the production of legumes and grasses, which benefit numerous wildlife species but which also create a more flammable understory. At the turn of the century, summer fires were quite common in the Southeastern U.S. as farmers burned the land to facilitate grazing. They learned from early settlers, who in turn learned from their Indian predecessors, that growing-season fires best maintained an open forest with a rich herbaceous layer. Thus, a burning regime of frequent fire functions to create and maintain a ground cover that encourages the return of fire, which for the reasons stated above would favor the establishment of oak advance regeneration.

Van Lear's hypothesis is that silvicultural use of fire, which mimics the disturbance regime that created present-day stands dominated by mature oak, will create future stands dominated by oak.

Further research will be necessary to test and fine-tune these suggestions before they can be recommended as silvicultural practices. This is particularly true for the Eastern Shore of Maryland, where relatively few studies have been conducted on the silvicultural use of prescribed burning for oak regeneration and maintenance.

Van Lear suggests that a burning regime might include a mix of winter and growing-season fires adjusted to enhance the relative position of oak in the advance regeneration pool, but warns that low-intensity backing fires conducted in the winter might be necessary to prevent cambium damage to mature trees. Frequent understory burns during a period of 5 to 20 years prior to harvest should promote a favorable root/shoot ratio during oak seedling establishment. The timing of the burns would be dependent on the observed vigor of the oak advance regeneration and its competitors. Once an adequate number of oak seedling-sprouts are present and numbers of competing species have been sufficiently reduced, fire should be withheld to allow the oak advanced regeneration to attain sufficient size to outgrow other species, which germinate or sprout after the mature stand is cut. A relatively open stand with few mid-story and understory trees would provide adequate light for the oak advanced regeneration to develop satisfactorily.

Where clearcutting is used as a silvicultural practice, Van Lear suggests that broadcast burning of the site following harvest may be conducive to oak establishment. Burning would xerify the site, encourage jays and squirrels to import acorns, and promotes better quality oak sprouts by forcing them to develop from the ground line

Until the past century, frequent fires apparently allowed oak regeneration to accumulate and develop in the open understory of mature stands at the expense of shade-tolerant, fire-intolerant species. When the overstory of these stands was removed by various agents (wind, insects, wildfire, Indian clearing, harvesting, etc.), conditions were created which allowed advance regeneration dominated by oak to develop into mature stands dominated by oak. If oaks are to be maintained as a dominant overstory species on good quality sites on the Eastern Shore, foresters will have to either restore fire to some semblance of its historical role as a major environmental factor or develop methods that simulate the

effects of fire. It will be essential for foresters, as well as the public, to recognize that fire was a major factor shaping the composition and structure of many forest ecosystems.

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LITERATURE CITED

Baker, J.B. and O. G. Langdon. 1990. Loblolly Pine. Pages 497-512. *in* Silvics of North America, Volume 1 (Conifers). USDA Forest Service, Agriculture Handbook 654.

Frost, C.C. 1998. Presettlement fire frequency regimes of the United States: a first approximation. Pages 70-81. *in* Teresa L. Pruden and Leonard A. Brennan (eds.). Fire in ecosystem management: shifting the paradigm from suppression to prescription. Tall Timbers Fire Ecology Conference Proceedings. No. 20. Tall Timbers Research Station, Tallahassee, FL.

Patterson, W.A. 1997. Personal communication.

Potter, S.R. 1993. Commoners, Tributes, and Chiefs: The Development of Algonquian Culture in the Potomac Valley. University Press of Virginia.

Pyne, S.J. 1982. Fire in America. Princeton University Press.

Rountree, H.C. and T.E. Davidson. 1997. Eastern Shore Indians of Virginia and Maryland. University Press of Virginia.

Van Lear, D.H. and J.M. Watt. 1992. The role of fire in oak regeneration. Pages 66-78. *in* Loftis, D.L. and C.E. McGee (eds.). Proceedings Oak Regeneration: Serious Problems, Practical Recommendations; 1992 September 8-10; Knoxville, TN. Gen. Tech. Rep. SE-84.

Walker, L.C. 1980. The southern pine region. Pages 231-276. *in* Regional Silviculture of the United States, second edition. John Wiley & Sons, Inc.

Wright, H.A. and A.W. Bailey. 1982. Southeastern forests. Pages 374-378. *in* Fire Ecology. John Wiley & Sons, Inc.

APPENDIX G

EFFECTIVE: JULY 19, 2005
OPERATION ORDER 2005-601 - ANNAPOLIS, MARYLAND

Policy for SFI Management Review & Continual Improvement

Objective

This order establishes the Maryland Department of Natural Resources Forest Service policy for a management review system to examine findings and progress in implementing the Sustainable Forest Initiative (SFI) Standard on those lands subject to the Standard, to make appropriate improvements in programs, and to inform employees of changes.

Overview

The Sustainable Forest Initiative Standard Objective 13 requires landowners with lands subject to the Standard to promote continual improvement in the practice of sustainable forestry and monitor, measure, and report performance in achieving the commitment to sustainable forestry.

Therefore:

1. Biannual reports will be filed by the State Forest manager (with input by the management contractor, if applicable) to the State Forester on progress of meeting SFI requirements, status of Corrective Action Requests (CAR), and suggested opportunities for continual improvement. The first report will be due within 60 days after the Sustainable Forest Initiative annual audit and the second report about six months after that.
2. A summary of the biannual reports will be posted on the DNR Forest Service website and optionally other appropriate public outlets.
3. A meeting will be held annually to report on the progress of meeting SFI requirements, CAR status, opportunities for continual improvement on meeting SFI requirements and for the adjustment and establishment of new SFI implementation goals. This will require attendance by the forest manager, management contractor (if applicable), State Forester and appropriate staff. This meeting should be in conjunction with the release of the second report and coordinated by State Forest manager, contractor (if applicable) and State Forester.
4. This policy shall be included as a requirement in the agreement with any forest management contractors with DNR Forest Service the requirement to fulfill the above written policy conditions.

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Steven W. Koehn, Director / State Forester

APPENDIX H

Management Guidelines for the Conservation & Protection of Old-Growth Forests

Purpose/Vision Statement

The purpose of this document is to provide resource management guidelines for land unit managers to implement and advance the Department of Natural Resources' (DNR) policy on "Conservation and Protection of Old-Growth Forests." The policy objective is to enhance the functionality of old growth forest ecosystems on DNR lands by increasing old growth acreage and managing old growth ecosystems in a landscape context. Three fundamental questions must be answered to achieve this vision:

1. How much old growth forest is needed on the landscape to ensure the unique characteristics of these ecosystems are preserved?
2. How should old growth forest ecosystems be located and connected on the landscape?
3. Which forest species associations need to be included in Maryland's old growth network to maintain the full range of the state's forest habitats?

Answers to these broad questions will be achieved through a continuing process of scientific literature review, planning processes, and inventory and analysis. The guidance provided in this document is intended to ensure these questions are specifically addressed in the Department's comprehensive land planning processes, and to guide DNR land managers in the application of appropriate scientific management practices to achieve the desired outcome.

Background and Summary of Current Old Growth Forests in Maryland

In August 1989, a DNR committee report entitled "Old Growth Forest Ecosystems" was drafted to provide land managers with a scientific list of old growth forest characteristics for use in identifying and managing potential old growth forests on DNR lands. In 2002, DNR up-dated the 1989 report with an extensive review of current scientific information on eastern old growth forests, and finalized the definition of old growth forests deemed most appropriate to Maryland. This was followed up by an extensive old growth inventory project from 2003-2006.
The DNR's 2003-2006 inventory process identified 40 sites statewide as meeting the DNR's old growth definition (see Appendix 1 for list of specific sites). In total, approximately 2,176 acres (930 hectares) were identified; more than 1,700 of the designated old growth acres (688 hectares) were found on State Forest lands. The largest identified old-growth tract is within the Big Savage and South Savage Wildlands of Savage River State Forest, an area totaling more than 770 acres (312 hectares).

Most (82%) of the identified old growth stands are co-dominated by mixed oak species (Table 21). Youghiogheny Grove (Swallow Falls State Park) and Rocky Gap (Rocky Gap State Park) are co-dominated by Eastern hemlock (*Tsuga canadensis*). Youghiogheny Grove and Keenan Ridge (Green Ridge State Forest), and Schoolhouse Woods (Wye Island Natural Resources Management Area) also are codominated by pines (*Pinus sp*.). (See Appendix 2 for a listing of the dominant cover species for each identified old growth area).

Table 22: Summary of co-dominant species in identified old growth stands

Acres	Ecological Land Classification
559.4	*Quercus prinus - Quercus rubra - Carya (glabra, alba)/Gaylussacia baccata*
539.9	*Quercus (alba, rubra, velutina)/Cornus florida/Viburnum acerifolium*
305.5	*Acer saccharhum - Fraxinus americana - Tilia americana - Liriodendron tulipifera/Actaea racemosa*
303.8	*Quercus prinus - Quercus (rubra, velutina)/Gaylussacia baccata*
277.9	*Quercus alba - Quercus (rubra, coccinea) - Carya (alba, glabra)/ Vaccinium pallidum*
66.0	*Quercus rubra - Quercus prinus - Carya ovalis/Cercis canadensis/Solidago caesia*
35.7	*Pinus strobus - Tsuga canadensis/Acer pensylvanicum/Polystichum acrostichoides*
17.3	*Pinus virginiana - Pinus (rigida, echinata) - (Quercus prinus)/Vaccinium pallidum*
14.4	*Pinus taeda - Quercus falcata/Gaylusaccia frondosa*
6.4	*Liquidambar styraciflua - Acer rubrum - Nyssa biflora/Carex joorii*

Landscape Context

Currently, old growth forests in Maryland are located in patches that are limited in size, connectivity, and forest vegetation type. To achieve the desired vision of enhancing old growth ecosystem functionality, the current "patch" arrangement of old growth needs to be developed into a larger, connected "network" of old growth forest across the landscape. This requires planning at a larger spatial scale to identify forest areas suitable for old growth expansion and connection, and for inclusion of appropriate forest community types. Site level prescriptions are then developed for all areas to achieve the broader goals determined by landscape-level plans. These include actions that increase the size and functionality of old-growth forests by promoting biodiversity and natural processes, and by minimizing edge effects.

Ideally, landscape-level planning can be used to identify a network or management complex of old growth sites that restores ecological function to a broad landscape, while maintaining the capacity to provide economic goods and ecological services. A landscape that meets old growth goals can be designed through the use of general guidelines that address major threats and limitations (fragmentation, edge effects, isolation, small size, and lack of forest types). The landscape that results from the application of these guidelines should continue to be assessed as part of the land management process to ensure it meets the overall old-growth forest goals. Data from known old growth stands, and how they differ from other stand ages, should be used to guide restoration efforts such as managing for old growth. Naturally young forests may support biotic communities that are more similar to old-growth forests than older, managed forests. These forests should be identified and considered appropriately to meet old growth forest goals. A regional context should also be considered in this approach.

Table 23: Known threats/impacts to old-growth forest ecosystems & their sources.

Threat/Negative Condition	Impact	Source
Fragmentation (increased edge, reduction of forest interior)	Reduced survival/reproduction, increased invasive species impacts, loss of species diversity, decreased seedling recruitment and regeneration in gaps, some species more abundant at edges	Roads, forest loss, magnitude of impacts affected by shape of forest remnant
Isolation/lack of connectivity	Alters species interactions, limits plant and animal dispersal, divides populations, alters post-disturbance recovery, reduces effective population size leading to loss of species and genetic diversity	Dispersal barriers such as roads and inhospitable or dangerous landscape to traverse, change in surrounding land use
Small size	Reduces population size leading to loss of species and genetic diversity, increased vulnerability to invasive species impacts	Forest loss, land use changes
Limited forest types	Reduced species diversity, lack of reference sites	Forest loss, land use changes

Identifying Nearly Old-Growth Forests

"Nearly old-growth forests" are those forests which are approaching old-growth forest status. They exhibit many of the characteristics of an old-growth forest but the oldest trees are slightly less than half their maximum age, thus they are almost old growth.

For the purposes of old-growth forest conservation, DNR defines "nearly old-growth forest" as a minimum of 5 acres in size with a preponderance of old trees and exhibits many of the following characteristics:

1. The oldest trees exceed at least 40% of the projected maximum attainable age for that species (see Appendix 3).
2. Shade tolerant species are present.
3. There are randomly distributed canopy gaps.
4. There is a high degree of structural diversity characterized by multiple growth layers (canopy, understory trees, shrub, herbaceous, ground layers) that reflect a broad spectrum of ages.
5. There is an accumulation of dead wood of varying sizes and stages of decomposition, standing and down, accompanied by decadence in live dominant trees.
6. Pit and mound topography can be observed, if the soil conditions permit it.

The identification and conservation of these nearly old-growth forests are important for increasing the amount of old growth on DNR lands and to enhance the functionality of existing old growth in close proximity to these nearly old-growth forests. Appropriate conservation of nearly old-growth forests will be addressed in the sections on guidelines for conservation of old growth and guidelines for increasing old growth. Land managers, foresters, ecologists, biologists, and others on the DNR interdisciplinary teams should become familiar with nearly old-growth forests and delineate potential nearly old-growth forests for determination by the DNR's Old Growth Committee.

Note: Forests managed for extended rotations are not by default to be considered nearly old-growth forests.

Guidelines for Conservation of Old-Growth

The conservation of functional old-growth forest ecosystems is the goal. Simply protecting patches of old-growth forest does not result in a functional old-growth ecosystem. A functional system provides a multitude of values and is the desired outcome of DNR for old-growth forests. While patches of old-growth forest contain essential elements of an old-growth system, DNR will manage old-growth ecosystems in units of approximately 1,000 acres or more whenever practical. Emphasis should be given to those old-growth forests that will most likely become functional old-growth ecosystems. Some old-growth stands will be too isolated to function as an ecosystem and will be protected at the stand level.

The following guidelines are intended to protect old-growth forests while conserving and enhancing the functionality of the forested ecosystem within which the old-growth occurs:

- Designated old-growth forest will be excluded from timber harvest, including salvage, or other physical alterations.
- Designated old-growth forest will be excluded from protection from natural disturbance factors, such as native insect infestations or wild fire, unless such disturbance is introduced by an unnatural cause (e.g., exotic forest pests or invasive species) or will seriously jeopardize the continued existence of the old-growth ecosystem or significant resources adjacent to the old-growth forest.
- Control of the white-tailed deer population will be encouraged to maintain herd size at a level that does not adversely affect regeneration of trees in the understory.
- A no-cut buffer will be established to a width of at least 300 ft from the edge of the designated old growth. This buffer may be expanded based on specific site conditions or threats. The buffer will be excluded from timber harvest or other physical alterations. Any nonforested conditions within the buffer should be reforested, whenever feasible. Salvage harvesting should not occur within this buffer.
- A management zone will be established that includes the old-growth forest(s) and its primary buffer(s). This management zone will be approximately 1,000 acres in size or greater, whenever feasible. This management zone should incorporate as many designated old-growth and nearly old-growth sites as possible. Its shape should minimize edge to area ratio and be as contiguous as possible. Silvicultural treatments within this zone should be techniques that have as their primary objective the fostering of old-growth conditions, and would include practices such as uneven-aged management and limited even-aged management, extended rotations, techniques that more closely mimic the natural disturbances found in old-growth forests, structural complexity enhancement practices, or techniques that result in retention of at least 70% of the canopy trees. Standing snags and downed coarse woody debris will be retained. Any non-forested conditions within the secondary zone should be reforested, whenever feasible. Salvage harvesting is allowable with the retention of at least 33% of dead or dying snags (not damaged live trees) and coarse woody debris. At all times, the majority of the management zone shall be in the sawtimber size class, preferably a minimum of 75%. Areas within the management zone not designated old-growth or

nearly old growth at the time of initial assessment/inventory will not necessarily be managed as if they are designated old-growth.

- Nearly old-growth forests within the management zone should be managed as if they were designated old growth. Timber harvest or other alterations will be excluded. Protection of natural disturbance factors, such as insect infestations or wild fire, will be excluded unless such disturbance is introduced by an unnatural cause or seriously jeopardize the continued existence of the old-growth ecosystem or significant resources adjacent to the old-growth forest. Salvage harvesting should not occur within this forest.
- Passive recreational and educational use of old-growth forests and their buffers will be allowed, including hiking and hunting. No trails or roads will be built to access the old growth. Existing trails or roads will be managed to minimize impacts to the old-growth ecosystem or should be retired, whenever feasible. No campfires shall be allowed.
- An aggressive invasive species monitoring, prevention, and control program should be developed and implemented.
- Private land holdings within these buffers and management zones should be conserved in accordance with these guidelines through incentives, easements, or acquisitions.

Note: Extended rotation management may result in the harvesting of some trees older than half their maximum age.

For patches of old-growth that are too isolated to become functional old-growth ecosystems, the following guidelines shall apply:

- Designated old-growth forest will be excluded from timber harvest, including salvage, or other physical alterations.
- Designated old-growth forest will be excluded from protection from natural disturbance factors, such as native insect infestations or wild fire, unless such disturbance is introduced by an unnatural cause (e.g., exotic forest pests or invasive species) or will seriously jeopardize the continued existence of the old-growth ecosystem or significant resources adjacent to the old-growth forest.
- Control of the white-tailed deer population will be encouraged to maintain herd size at a level that does not adversely affect regeneration of trees in the understory.
- Old growth stands will be buffered by forest on all sides, when feasible.
- A no-cut buffer will be established to a width of at least 300 ft from the edge of the designated old growth. This buffer may be expanded based on specific site conditions or threats. The buffer will be excluded from timber harvest or other physical alterations. Any non-forested conditions within the buffer should be reforested, whenever feasible. Salvage harvesting should not occur within this buffer.
- Passive recreational and educational use of old-growth forests will be allowed, including hiking and hunting. No trails or roads will be built to access the old growth. Existing trails or roads will be managed to minimize impacts to the old-growth forest or should be retired, whenever feasible. No campfires shall be allowed.
- An aggressive invasive species monitoring, prevention, and control program should be developed and implemented.

Land managers are encouraged to consult with DNR's Old Growth Committee or other old-growth forest experts when developing specific plans to conserve old-growth forests and functional old-growth ecosystems.

Guidelines for Increasing Old-Growth

Increasing the amount of old-growth forest on DNR lands is desirable. State Forests, State Parks, Wildlife Management Areas, Natural Resources Management Areas, Natural Environmental Areas, and other designations should be assessed for the potential to increase old-growth forests and nearly old-growth forests. A functional system provides a multitude of values and is the desired outcome of DNR for old-growth forests. The following guidelines are intended to increase old-growth forest acreage on DNR land:

- Designated Wildlands, that are forested, will ultimately develop into old-growth forests over time.
- Certain Ecologically Significant Areas (ESA) will ultimately develop into old-growth forests over time.
- Nearly old-growth forests, as defined in Section 4, are those that can achieve old growth status in the quickest period of time. However, the locations and amount of nearly old-growth forests on DNR lands has not been determined. The following should be completed:
    - An assessment of nearly old-growth forests should be completed. The locations of all such forests should be mapped.
    - Until a complete assessment of nearly old-growth forests on DNR land units is completed, any forest that meet the criteria for nearly old-growth forest should be treated as old growth. During the annual work planning process, all forest stands considered for timber harvesting should be compared to the criteria for nearly old-growth forests and treated accordingly.
    - Once a complete assessment of nearly old-growth forests is completed, those forests with the largest acreages and those located on the landscape such that the functionality of old-growth ecosystems is enhanced should be conserved in a manner similar to designated old growth. Adequate buffers should be considered. Otherwise increased protection will not be required.
- Acquisition of privately-owned old-growth forests should be given extremely high priority, provided the tracts are not too isolated or small.
- Acquisition of privately-owned nearly old-growth forests adjacent to existing old growth should be pursued.
- Need to develop strategies for developing old-growth forests of under-represented forest types (e.g., loblolly pine-oak).
- If the old-growth acreage goal is not met through the inclusion of nearly old-growth forests and Wildlands, additional forest stands will be identified for management toward old-growth conditions. Once achieved these additional old-growth forest stands will be conserved as old-growth. Secondary management zones will be established and managed to mimic old-growth conditions using a variety of even-aged techniques, including extended rotations, and uneven-aged techniques to increase the functionality of the old-growth ecosystem.

Note: Extended rotation management may result in the harvesting of some trees older than half their maximum age.

Development of Specific (Land Unit) Management Plans

Land Unit Plans will provide the site-specific Old-Growth management strategies for each respective Land Unit. The site-specific management strategies will be developed in the context of the broader management guidelines contained within this document as part of the Comprehensive Planning Process. Additionally, as part of the Comprehensive Planning Process, the Department will actively engage stakeholders and the public to comment and participate on the specific Old Growth recommendations for each respective Land Unit.

Glossary

BIOLOGICAL DIVERSITY - The variety of life forms in a given area. Diversity can be categorized in terms of the number of species, the variety in the area's plant and animal communities, the genetic variability of the animals, or a combination of these elements.

BUFFER STRIP - A narrow zone or strip of land, trees, or vegetation bordering an area. Common examples include visual buffers, which screen the view along roads, and streamside buffers, which are used to protect water quality. Buffers may also be used to prevent the spread of forest pests.

DOMINANT [CO-DOMINANT]: The overstory life form or species in a plant community which contributes the most cover or basal area to the community, compared to other life form or species.

ECOLOGICAL TYPE (Habitat Type): A category of land having a unique combination of potential natural community; soil, landscape features, climate, and differing from other ecological types in its ability to produce vegetation and respond to management. Classes of ecological types include all sites that have this

ECOSYSTEM/COVER TYPE: The native vegetation ecological community considered together with non-living factors of the environment as a unit and, the general cover type occupying the greatest percent of the stand location. Based on tree or plant species forming a plurality of the stocking within the stand. May be observed in the field or computed from plot measurements.

INTERIOR FOREST: Habitat necessary for insulation from edge effects (e.g., noise, wind, sun, predation) which occurs within the interior of a patch.

LANDSCAPE LEVEL PLANNING: Planning of the distribution patterns of communities and ecosystems, the processes that affect those patterns, and changes in pattern and process over time.

LAND USE CLASS: The predominant purpose for which an area is employed. Classes include Agricultural Land, Forest land, Rangeland, Wetland, Urban/suburban, and Utility/Transportation Corridors (Roads, Railroads, Utility Corridors).

OLD GROWTH ECOSYSTEM FUNCTIONALITY: The ability of an ecosystem to produce the attributes and perform the continued operation of the plant and animal communities in an area together with the non-living physical environment that supports them. Functional Old Growth Ecosystems have physically defined boundaries, but they are also dynamic: their boundaries and constituents can change over time. They can import and export materials and energy and thus can interact with and influence other ecosystems. They can also vary widely in size.

Extended Rotation: Forest stands for which the harvest age is increased beyond the optimum economic harvest age [e.g., increasing the harvest age of an oak stand from 80-100 years (i.e., the "normal" economic harvest age for oak on most sites) to 150 or more years] to provide larger trees, wildlife habitat, and other non-timber values.

OLD GROWTH NETWORK / MANAGEMENT COMPLEX: interrelated areas of Old Growth that import and export materials and energy and interact with and influence each other as ecosystems.

SHADE-INTOLERANT TREES - Trees that cannot thrive in the shade of larger trees**.**

STAND AGE: The mean age of the dominant and co-dominant trees in the stand.

STAND CONDITION: A classification of forest stands based upon the age of maturity and structure of the overstory and understory.

- Old-Growth Stands: Ecosystems distinguished by old trees and related structural attributes. Old growth encompasses the later stages of stand development which typically differ from earlier stages in a variety of characteristics that may include tree size, accumulations of large dead woody material, number of canopy layers, species composition, and ecosystem function. The age at which old growth develops and the specific structural attributes that characterize old growth will vary widely according to forest type, climate, site conditions and disturbance regime. For example, old growth in fire-dependent forest types may not differ from younger forests in the number of canopy layers or accumulation of down woody material. However, old growth is typically distinguished from younger growth by several of the following structural attributes:
    - Large trees for species and site.
    - Wide variation in tree sizes and spacing.
    - Accumulations of large-size dead standing and fallen trees that are high relative to earlier stages.
    - Decadence in the form of broken or deformed tops or bole and root decay.
    - Multiple canopy layers.
    - Canopy gaps and understory patchiness.
- Young-Growth Stand: Any forested stand not meeting the definition of old growth.

STRUCTURAL COMPLEXITY ENHANCEMENT: Silvicultural practices that promote old-growth structural characteristics such as multi-layered canopies, elevated large snag and downed log densities, variable horizontal density, and a greater proportion of tree basal area in large diameter classes.

Appendix 1. Old Growth areas identified by the initial Maryland Old Growth Inventory Project, 2003-2006.

Management Area	Site Name	Management Zone	Acreage (Hectares)
State Forest Lands			
Green Ridge State Forest			
Allegany County	Bells Hill	Private / General Management	6 (2.5)
	Boyer Knob	General Management	18 (7.3)
	Deep Run	General Management	5 (2.2)
	Green Ridge Southwest	Special Management	5 (2.2)
	Jacobs Road South	General Management	6 (2.4)
	Keenan Ridge	Special Management / Water Influence	17 (7)
	Mertens-Oldtown Road	General Management	7 (2.9)
	Carroll Rd	Special Management / Water Influence	64 (25.9)
	Roby Ridge 1	Water Influence Zone	19 (7.8)
	Roby Ridge 2	Federal / Water Influence	13 (5.1)
	South Town Hill East	Special / General Management	5 (2.1)
	Stafford Slope	Private / General Management	8 (3.1)
	Town Hill East	General Management	6 (2.6)
	Tunnel Hill	Special Management	7 (2.9)
Pocomoke State Forest			
Worcester County	Cottingham Mill Run	Water Influence	6 (2.6)
Potomac-Garrett State Forest			
Garrett County	Ashton's Woods	Special Management	26 (10.7)
	Backbone Mountain	Private / General Management	40 (16.4)
	Crabtree Slope	General Management	228 (92.2)
	Hungry Hollow	Special Management	20 (8.1)
	Lower Schell	Water Influence	31 (12.6)
	Lostland Run	Water Influence	72 (29.3)
	Maple Lick Run	Special Management	22 (89.9)
Savage River State Forest			
Garrett County	Big Savage	Wildland	392 (158.8)
	Blackhawk Run	Wildland	21 (8.4)
	Coleman Hollow/South Savage	Wildland	382 (154.6)
	Cucumber Hollow	General Management	43.8 (17.7)
	Custer Hollow	Wildland	35 (14.3)
	High Rock	Wildland	150 (60.8)
	Mill Run (Michael Road)	General Management	19 (7.8)
	McCann's Ridge	Wildland	10 (4.2)
	Tom Ridge	Wildland	14 (5.6)
	Turkey Lodge Ridge	General Management	12 (4.7)
Wildlife Management Lands			
Dan's Mountain Wildlife Mngmnt Area			
Allegany County	Upper Dan's Mountain	Wildlife Management Area	18 (7.1)
	Lower Dan's Mountain	Wildlife Management Area	25 (10.2)
	Upper Mill Run	Wildlife Management Area	129 (52.2)
State Park Lands			
Rocky Gap State Park			
Allegany County	Rocky Gap	State Park	69 (28.1)
Swallow Falls State Park			
Garrett County	Youghiogheny Grove	State Park	36 (14.4)
Additional Lands			
Belt Woods Natural Environment Area			
Prince George's County	Belt Woods	Natural Environment Area	42 (17.0)
Wye Island NRMA			
Queen Anne's County	Schoolhouse Woods	Natural Resources Management Area	14 (5.8)
Monocacy NRMA			
Frederick County	Monocacy NRMA	Natural Resources Management Area	66 (26.7)
South Mountain Recreation Area			
Washington County	Weverton Cliffs	Recreation Area	55 (22.4)

Appendix 2. Approximate maximum ages and dominant tree species in Approved Old Growth Areas, 2003 - 2006.

Site	County	MaxAge	Dominant Cover Species
Bells Hill	Allegany	250	Quercus alba, Quercus rubra, Quercus prinus
Boyer Knob		366	Quercus rubra, Quercus prinus, Quercus alba
Carroll Rd		209	Quercus prinus, Pinus virginiana, Quercus rubra
Deep Run		280	Quercus prinus, Quercus rubra
Green Ridge Southwest		206	Quercus alba, Quercua rubra, Carya glabra
Jacobs Road South		226	Quercus alba, Quercus prinus
Keenan Ridge		222	Pinus rigida, Pinus vriginiana, Quercus alba
Lower Dan's Mountain		264	Quercusprinus, Quercus rubra
Mertens-Oldtown Road		299	Quercus alba, Quercus prinus, Quercus velutina
Roby Ridge 1		309	Quercus alba, Quercus prinus, Pinus strobus
Roby Ridge 2		267	Quercus alba, Quercus prinus, Pinus virginiana
Rocky Gap		338	Quercus prinus, Tsuga canadensis, Quercus alba
South Town Hill		205	Quercus rubra, Quercus prinus
Stafford Slope		240	Quercus alba, Quercus rubra, Quercus prinus
Town Hill East		212	Quercus prinus, Quercus rubra
Tunnel Hill		313	Quercus alba, Quercus rubra, Quercus velutina
Upper Dan's Mountain		357	Quercus alba, Quercus rubra, Pinus echinata
Upper Mill Run		230	Quercus prinus, Quercus rubra
Monocacy NRMA	Frederick	254	Quercus prinus, Quercus rubra, Liriodendron tulipifera
Ashton's Woods	Garrett	223	Quercus rubra
Backbone Mountain		308	Quercus rubra, Quercus velutina
Big Savage		365	Quercus rubra, Quercus prinus, Quercus alba
Blackhawk Run		306	Quercus rubra, Quercus prinus, Liriodendron tulipifera
Crabtree Slope		221	Quercus rubra, Acer saccharum
Cucumber Hollow		321	Quercus rubra, Quercus prinus, Quercus alba
Custer Hollow		391	Quercus rubra, Quercus prinus, Quercus alba
High Rock		215	Quercus rubra, Quercus prinus, Acer saccharum
Hungry Hollow		237	Quercus rubra, Acer saccharum, Tilia americana
Lostland Run		265	Quercus rubra, Liriodendron tulipifera, Acer saccharum
Lower Schell		230	Quercus prinus, Quercus alba
Maple Lick Run		306	Quercus prinus, Quercus rubra
McCann's Ridge		341	Quercus rubra, Quercus prinus
Mill Run (Michael Road)		205	Quercus rubra, Quercus prinus, Quercus alba
South Savage (Coleman Hollow)		389	Quercus rubra, Quercus prinus, Quercus alba
Tom Ridge		300	Quercus alba, Quercus prinus
Turkey Lodge Ridge		383	Quercus rubra, Quercus prinus, Acer saccharum
Youghiogheny Grove		225	Pinus strobus, Tsuga canadensis, Quercus rubra
Belt Woods	Prince George's	240	Quercus alba, Liriodendron tulipifera
Schoolhouse Woods	Queen Anne's	215	Quercus alba, Pinus taeda
Weverton Cliffs	Washington	220	Quercus prinus, Quercus rubra
Cottingham Mill Run	Worcester	210	Quercus lyrata

Appendix 3. Half and 40% maximum attainable ages for Maryland trees for use in defining Nearly Old Growth tree ages.

Scientific Name	Common Name	Typical Life Span	Maximum Life Span	Half of Maximum Attainable Age*	40% Maximum Attainable Age**
Abies balsamea	Balsam Fir	80-125	150-200	90	72
Acer negundo	Boxelder	60-75	100	50	40
Acer pensylvanicum	Striped Maple	100	No data	75	60
Acer rubrum	Red Maple	80	150	75	60
Acer saccharinum	Silver Maple	100	125-130	65	52
Acer saccharum	Sugar Maple	300	400	200	160
Betula alleghaniensis	Yellow Birch	150	300	150	120
Betula lenta	Sweet Birch	150	250	125	100
Betula nigra	River Birch	No data	No data	No data	No data
Betula papyrifera	Paper Birch	100	140	70	56
Carpinus caroliniana	American Hornbeam (Musclewood)	100	150	75	60
Carya cordiformis	Bitternut Hickory	175	200	100	80
Carya glabra	Pignut Hickory	200	300	150	120
Carya ovata	Shagbark Hickory	250	300	150	120
Carya pallida	Sand Hickory	No data	No data	No data	No data
Carya spp.	Hickory	175-200	200-300	100-150	80-120
Carya tomentosa	Mockernut Hickory	200	300	150	120
Celtis laevigata	Sugarberry	125	150	75	60
Celtis occidentalis	Hackberry	150	200	100	80
Cercis canadensis	Eastern Redbud	75	90	45	36
Chamaecyparis thyoides	Atlantic White Cedar	200	No data	150	120
Cornus florida	Flowering Dogwood	125	No data	100	80
Crataegus spp.	Hawthorn	40	No Data	40	32
Diospyros virginiana	Persimmon	60-80	80	40	32
Fagus grandifolia	American Beech	300	400	200	160
Fraxinus americana	White Ash	260	300	150	120
Fraxinus nigra	Black Ash	150	200	100	80
Fraxinus pennsylvanica	Green Ash	125	150	75	60
Fraxinus profunda	Pumpkin Ash	No data	No data	No data	No data
Fraxinus spp.	Ash	125-250	150-300	75-150	60-120
Ilex opaca	American Holly	100	150	75	60
Juglans cinerea	Butternut	75	75?	50	40
Juglans nigra	Black Walnut	150	250	125	100
Juniperus virginiana	Eastern Red Cedar	150	300	150	120
Larix laricina	Larch or Tamarack	150	180	90	72
Liquidambar styraciflua	Sweetgum	200	300	150	120
Liriodendron tulipifera	Yellow-Poplar	200	250	125	100
Magnolia acuminata	Cucumber Tree	80	150-250	100	60-100

Scientific Name	Common Name	Typical Life Span	Maximum Life Span	Half of Maximum Attainable Age*	40% Maximum Attainable Age**
Magnolia virginiana	Sweetbay	70	No data	60	48
Morus rubra	Red Mulberry	100	125	65	50
Nyssa aquatica	Water Tupelo	No Data	No Data	No data	No data
Nyssa sylvatica var. biflora	Swamp Tupelo	60-100	No Data	75	60
Nyssa sylvatica var. sylvatica	Black Tupelo (Blackgum)	150	250	125	100
Ostrya virginiana	Eastern Hophornbeam	100	150	75	60
Oxydendrum arboreum	Sourwood	100	120	60	48
Persea borbonia	Redbay	56-80	No data	50	40
Picea rubens	Red Spruce	200	300	150	120
Pinus echinata	Shortleaf Pine	200	300	150	120
Pinus pungens	Table Mountain Pine	100	200	100	80
Pinus rigida	Pitch Pine	100	200	100	80
Pinus serotina	Pond Pine	60-100	No data	75	60
Pinus strobus	Eastern White Pine	200	450	225	180
Pinus taeda	Loblolly Pine	100	250	125	100
Pinus virginiana	Virginia Pine	100	200	100	80
Platanus occidentalis	Sycamore	250	500	250	200
Populus deltoides	Eastern Cottonwood	60	100-200	75	60
Populus heterophylla	Swamp Cottonwood	58-120	No data	90	72
Populus grandidentata	Bigtooth Aspen	60-70	100	50	40
Populus tremuloides	Quaking Aspen	70	125-200	80	50-80
Prunus pensylvanica	Pin Cherry	35	No data	30	24
Prunus serotina	Black Cherry	100	250	125	100
Quercus alba	White Oak	300	600	300	240
Quercus bicolor	Swamp White Oak	120-300	350	175	140
Quercus coccinea	Scarlet Oak	50-150	180-250	100	80
Quercus falcata	Southern Red Oak	150-200	200-275	120	96
Quercus falcate var. pagodifolia	Cherrybark Oak (Swamp Red Oak)	150	275	140	110
Quercus imbricaria	Shingle Oak	No data	No data	No data	No data
Quercus lyrata	Over-cup Oak	300	400	200	160
Quercus macrocarpa	Bur Oak	200	400	200	160
Quercus marilandica	Blackjack Oak	100	230	115	92
Quercus michauxii	Swamp Chestnut Oak	100	200	100	80
Quercus muehlenbergii	Chinkapin Oak	150	250	125	100
Quercus nigra	Water Oak	120-175	No data	100	80

Scientific Name	Common Name	Typical Life Span	Maximum Life Span	Half of Maximum Attainable Age*	40% Maximum Attainable Age**
Quercus palustris	Pin Oak	100	150	75	60
Quercus phellos	Willow Oak	200	No Data	175	140
Quercus prinus	Chestnut Oak	300	400	200	160
Quercus rubra	Northern Red Oak	200	400	200	160
Quercus shumardii	Shumard Oak	No data	480	240	192
Quercus stellata	Post Oak	250	400	200	160
Quercus velutina	Black Oak	100	200	100	80
Robinia pseudoacacia	Black Locust	60	100	50	40
Salix nigra	Black Willow	70	85	45	34
Sassafras albidum	Sassafras	100	500	250	200
Taxodium distichum var. distichum	Bald Cypress	250-600	400-1200	500	400
Taxodium distichum var. nutans	Pond Cypress	250	No Data	300	240
Thuja occidentalis	Northern White Cedar	300	400	200	160
Tilia americana	American Basswood	100	140	70	56
Tilia heterophylla	White Basswood	100	200	100	80
Tsuga canadensis	Eastern Hemlock	450	800	400	320
Ulmus americana	American Elm	175	300	150	120
Ulmus rubra	Slippery Elm	200	300	150	120
Ulmus spp.	Elms	125-200	300	150	120

,*If no data for maximum age were available, a number close to Typical Life Span has been chosen. If data show a range for maximum age, a number near one half or 40% of the mean of the endpoints of the range has been chosen for half and 40% of maximum age columns, respectively.

Sources of Information: Loehle, C. 1987. Tree life history strategies. Can. J. For. Res. 18:209-222; Burns, R.M. and Honkala, B.H. (tech. coords.). 1990. Silvics of North America. Ag. Handb. 654, USDA Forest Service, (www.na.fs.fed.us/spfo/pubs/silvics_manual/table_of_contents.htm); various publications in USFS Old Growth Forest series.

APPENDIX I

Pocomoke State Forest – Modeling Long-term Sustainability

Criteria used in this 75 year model run:

- Maximum age
  - Lobolly – 200
  - Mixed pine/hardwood – 200
  - Bottomland/mixed hardwood – 450
  - Short-leaf pine – 300
  - Cypress – 1000
- Yields/returns taken from Chesapeake model from ~3 years ago
- Harvests
  - DFS/ESA 1st thinning can occur between ages 15 and 23
  - FIDS 1st thinning can occur between ages 18 and 30
  - DFS 2nd thinning from age 25 to 35
  - FIDS 2nd thinning from 30 to 45
  - ESA 2nd thinning from age 22 to 32
  - DFS/ESA final harvest can occur starting at age 40
  - FIDS final harvest can occur starting at age 60
  - Lobolly stands in DFS areas
    - 65% regenerate (nat/plant) into loblolly
    - 20% regen into PH
    - 10% regen into HP
    - 5% regen into SLP
  - All pine (lob, ph, hp) FIDS stands regenerate into HP
  - Other loblolly stands (non-DFS or FIDS)
    - 40% to HP
    - 60% to PH
  - Pine stands in ESA go to HP 100%
  - SLP stands regenerate into SLP 100%
- Death
  - If death occurs, stands in G3 areas regenerate as SLP
  - All other deaths just reset the age to 0 (no change in cover, etc)
- Model maximizes total dollar return over entire model run
- Constraints
  - Total harvest area cannot exceed 2500 acres per year
  - Total T1 area cannot exceed 2000 acres per year
  - Total FH area cannot exceed 1500 acres per year
  - Even flow constraints

- Total volume harvested cannot change from the maximum by more than 20%
- Total thin 1 or thin 2 areas cannot change from the max more than 35%
- Total FH level cannot change more than 30% from max
- Total standing inventory cannot change by more than 20% from the max

The following forest modeling graphs are derived from the current database for Pocomoke State Forest as of March 2010. The forest modeling projections below are estimates on what can be expected to occur over a 75 year time frame.

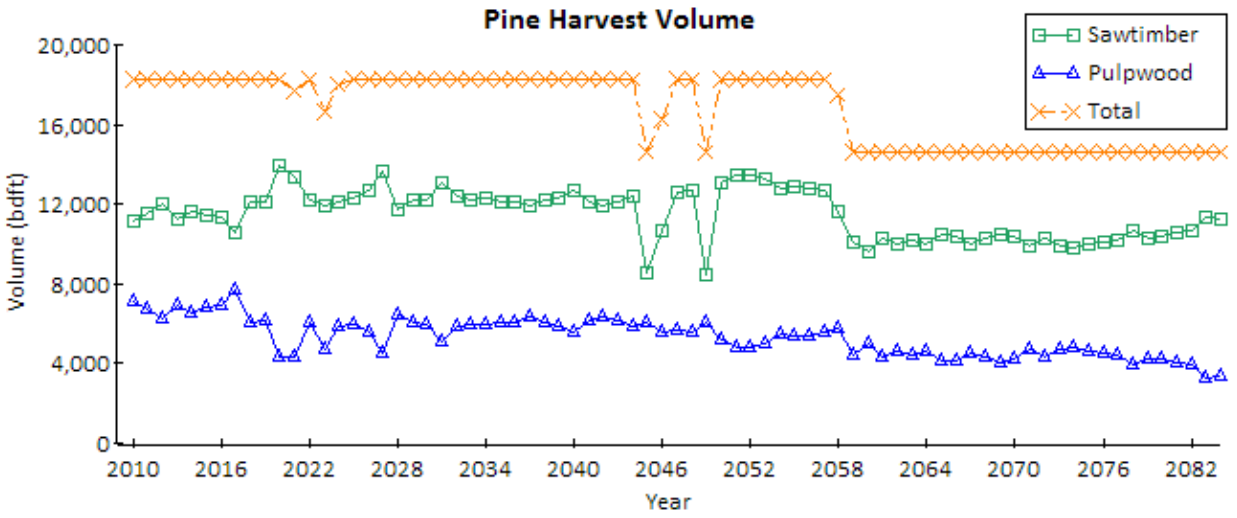


Figure 15: Estimated Pine Harvest Volume on PSF based on 75 year projection

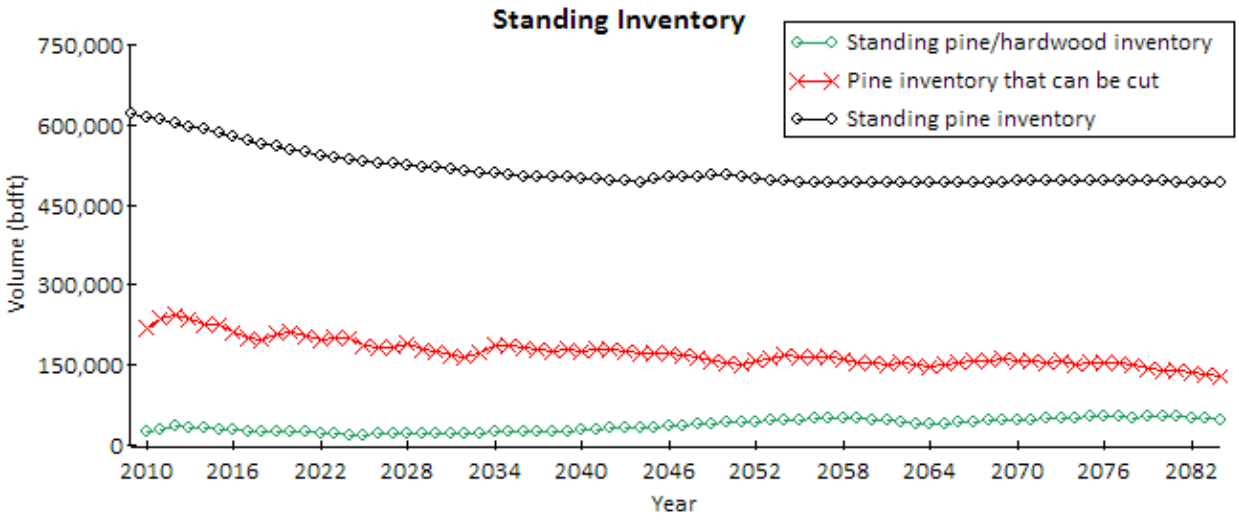


Figure 16: Standing Inventory on PSF based on a 75 year projection

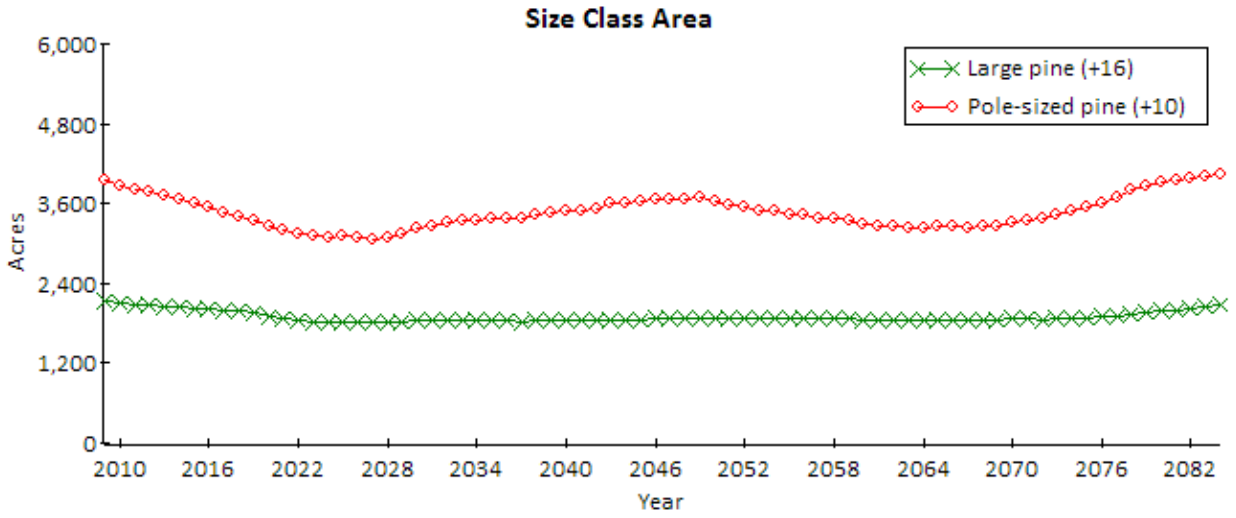


Figure 17: Size Class Area in Acres on PSF over 75 year projection

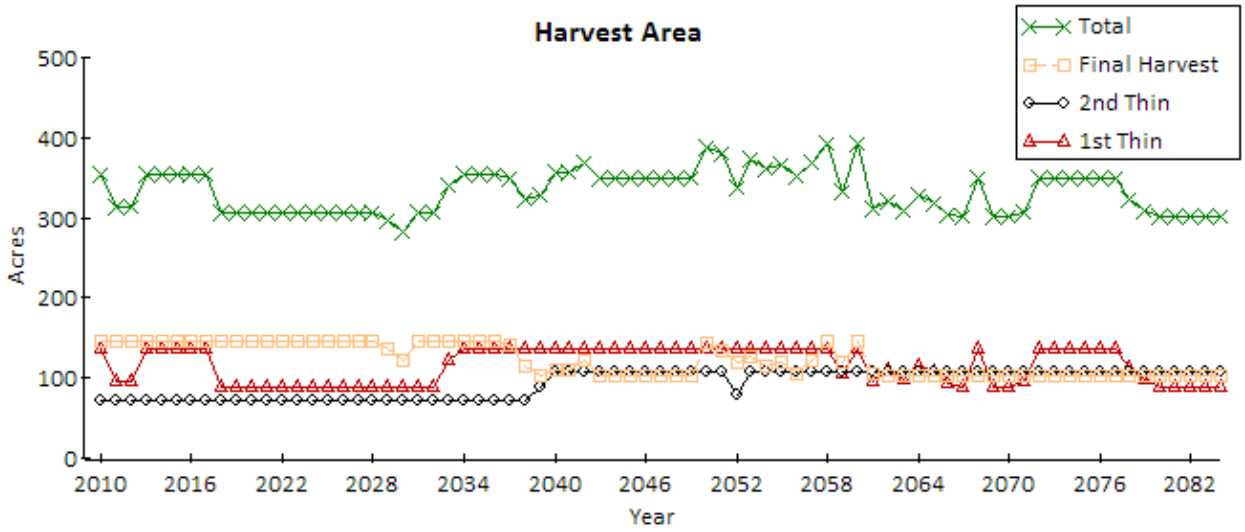


Figure 18: Estimated Available Harvest Acres for Various Harvest Methods over a 75 year period

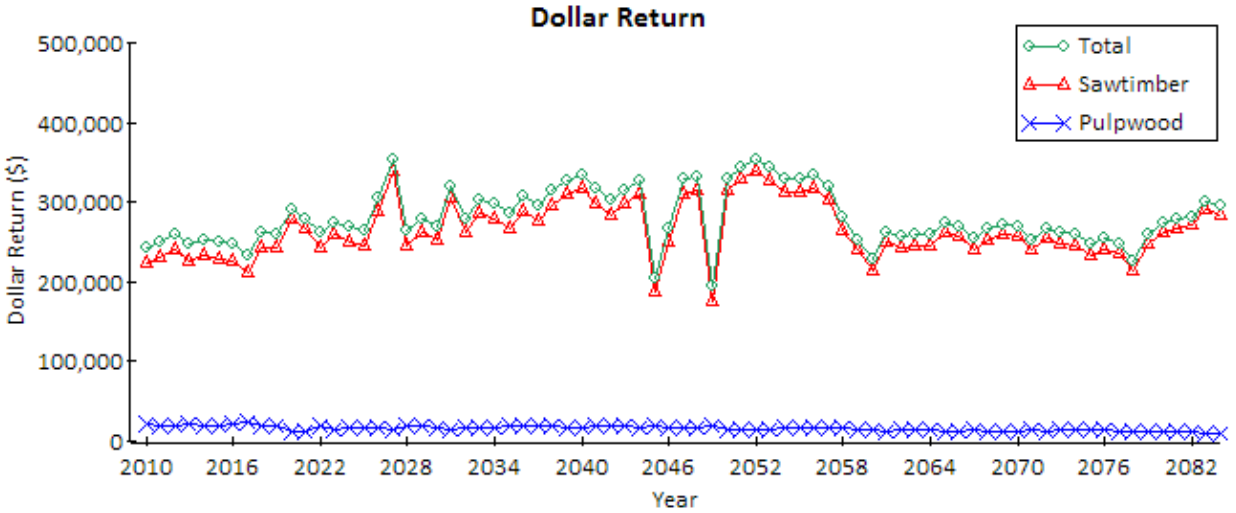


Figure 19: Estimated Revenue projections from various Harvest Types, 75 year period.

APPENDIX J

Pocomoke State Forest – Priority Management Areas

Table 24: PSF Acres in Each Priority Management Area

Acreages of PSF Priority Management Areas, Version 3 (4/20/21)		
Management Classification	**Acres**	**% of PSF**
HCVF = High Conservation Value Forest		
ESA Total	**7,943.8**	**43.0%**
ESA Zone 1 *(HCVF)*	7,480.7	40.5%
ESA Zone 1 - Sand Ridge Community *(HCVF)*	12.8	0.1%
ESA Zone 2 *(HCVF)*	46.3	0.3%
ESA Zone 3 - Pulpwood Mgt.	96.6	0.5%
ESA Zone 3 - Sawtimber Mgt.	307.4	1.7%
ESA Zone 3 Total	404.1	2.2%
Core FIDS Mgt. Areas Outside of ESA *(HCVF)*	26.2	0.1%
Riparian Forest Buffers outside ESA, FIDS & DFS *(HCVF)*	1,065.5	5.8%
DFS *Core* Areas Outside of ESA & Core FIDS *(HCVF)*	237.9	1.3%
DFS *Future Translocation* Areas Outside of ESA & Core FIDS	362.9	2.0%
DFS *Future Core* Areas Outside of ESA, Core FIDS & DFS Translocation	8,852.2	47.9%
General Mgt. Zone	3.5	0.0%
Entire Pocomoke State Forest (PSF) Project:	**18,492.0**	**100.0%**
SUMMARY		
1) Areas Available for Limited Forest Harvest *(HCVF)*:		
ESA Zone 1 *(HCVF)*	7,480.7	40.5%
ESA Zone 2 *(HCVF)*	46.3	0.3%
Areas Available for Limited Forest Harvest *(HCVF)* - TOTAL:	**7,527.0**	**40.7%**
2) Areas Available for Sustainable Forestry:		
ESA Zone 1 - Sand Ridge Community *(HCVF)*	12.8	0.1%
ESA Zone 3 - Pulpwood Mgt.	96.6	0.5%
ESA Zone 3 - Sawtimber Mgt.*	295.0	1.6%
Core FIDS Mgt. Areas Outside of ESA *(HCVF)*	26.2	0.1%
DFS *Core* Areas Outside of ESA & Core FIDS *(HCVF)*	237.9	1.3%
DFS *Future Translocation* Areas Outside of ESA & Core FIDS	362.9	2.0%
DFS *Future Core* Areas Outside of ESA	8,852.2	47.9%
General Mgt. Zone	3.5	0.0%
Areas Available for Sustainable Forestry - TOTAL:	**9,887.1**	**53.5%**
Total Forest Area designated as HCVF	*7,803.9*	*42.2%*
*loblolly pine and mixed hardwood/pine only		

APPENDIX K

Land Additions and Acquisitions to Pocomoke State Forest

23.1 Pocomoke River Corridor

Multiple parcels along the Pocomoke River purchased in conjunction with The Conservation Fund and The Nature Conservancy.

23.2 Sturges Creek

This property consists of 290 acres acquired through Program Open Space (POS) from the Nature Conservancy in 2013. The property, which contains forested wetlands, wooded uplands and shoreline, is located on a tributary to Nassawango Creek directly adjacent to Maryland Department of Natural Resources (DNR) lands. It is part of the Pocomoke River North American Wetlands Conservation Act (NAWCA) Partnership project and contains 53 acres of forested wetlands and 237 acres of upland forest located along Sturges Creek in Worcester County.

23.1 Furnace Tract

This property consists of 595 acres located in Worcester County near Furnace Town purchased from the Forestland Group in 2013. This property contains globally rare community types, state endangered species, and unique habitats.

23.2 ACE Timberlands LLC/ABC Woodlands LLC

The ACE Timberlands LLC and ABC Woodlands LLC properties totaling 3,485.78 acres are contiguous with Pocomoke State Forest and existing State Forest and Wildlife Management Areas. ACE Timberlands LLC and ABC Wooodlands LLC have been exclusively offered for sale in fee; and would be included into Chesapeake Forest for management given their proximity, with certain tracts comprising in-holdings within the Forest. The properties contain many outstanding natural resource features and would protect significant areas of 3 major river systems and numerous subwatersheds on the Eastern Shore. Collectively, these lands support one of the largest concentrations of upland game on the entire Eastern Shore and help connect more than 84,200 acres of existing forestland that is integral to the water quality of the Bay and its tributaries. Maintaining forest cover on lands in these watersheds will improve water quality for oyster beds, reduce nutrient loading, and protect significant amounts of wildlife habitat. These watersheds have been identified by federal, state, and local officials as well as non-governmental organizations as priority watersheds to maintain or restore under the State's Clean Water Action Plan – a program element of the Environmental Protection Agency (EPA) and an important component of Maryland's Chesapeake Bay Restoration Strategy.

These lands contain large areas of critical habitat that will be protected for overwintering migratory waterfowl, shorebirds and wading birds, bobwhite quail, wild turkey, white-tailed deer, sika deer and other rare, threatened, and endangered species. The majority of this forestland is significant breeding habitat for a variety of neo-tropical songbirds that are suffering ecological stresses both in the mid-Atlantic and in their winter homes in South America and the Caribbean. Significant protection will be provided to watersheds that drain into tidal waters that support the most important submerged aquatic vegetation (SAV) beds in the Bay for juvenile fish and crabs.

The opportunity for the State of Maryland to protect and manage these vast forestland holdings is profound. It closely dovetails with the extraordinary circumstances that allowed the state to acquire over

58,000 acres of Chesapeake Forest lands in 1999. It is very unlikely that a transaction of this size would materialize in the future, as there are fewer larger tracts in single ownership in Maryland. Together with the Chesapeake Forest acquisition, ACE Timberlands and ABC Woodlands fee acquisition would have tremendous long-term beneficial impacts and preserve the outstanding forested ecosystems of the Lower Eastern Shore. These properties provide substantial linkage of existing protected forestlands and will safeguard against the damaging fragmentation that would result if the properties were sold to multiple buyers. Management by the DNR's State Forest system would assure that environmental sound, sustainable forest would appreciably benefit the local and regional economies supporting hundreds of local jobs.

APPENDIX L

Pocomoke State Forest – Tract Maps

Legend

P01

Old Furnace I / II

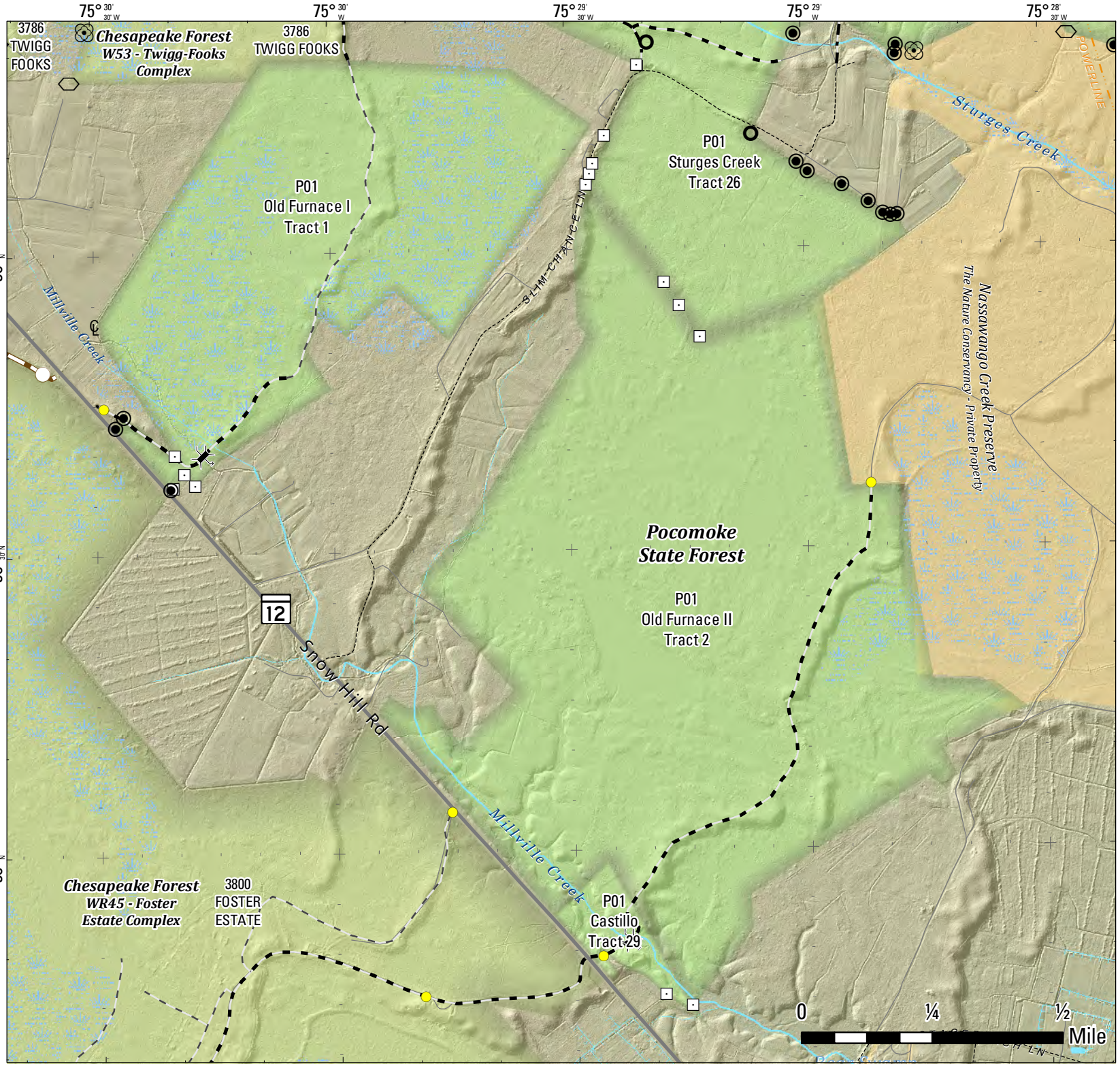
Tract 1,2,29

867.5 Acres

Public Hunting

8.4 mi boundary lines
painted 1995-2008
from partial survey

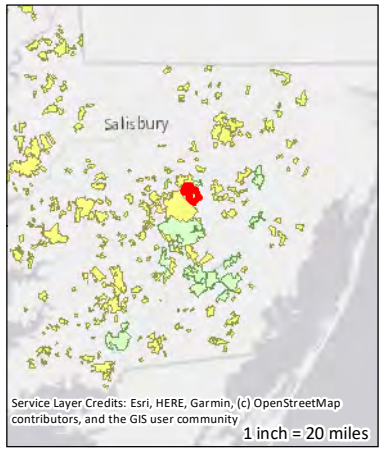
1 inch = 1,320 feet



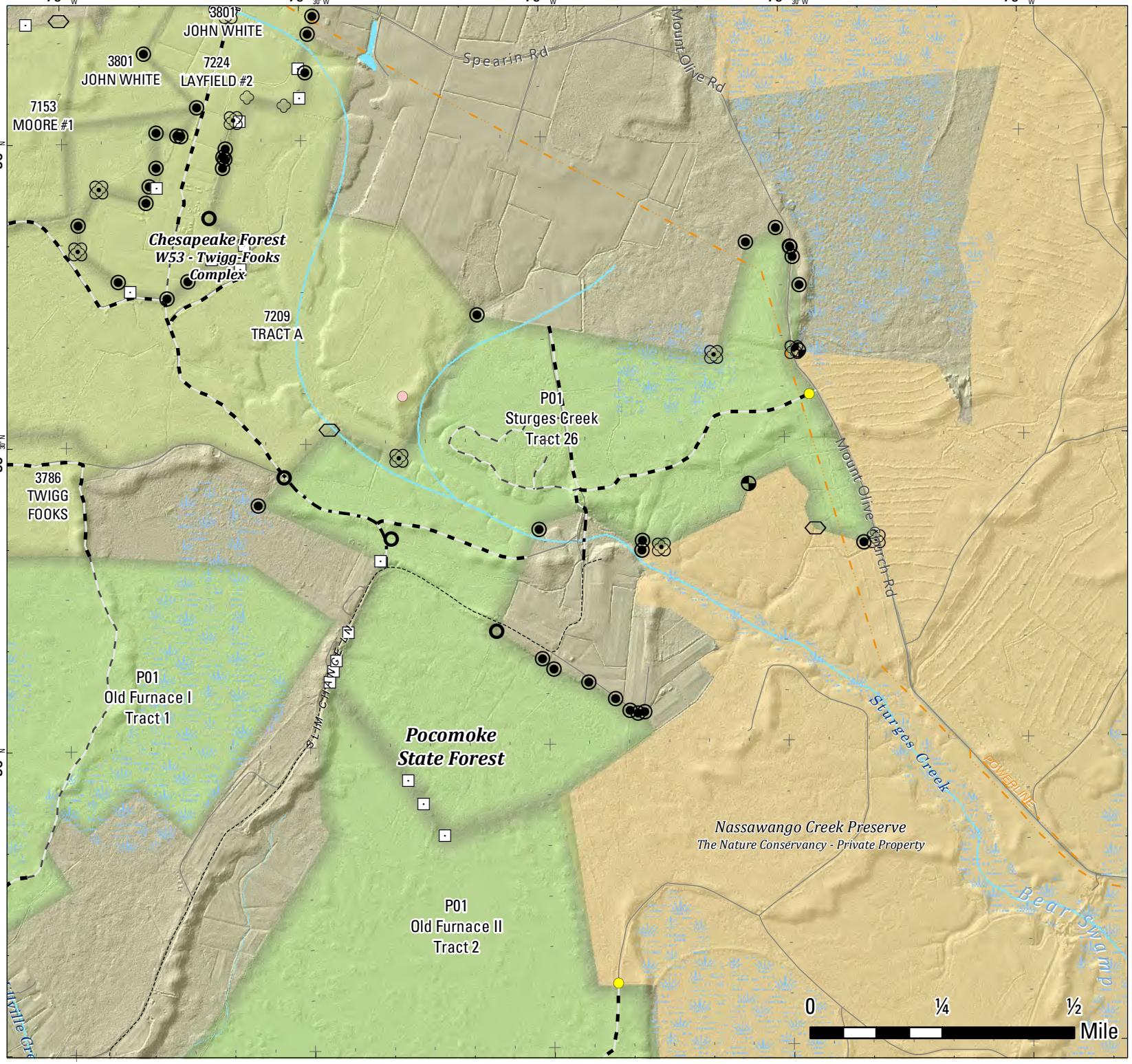
Legend

- Pocomoke SF Tracts

N



ASC-DNR Forest Service
07/2022 v5.0



P01

Sturges Creek

Tract 26

344.0 Acres

Public Hunting

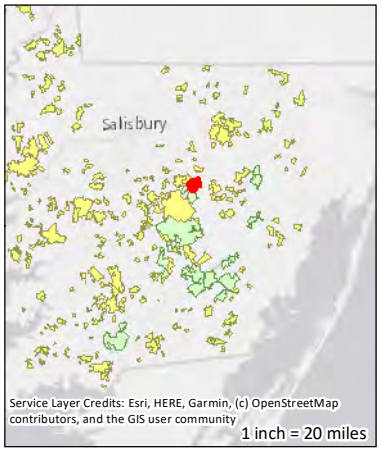
5.1 mi boundary lines
painted 2013
from survey

1 inch = 1,320 feet

Legend

Pocomoke SF Tracts

N



ASC-DNR Forest Service
07/2022 v5.0

P02

Nazareth Church

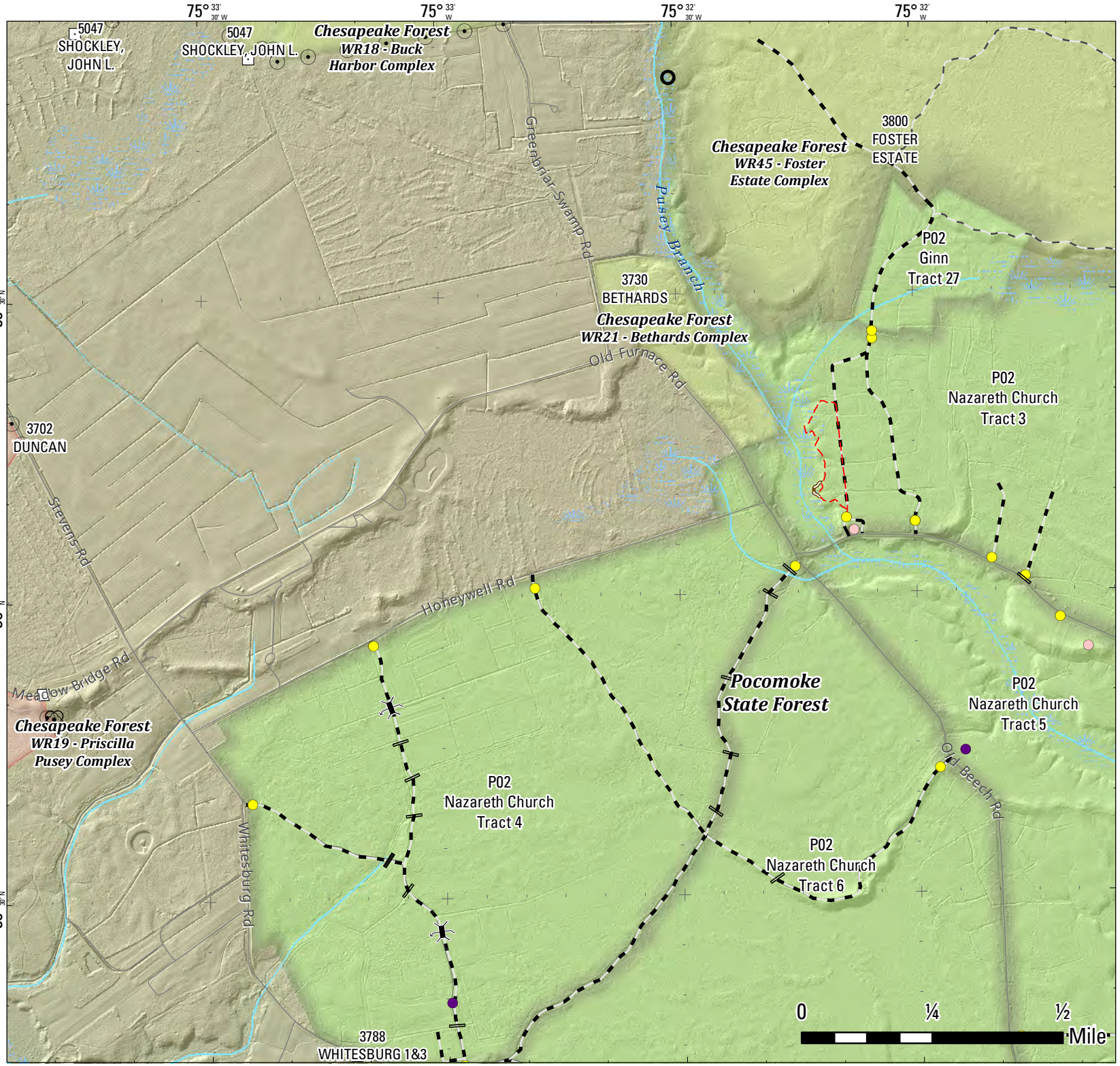
Tract 3,4,5,6,27

781.0 Acres

Public Hunting

6.6 mi boundary lines
painted 2005
from UNK

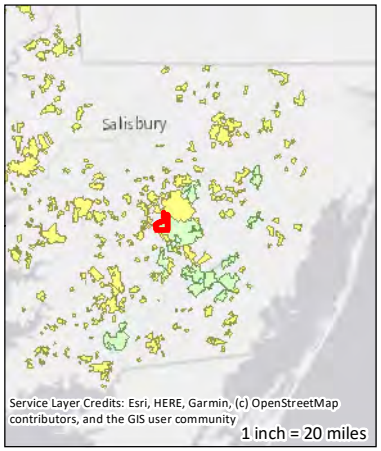
1 inch = 1,320 feet



Legend

Pocomoke SF Tracts

N



ASC-DNR Forest Service
07/2022 v5.0

P02

Nazareth Church

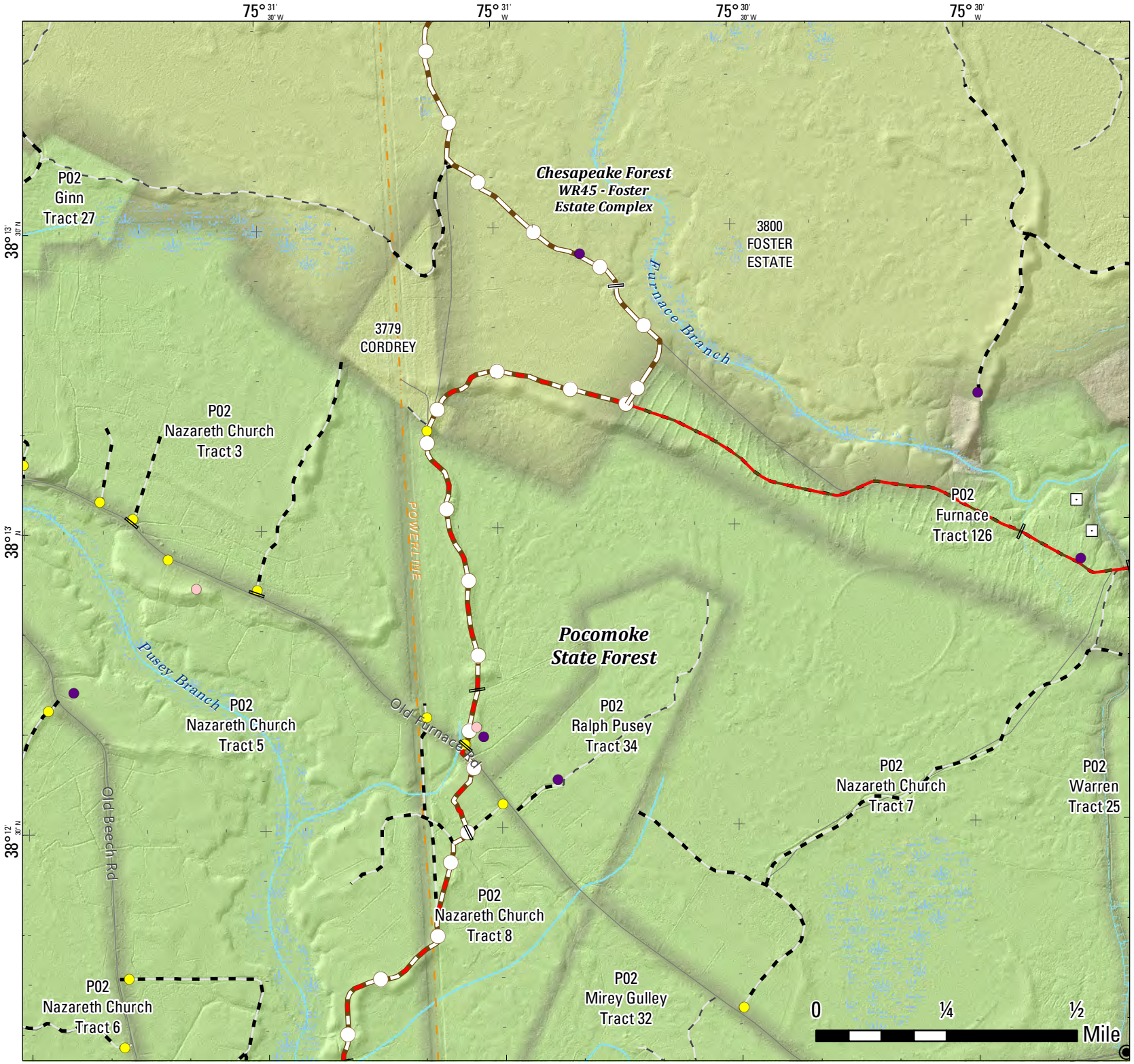
Tract 3,5,6,7,8,27,126

1,506.0 Acres

Public Hunting

7.7 mi boundary lines
painted 2005
from UNK

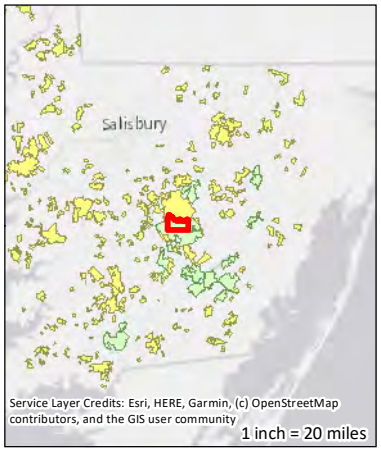
1 inch = 1,320 feet



Legend

Pocomoke SF Tracts

N



ASC-DNR Forest Service
07/2022 v5.0

P02

Nazareth Church

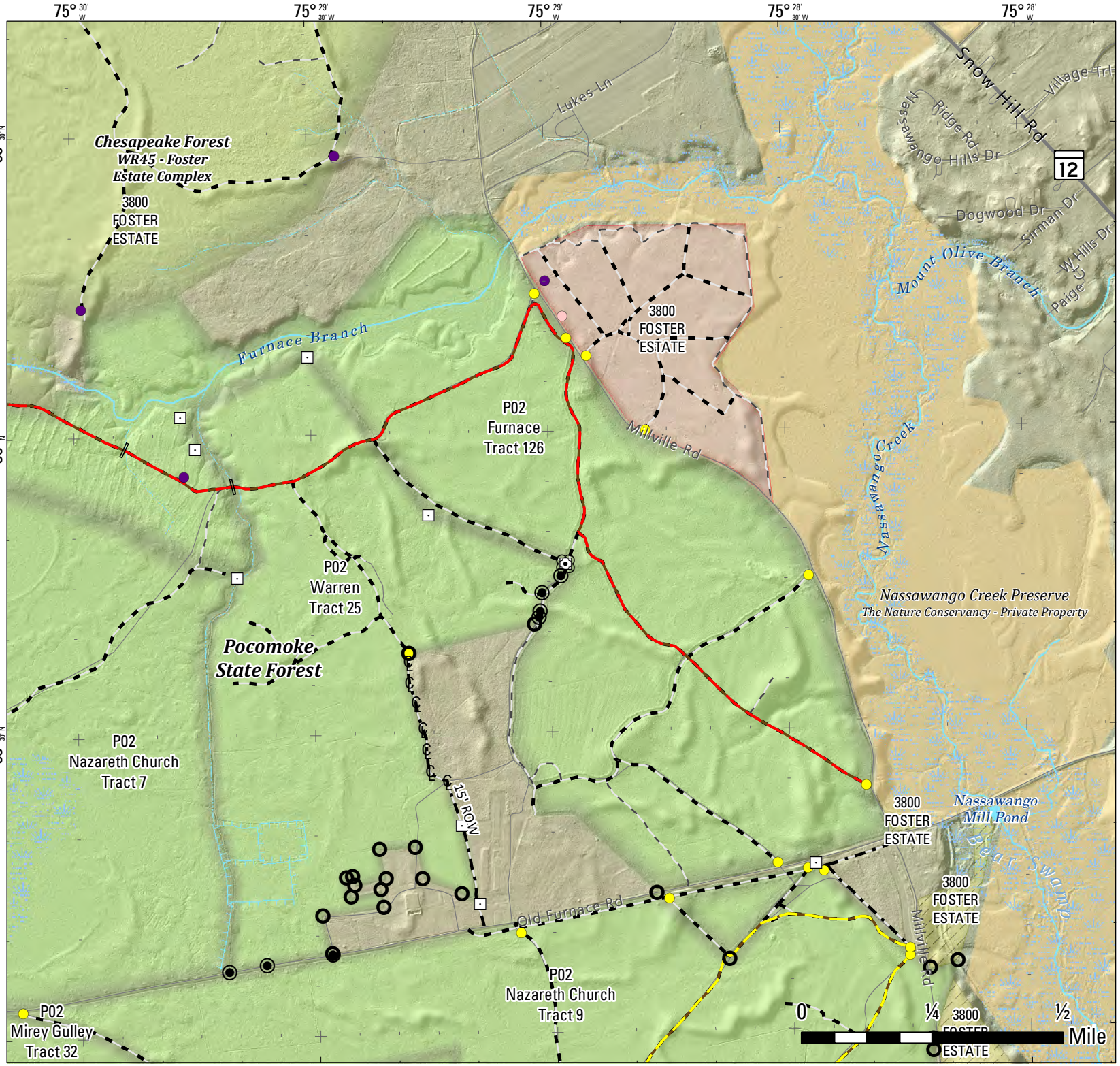
Tract 7,9,25,126

674.4 Acres

Public Hunting

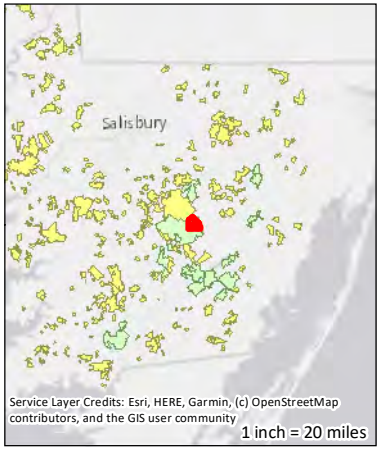
5.7 mi boundary lines
painted 2005
from UNK

1 inch = 1,320 feet



Legend

Pocomoke SF Tracts



ASC-DNR Forest Service
07/2022 v5.0

P02

Nazareth Church

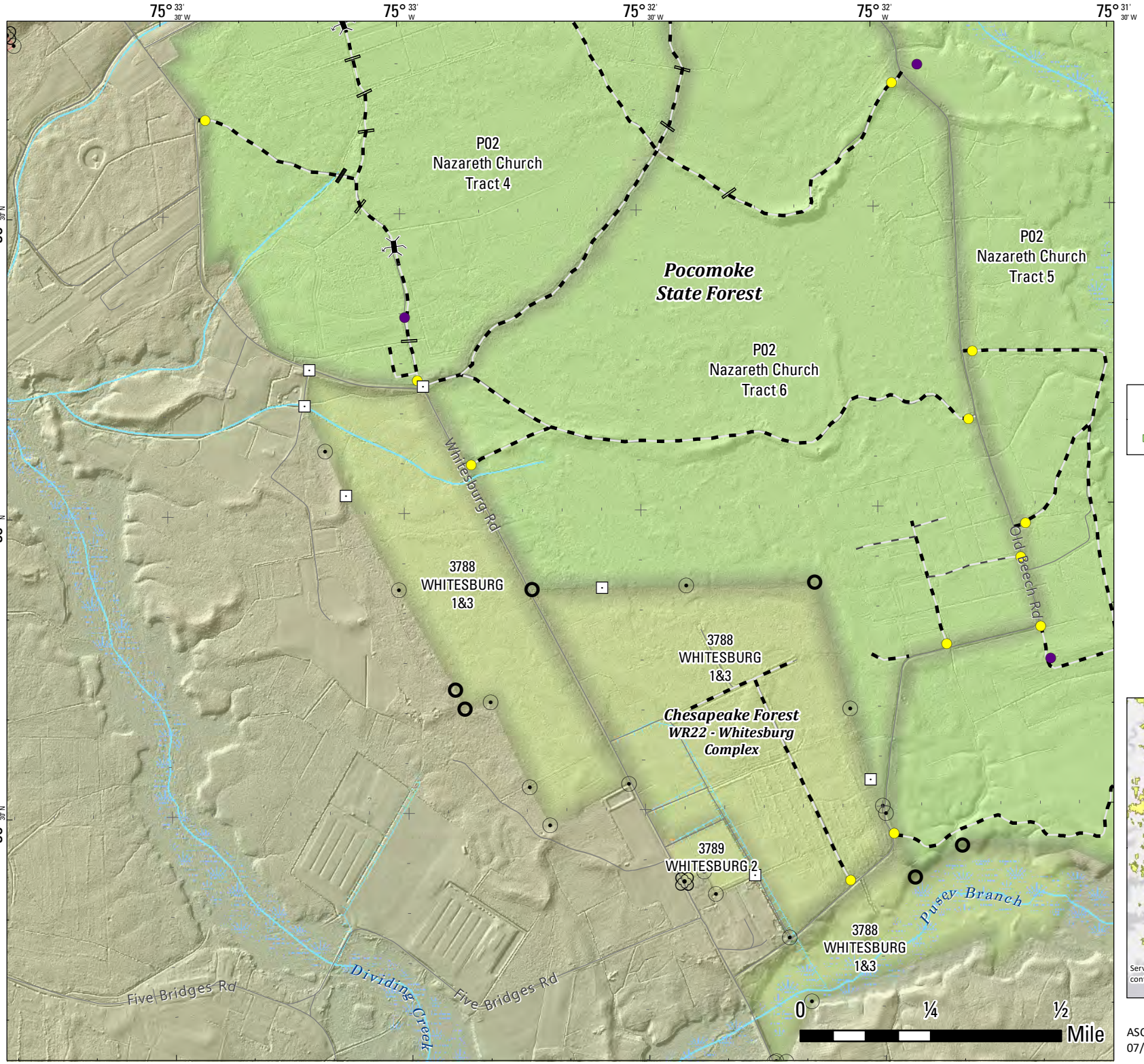
Tract 4,6

278.1 Acres

Public Hunting

3.7 mi boundary lines
painted 2005
from UNK

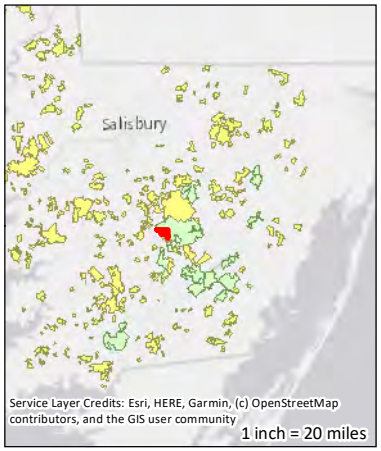
1 inch = 1,320 feet



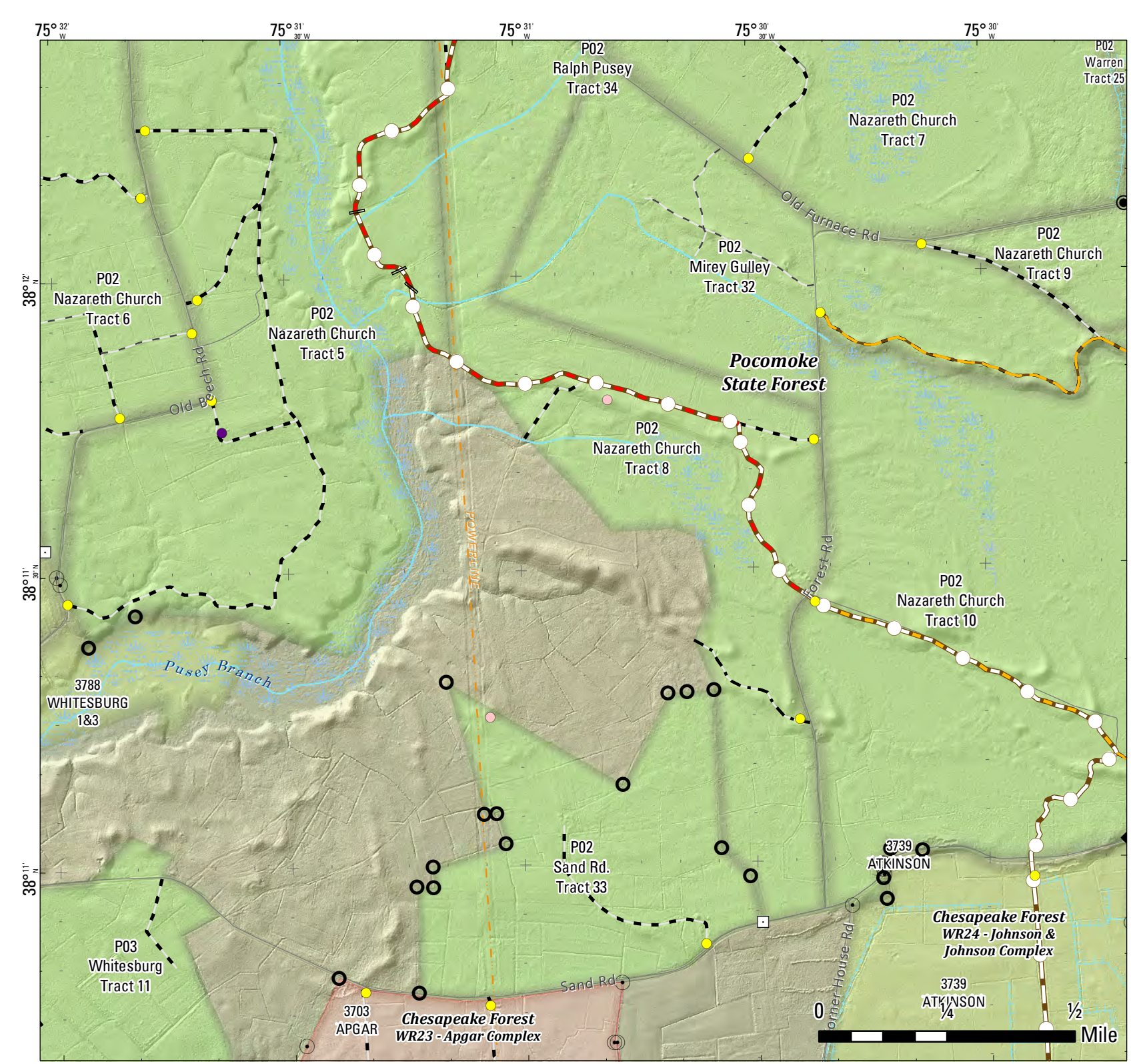
Legend

- Pocomoke SF Tracts

N



ASC-DNR Forest Service
07/2022 v5.0



P02

Nazareth Church

Tract 5,6,8,9,10,25,32,33

1,675.4 Acres

Public Hunting

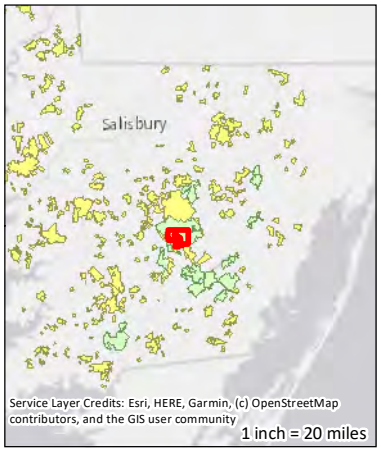
9.9 mi boundary lines
painted 2005
from UNK

1 inch = 1,320 feet

Legend

Pocomoke SF Tracts

N



ASC-DNR Forest Service
07/2022 v5.0

P02

Nazareth Church

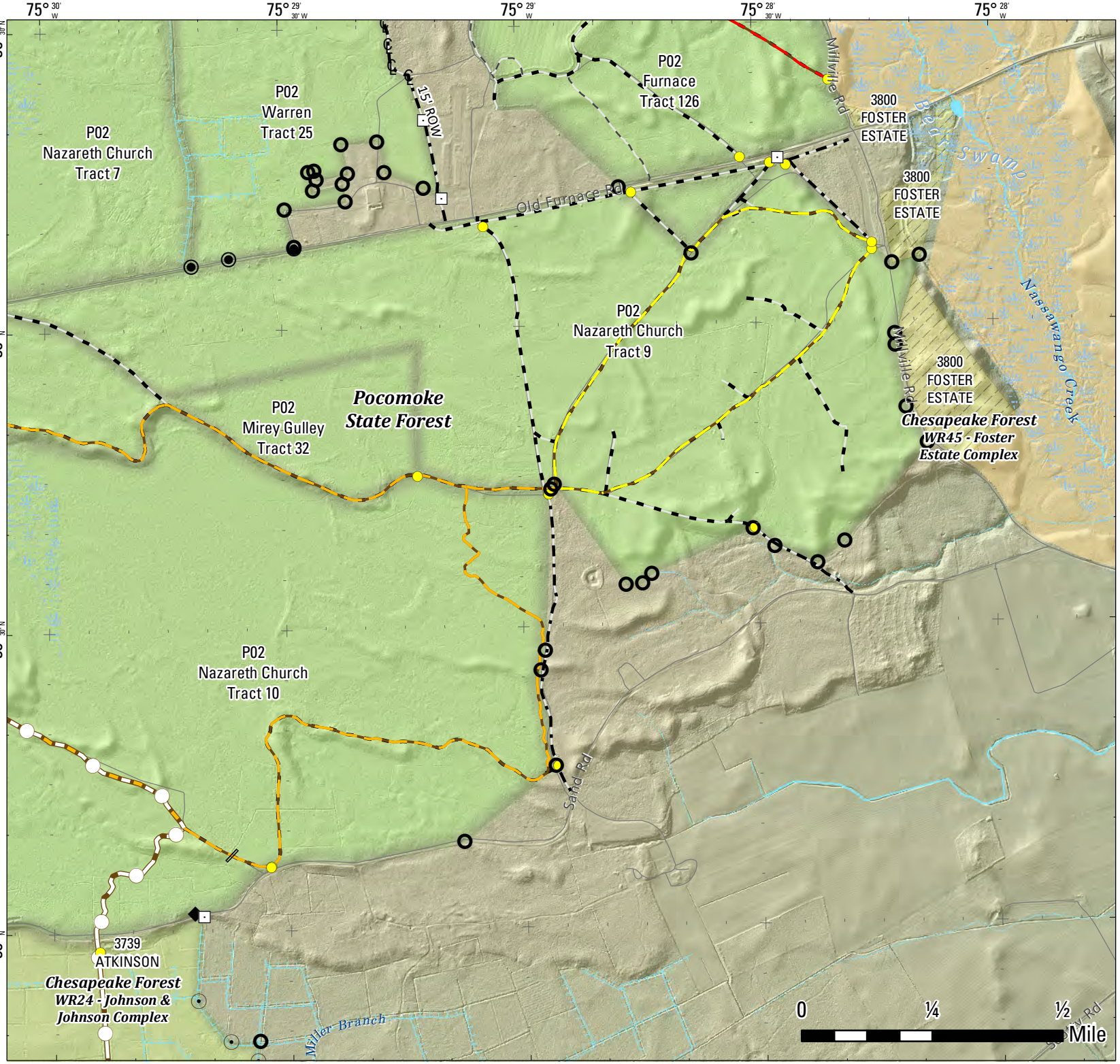
Tract 9,10,25,32,126

832.6 Acres

Public Hunting

7.2 mi boundary lines
painted 2005
from UNK

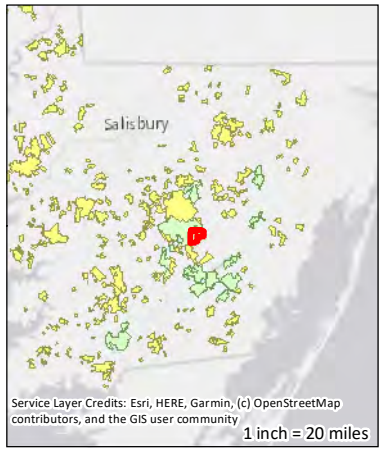
1 inch = 1,320 feet



Legend

- Pocomoke SF Tracts

N



P03

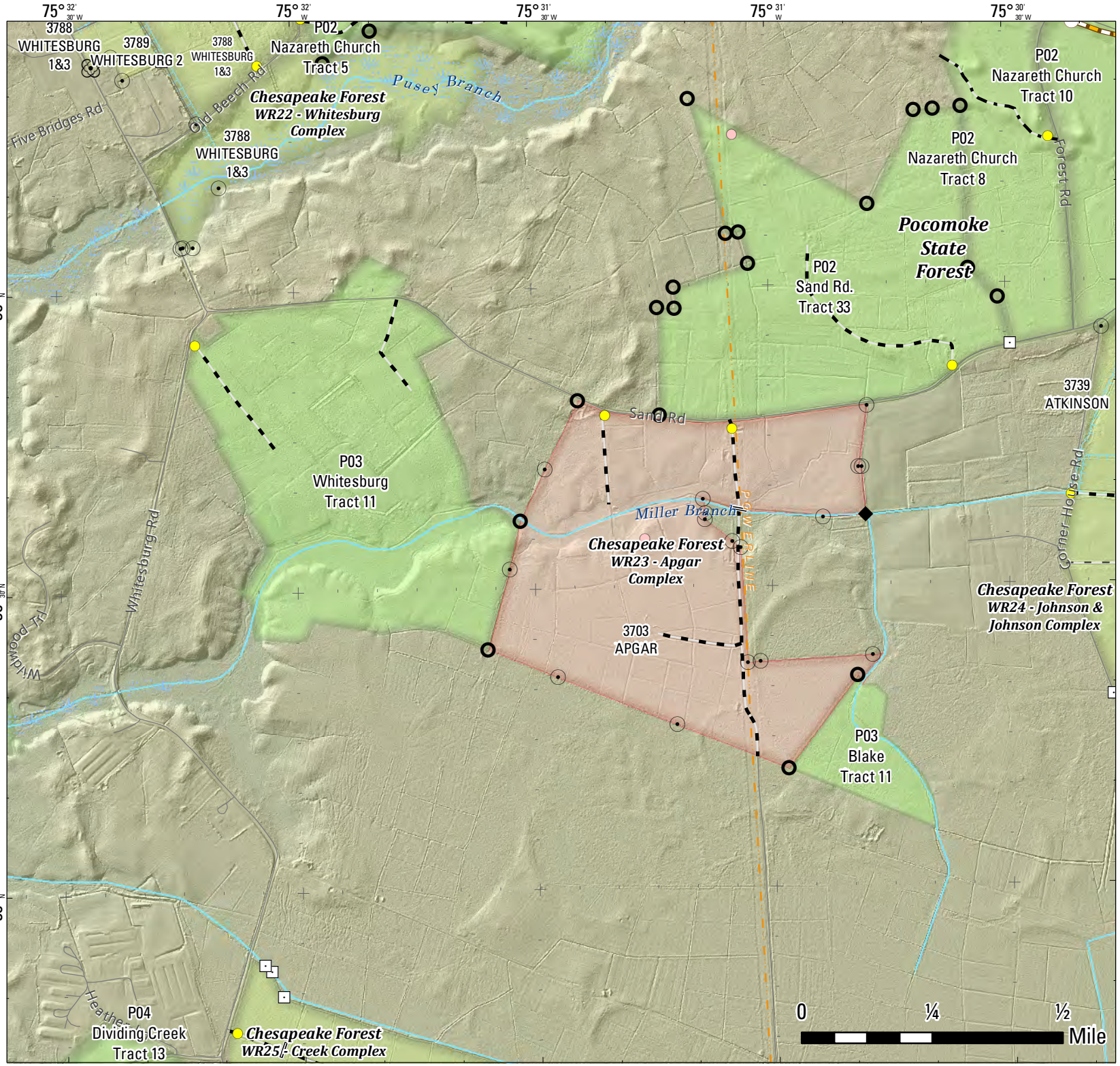
Whitesburg
Tract 11

217.9 Acres

Public Hunting

3.5 mi boundary lines
painted 2000
from UNK

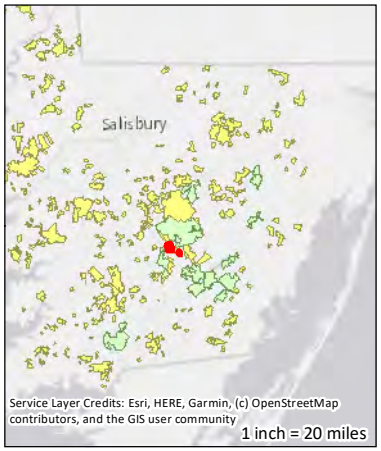
1 inch = 1,320 feet



Legend

Pocomoke SF Tracts

N



ASC-DNR Forest Service
07/2022 v5.0

P04

Dividing Creek

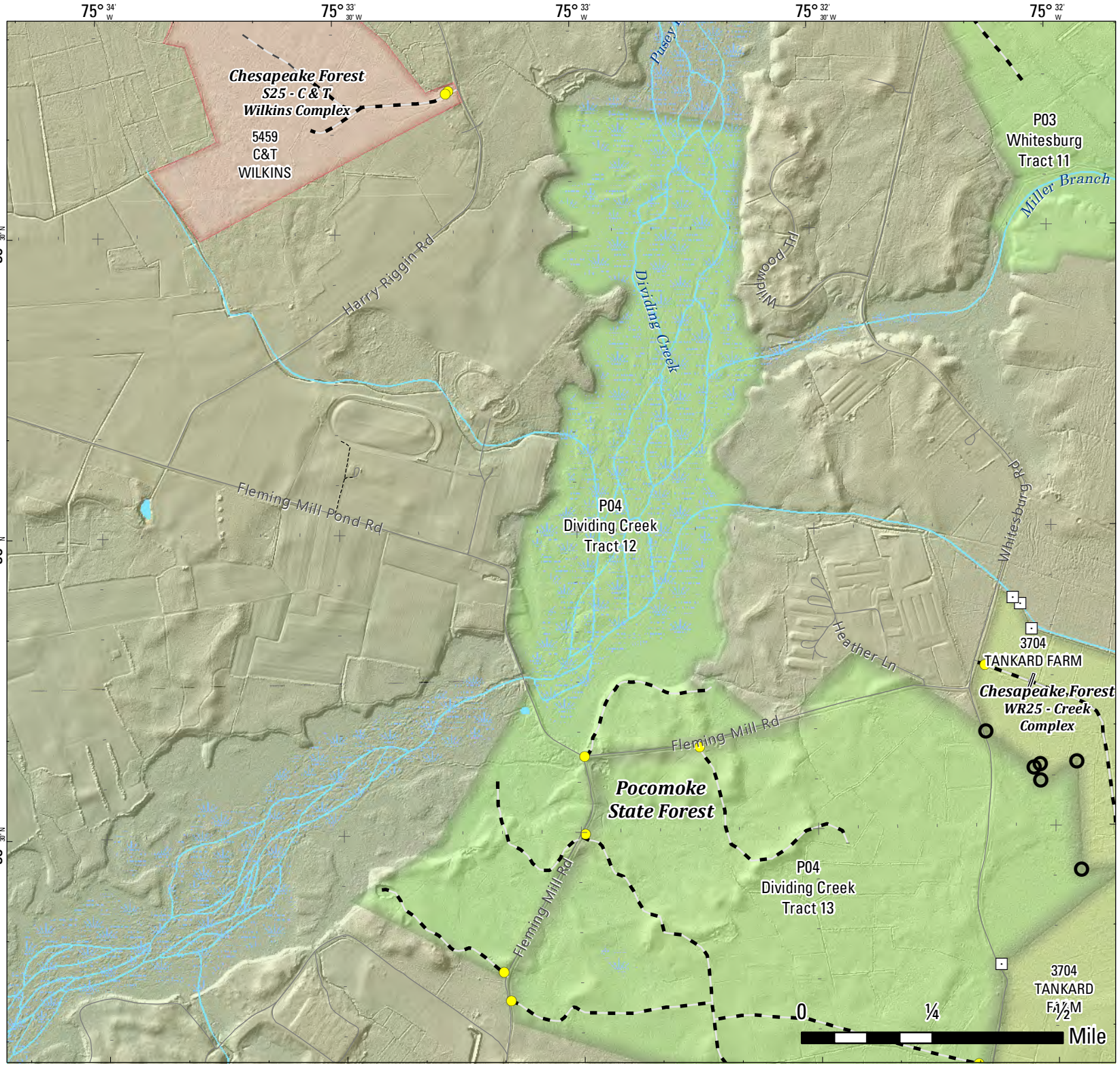
Tract 12

355.2 Acres

Public Hunting

5.1 mi boundary lines
painted 2008
from UNK

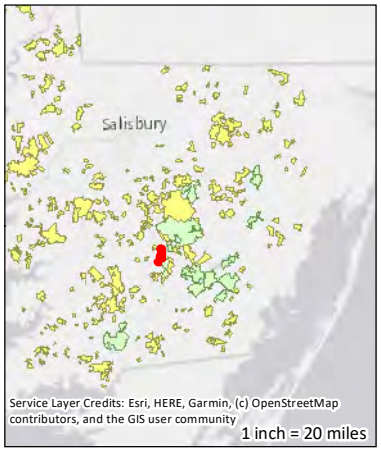
1 inch = 1,320 feet



Legend

Pocomoke SF Tracts

N



ASC-DNR Forest Service
07/2022 v5.0

P04

Dividing Creek

Tract 13

506.4 Acres

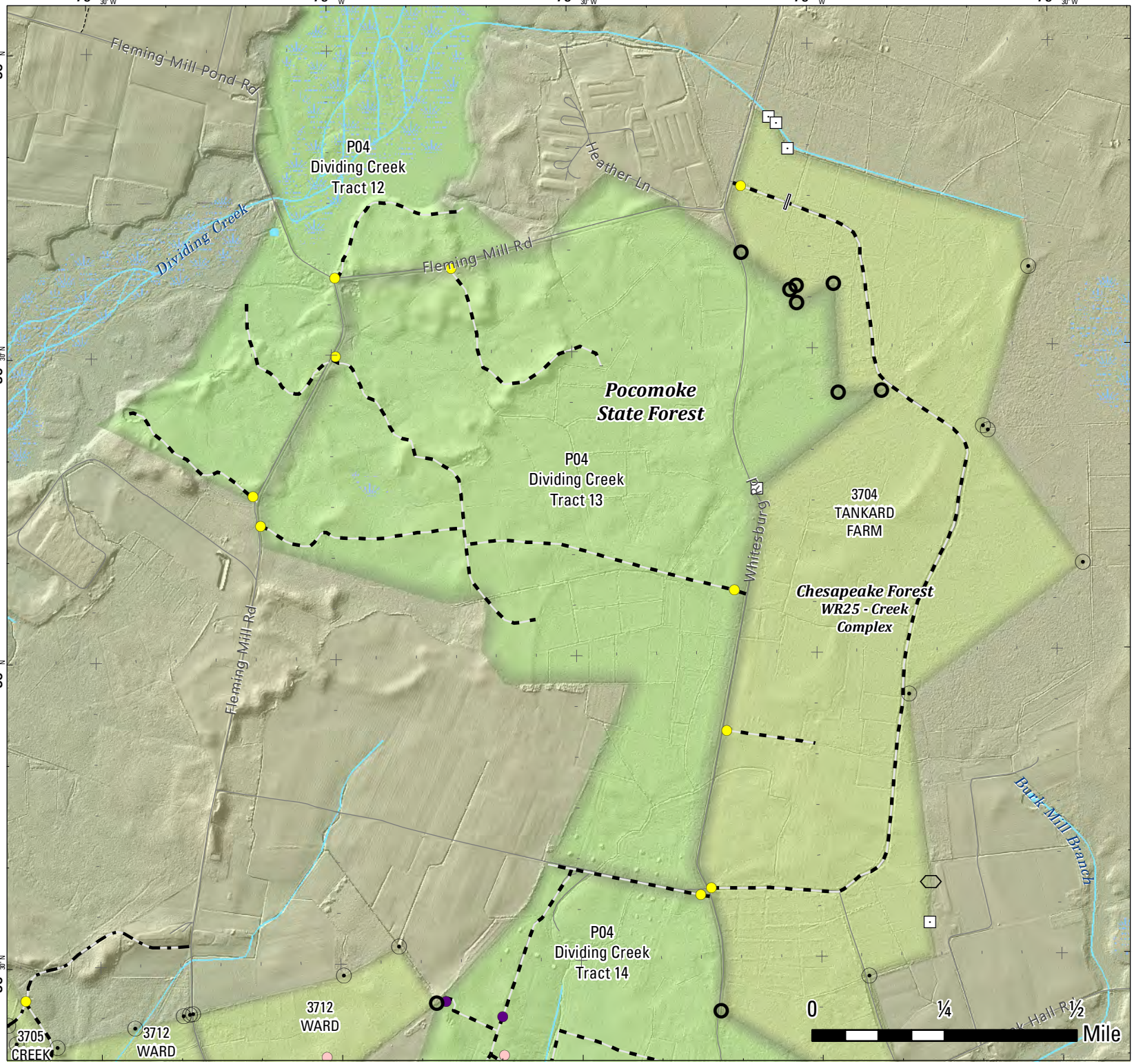
Public Hunting

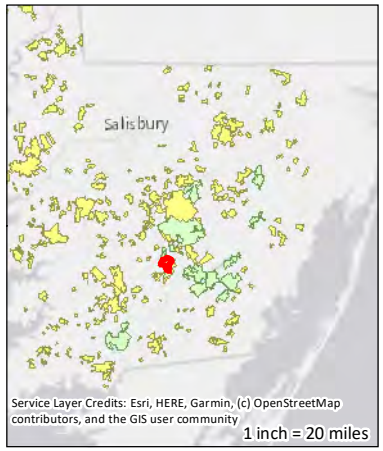
4.6 mi boundary lines
painted 2008
from UNK

1 inch = 1,320 feet

Legend

Pocomoke SF Tracts





ASC-DNR Forest Service
07/2022 v5.0

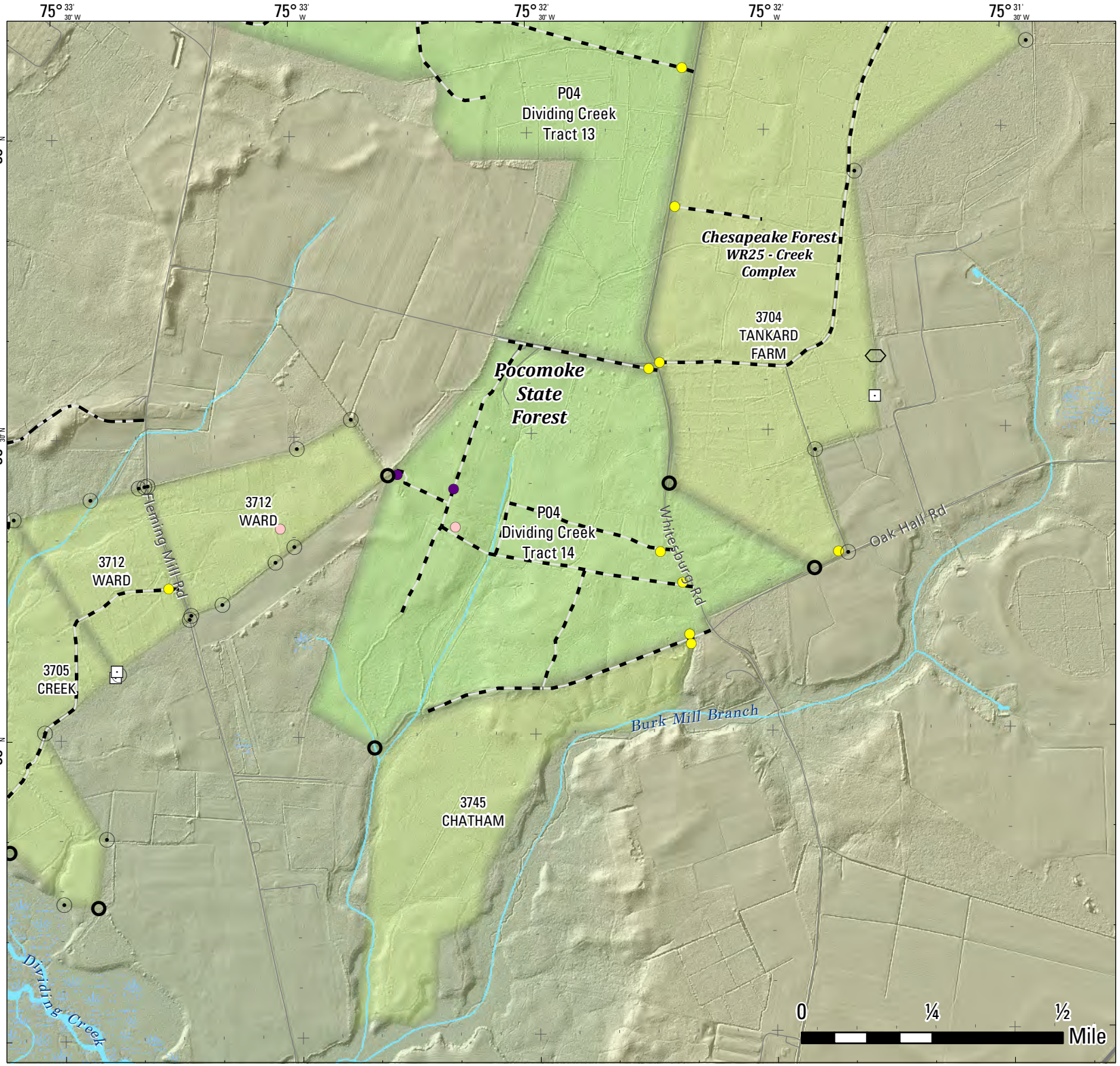
P04
Dividing Creek
Tract 14

257.2 Acres

Public Hunting

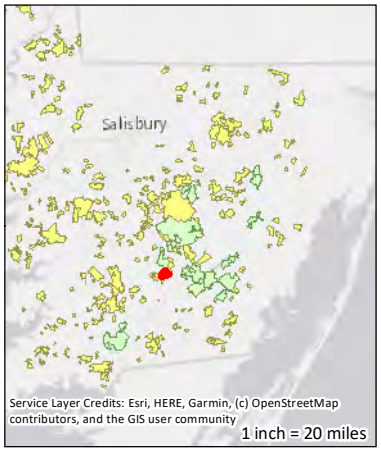
2.8 mi boundary lines
painted 2008
from UNK

1 inch = 1,320 feet



Legend

Pocomoke SF Tracts



ASC-DNR Forest Service
07/2022 v5.0

P05

Milburn Landing

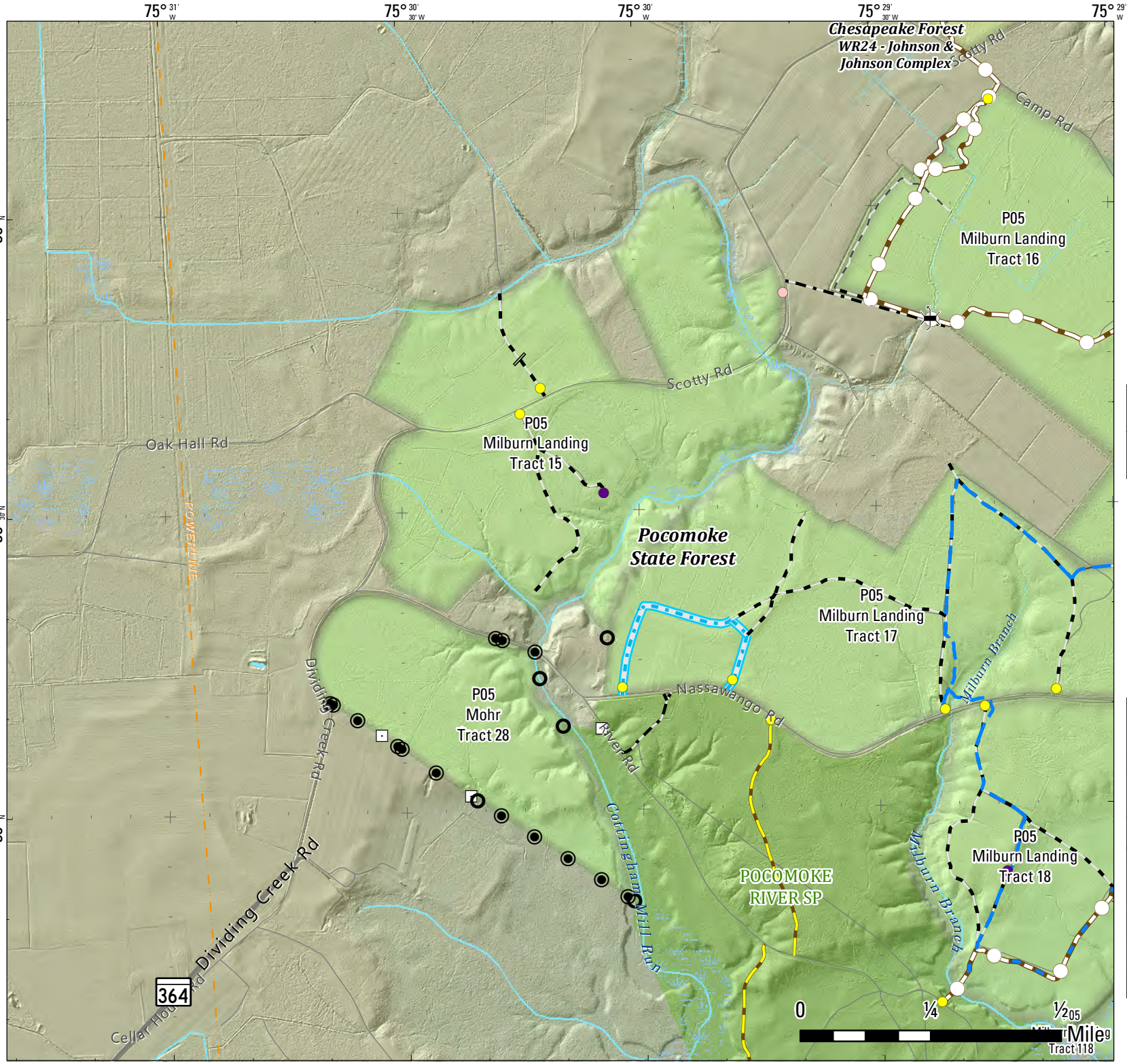
Tract 15,28

370.2 Acres

Public Hunting

5.6 mi boundary lines
painted 2008
from UNK

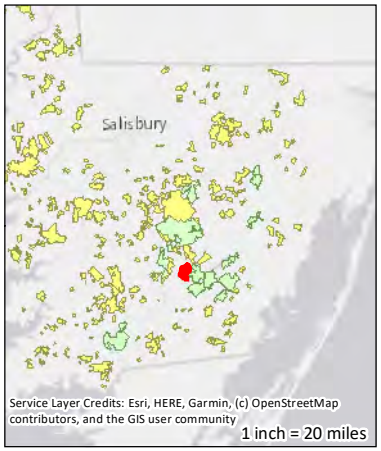
1 inch = 1,320 feet



Legend

- Pocomoke SF Tracts
- MD DNR Lands

N



ASC-DNR Forest Service
07/2022 v5.0

P05

Milburn Landing

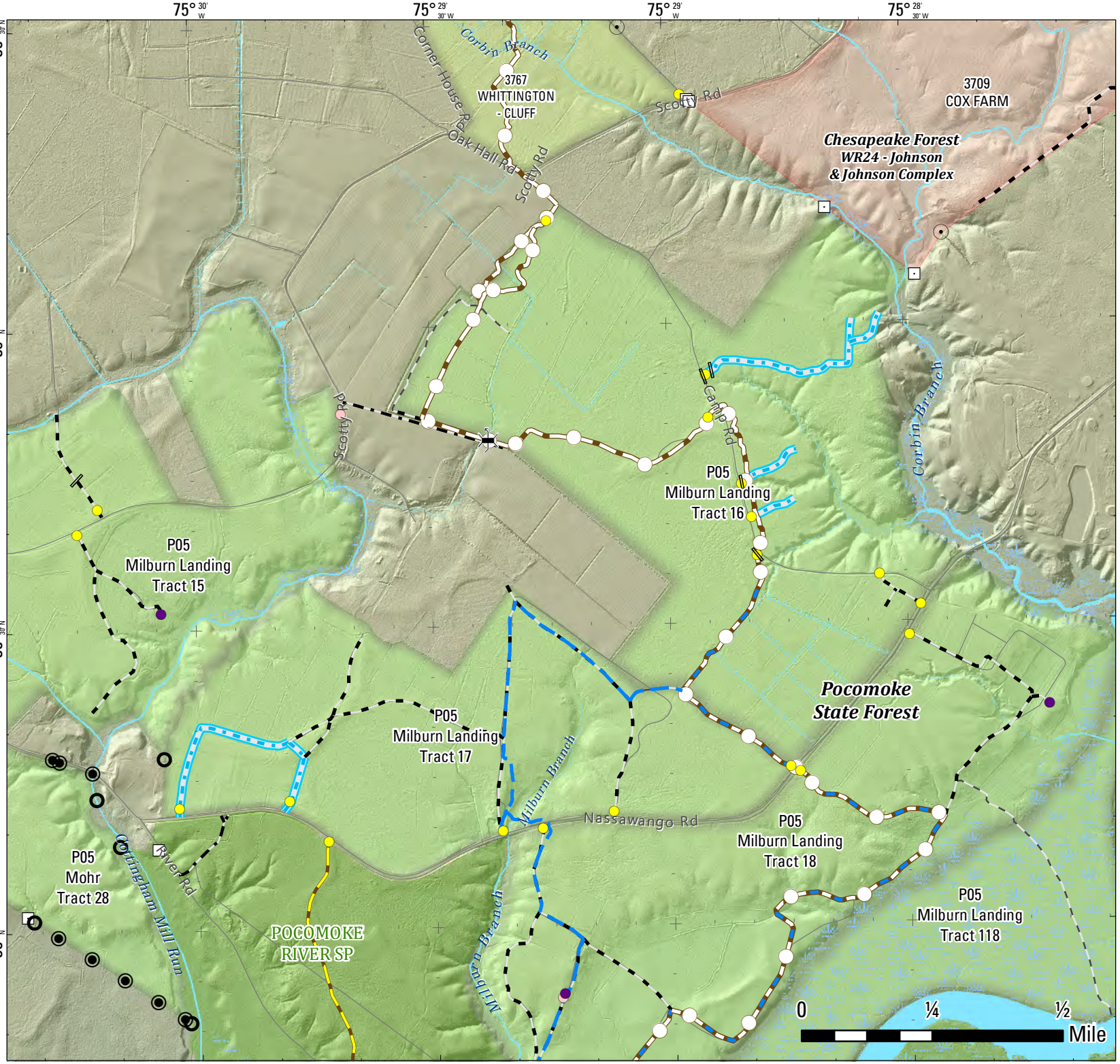
Tract 16,17

644.8 Acres

Public Hunting

6.2 mi boundary lines
painted 2008
from UNK

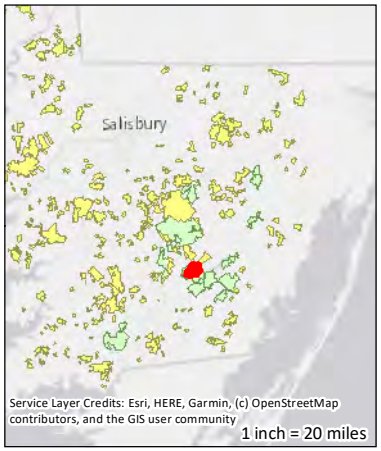
1 inch = 1,320 feet



Legend

- Pocomoke SF Tracts
- MD DNR Lands

N



P05

Milburn Landing

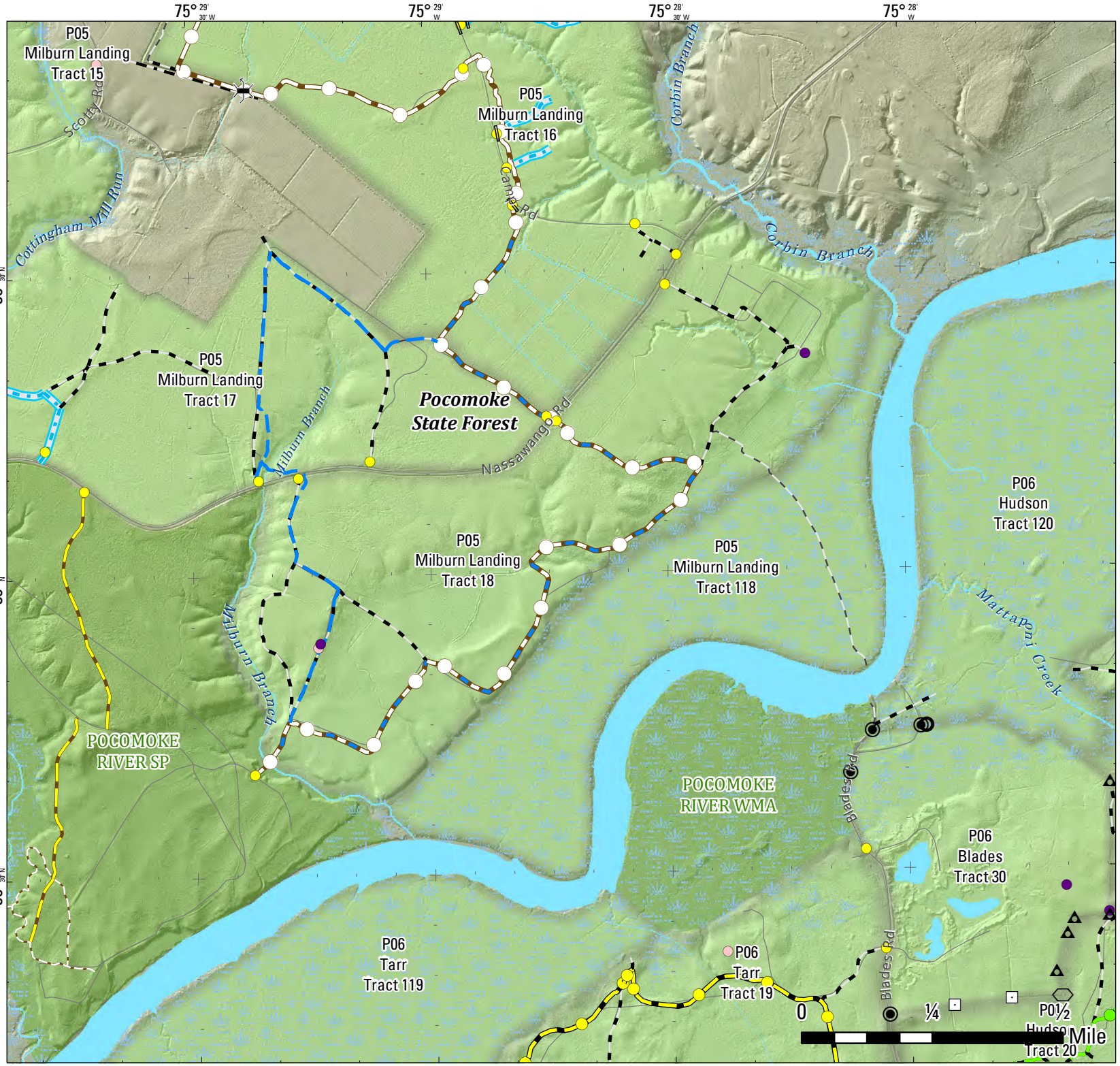
Tract 18,118

572.1 Acres

Public Hunting

4.4 mi boundary lines
painted 2008
from UNK

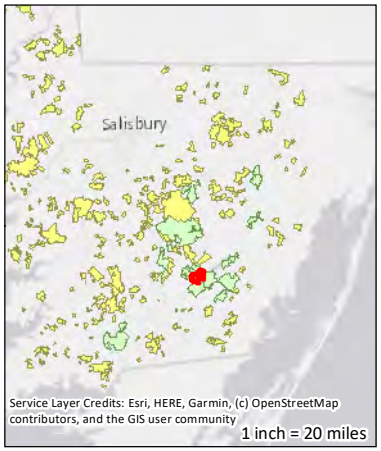
1 inch = 1,320 feet



Legend

- Pocomoke SF Tracts
- MD DNR Lands

N



ASC-DNR Forest Service
07/2022 v5.0

P06

Hudson

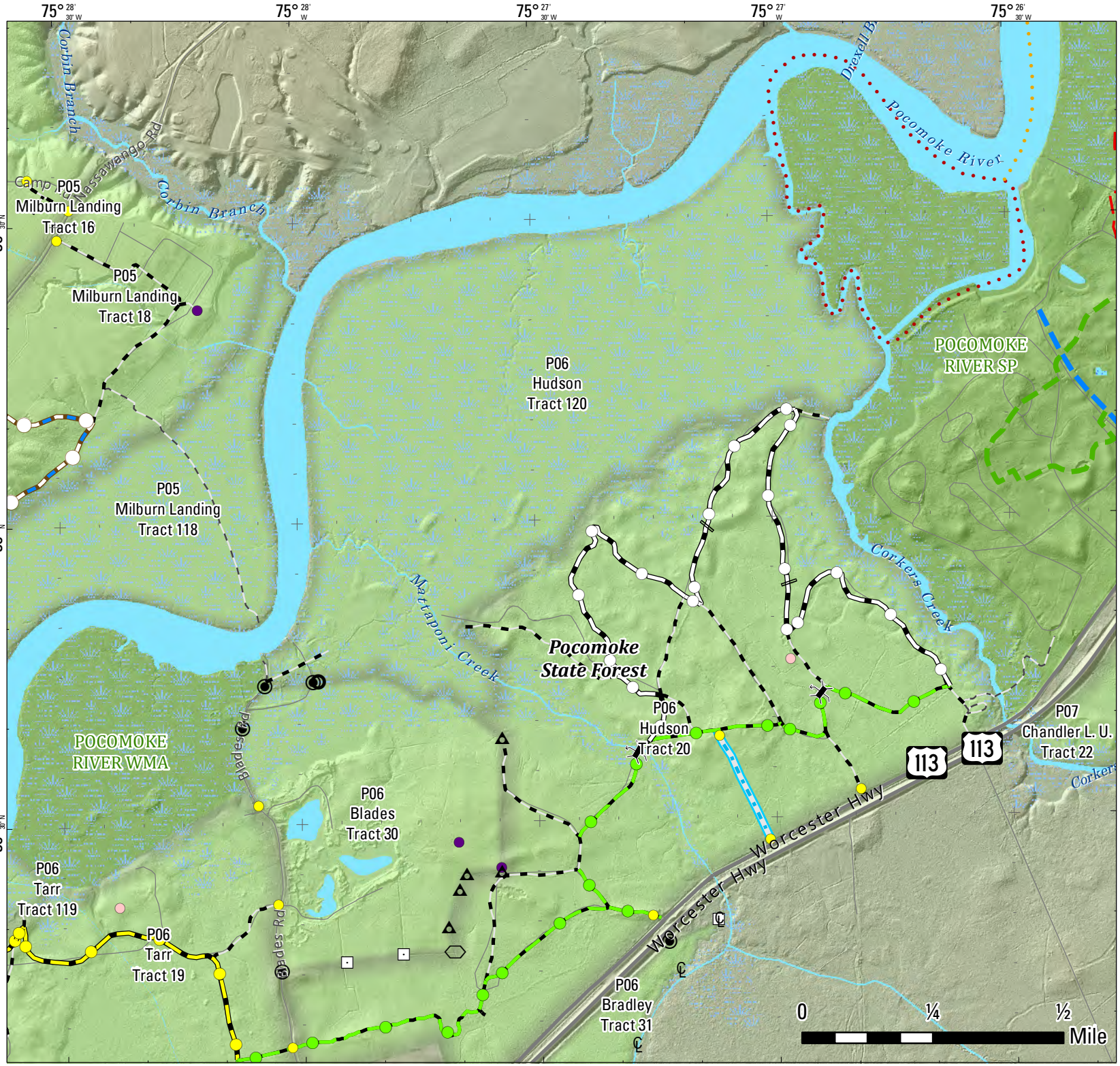
Tract 30,120

545.8 Acres

Public Hunting

5.4 mi boundary lines
painted 2004
from UNK

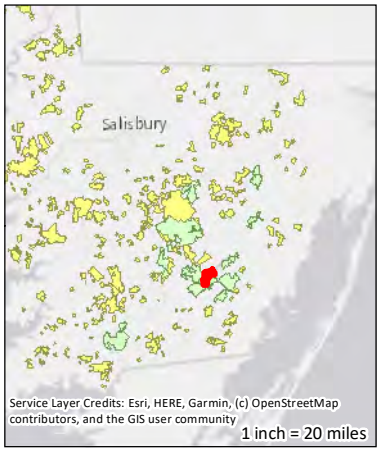
1 inch = 1,320 feet



Legend

- Pocomoke SF Tracts
- MD DNR Lands

N



ASC-DNR Forest Service
07/2022 v5.0

P06

Hudson

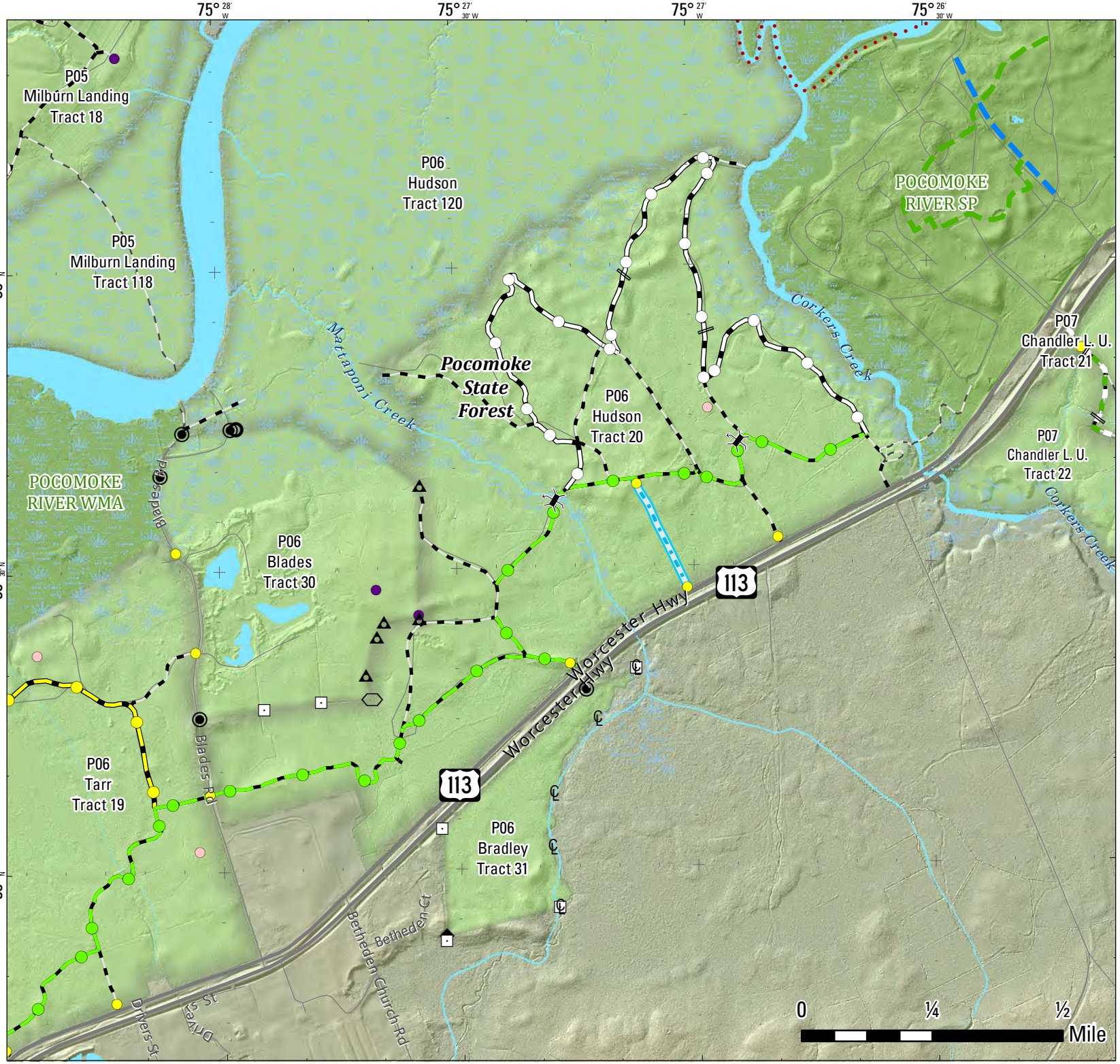
Tract 20,31

541.5 Acres

Public Hunting

6.4 mi boundary lines
painted 2004
from UNK

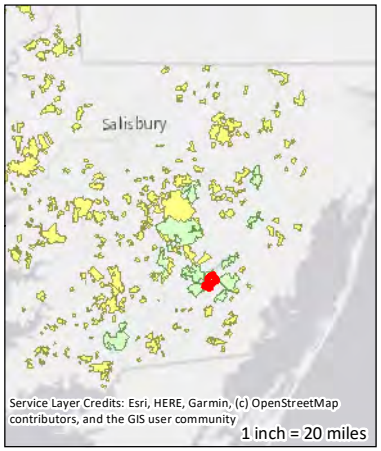
1 inch = 1,320 feet



Legend

- Pocomoke SF Tracts
- MD DNR Lands

N



ASC-DNR Forest Service
07/2022 v5.0

P06

Tarr

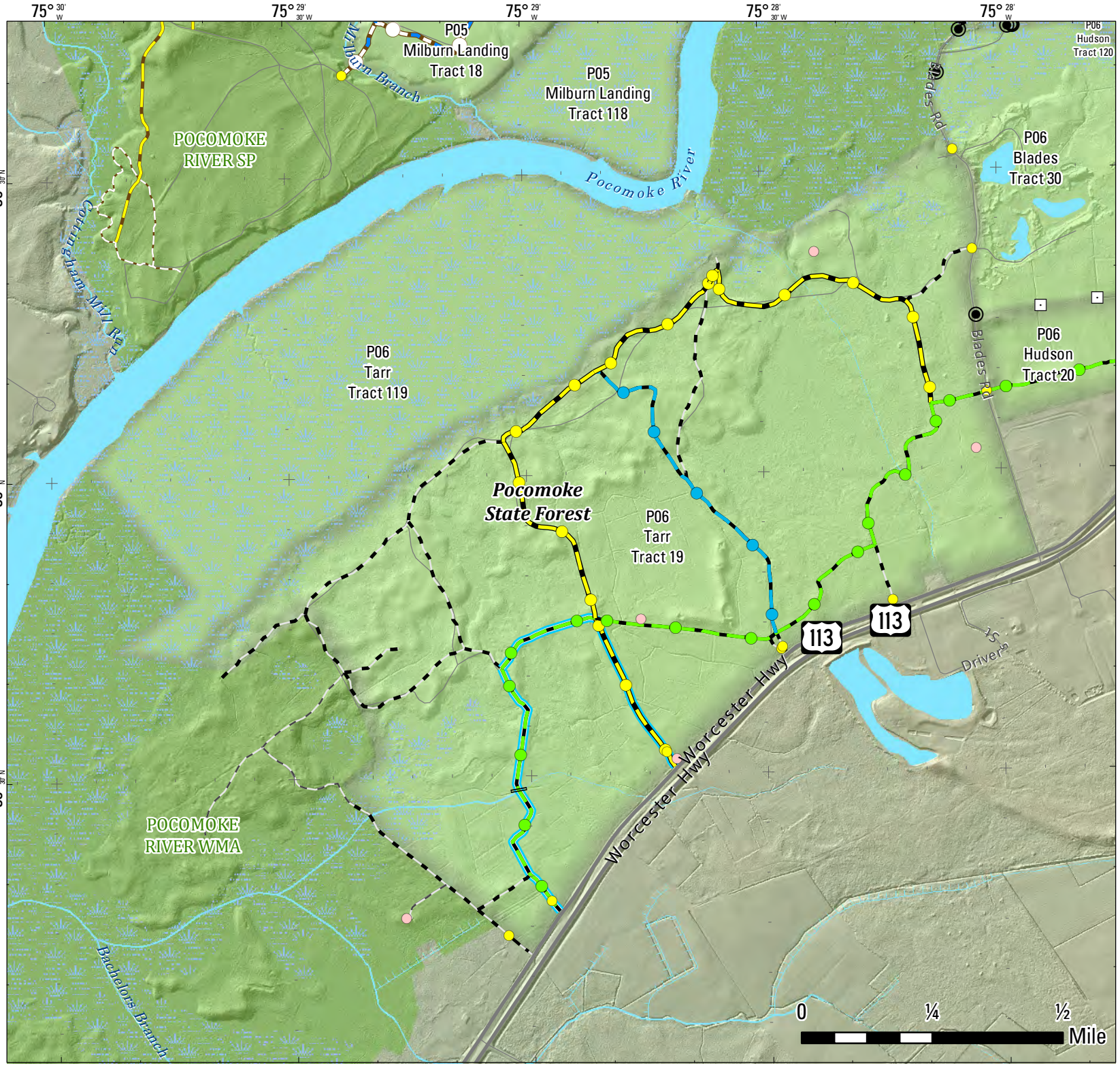
Tract 19,119

1,013.2 Acres

Public Hunting

5.9 mi boundary lines
painted 2004
from UNK

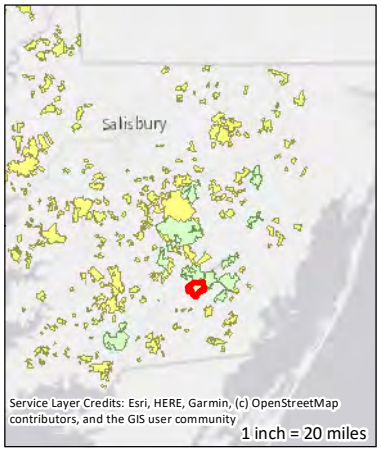
1 inch = 1,320 feet



Legend

- Pocomoke SF Tracts
- MD DNR Lands

N



P07

Chandler L. U.

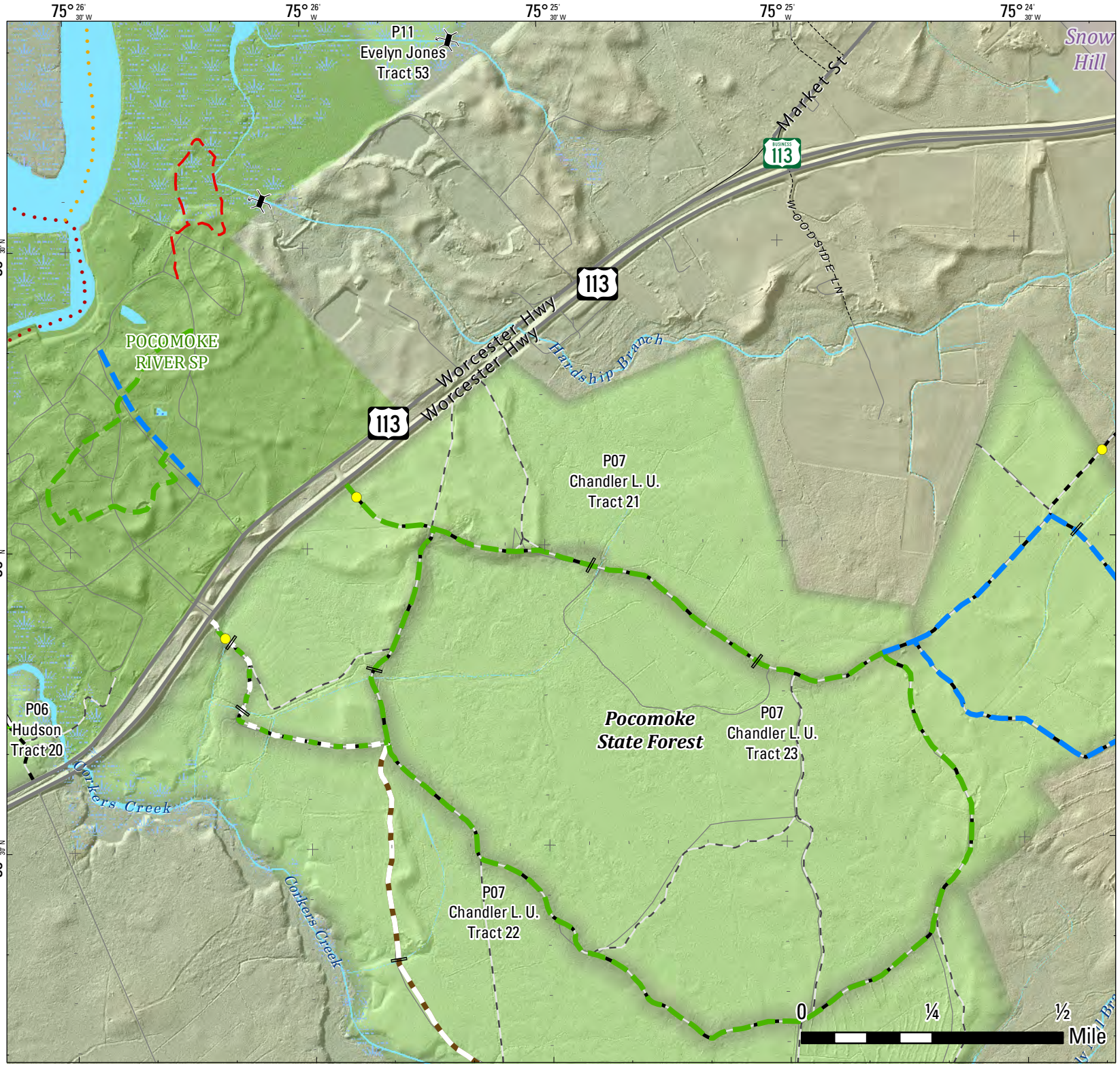
Tract 21

279.7 Acres

Public Hunting

4.1 mi boundary lines
painted 2005
from UNK

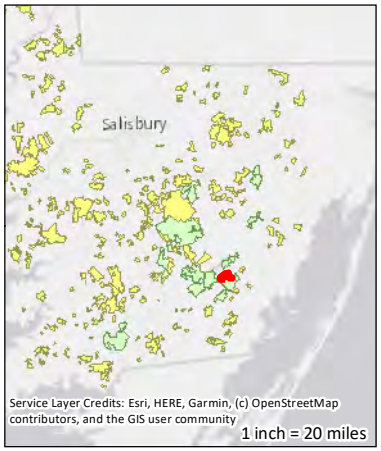
1 inch = 1,320 feet



Legend

- Pocomoke SF Tracts
- MD DNR Lands

N



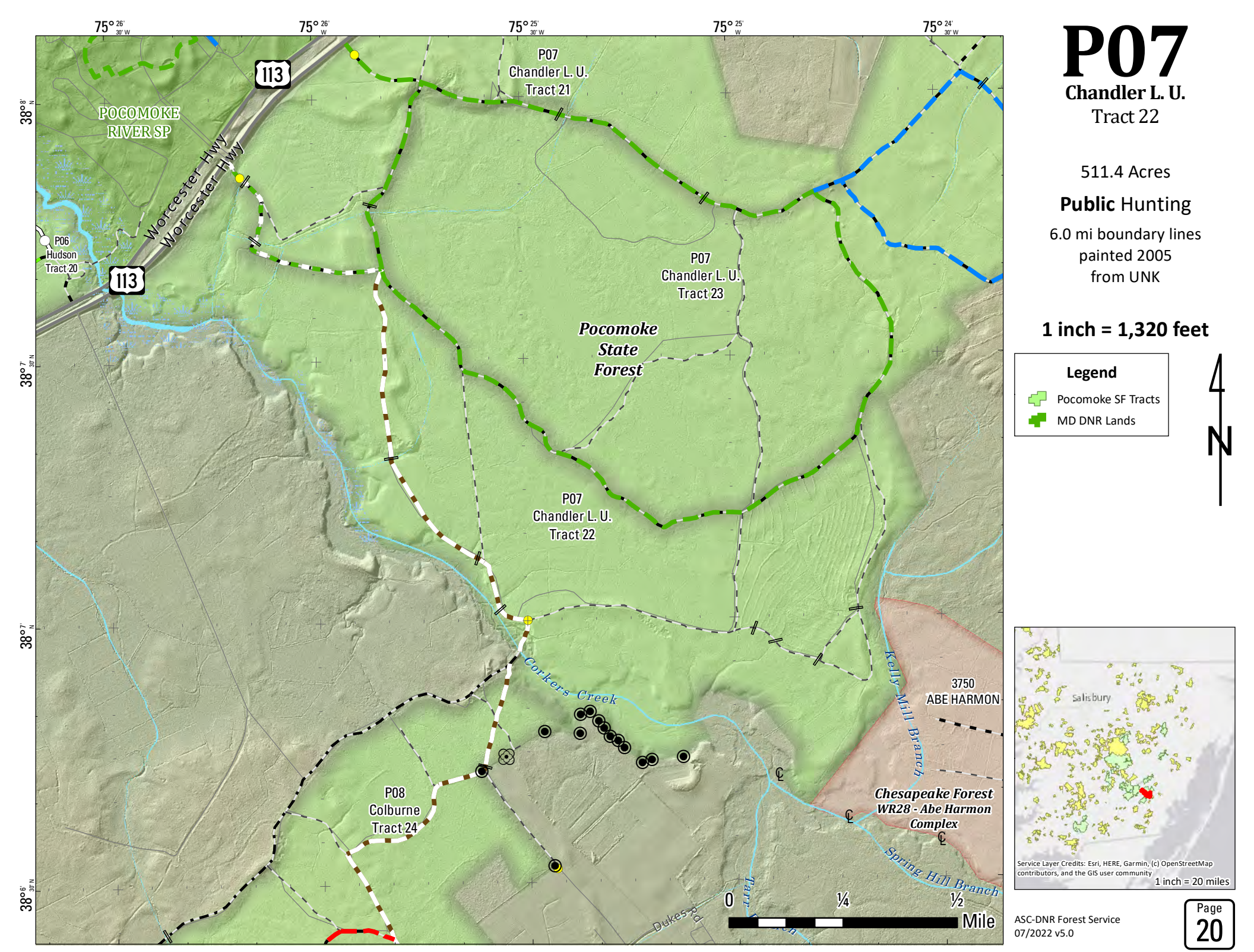
P07
Chandler L. U.
Tract 22

511.4 Acres

Public Hunting

6.0 mi boundary lines
painted 2005
from UNK

1 inch = 1,320 feet



Legend

- Pocomoke SF Tracts
- MD DNR Lands

P07

Chandler L. U.

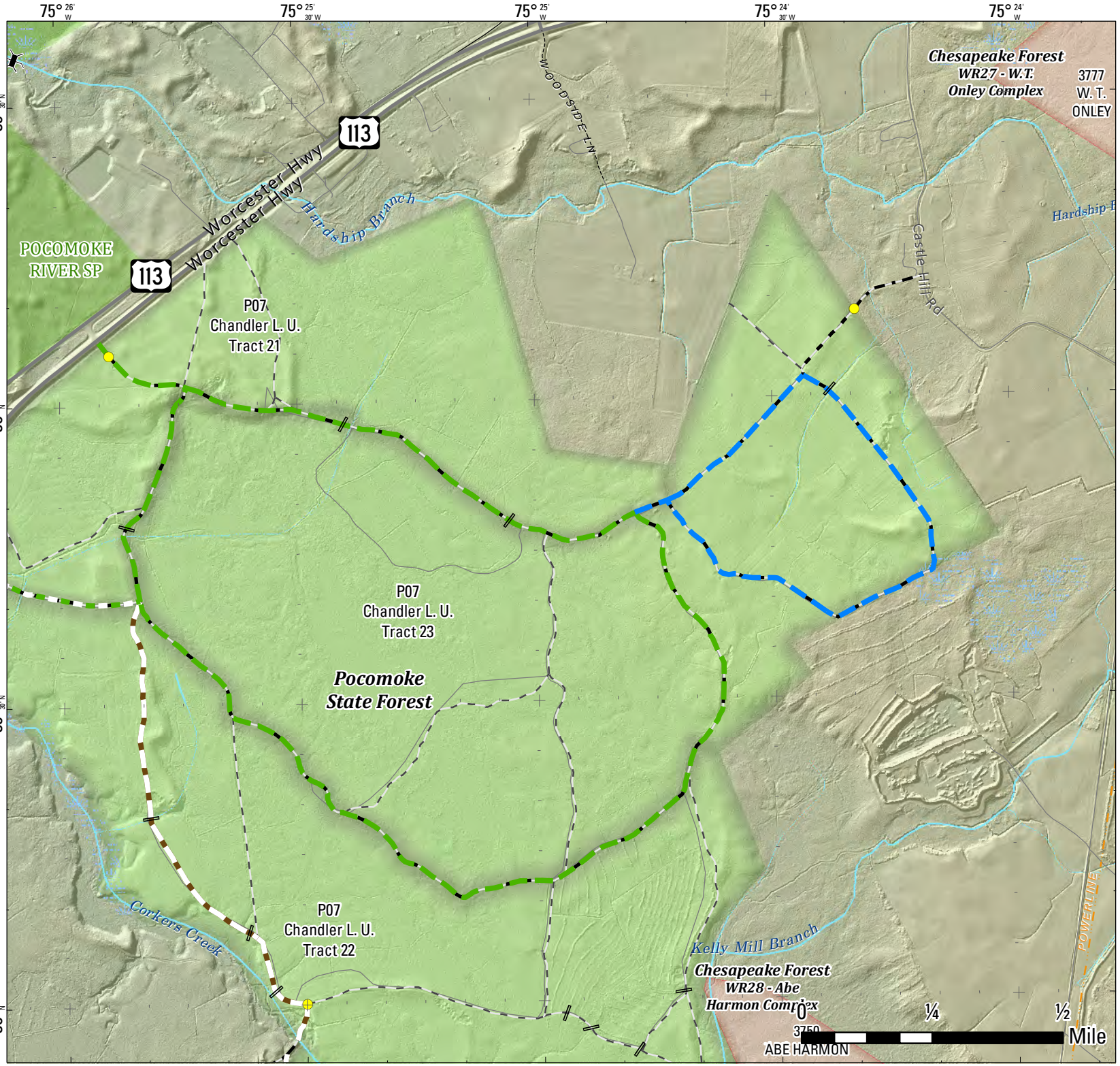
Tract 23

652.2 Acres

Public Hunting

5.2 mi boundary lines
painted 2005
from UNK

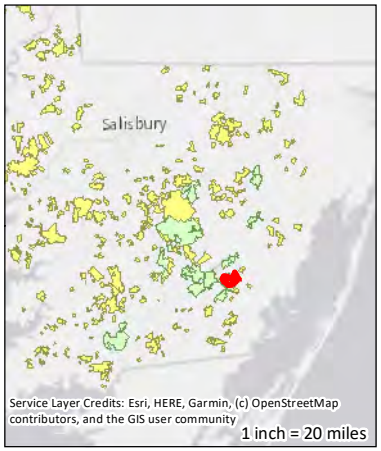
1 inch = 1,320 feet



Legend

- Pocomoke SF Tracts
- MD DNR Lands

N



ASC-DNR Forest Service
07/2022 v5.0

P08

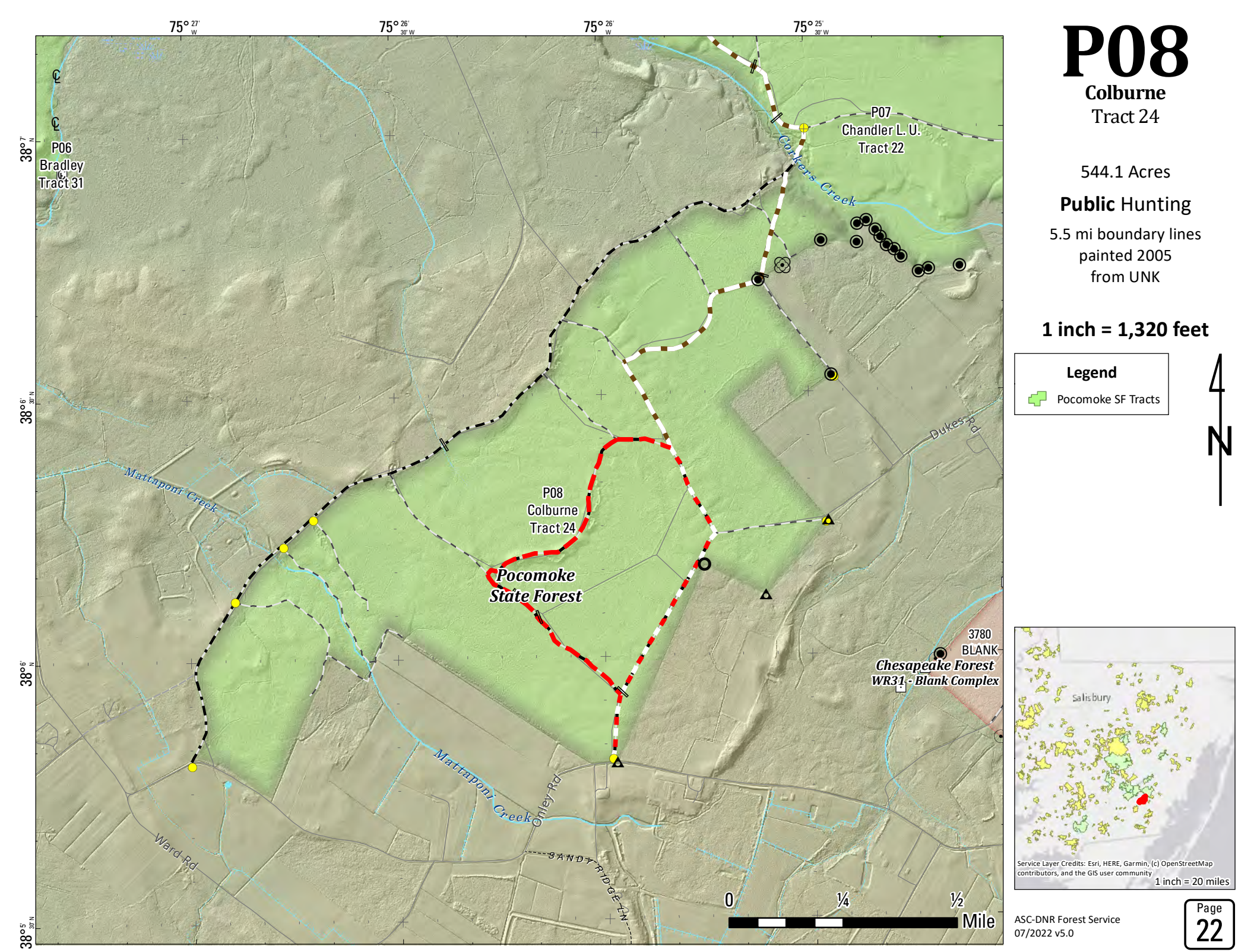
Colburne
Tract 24

544.1 Acres

Public Hunting

5.5 mi boundary lines
painted 2005
from UNK

1 inch = 1,320 feet



Legend

Pocomoke SF Tracts

N

ASC-DNR Forest Service
07/2022 v5.0

P10

Hickory Point

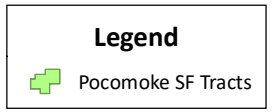
Tract 55

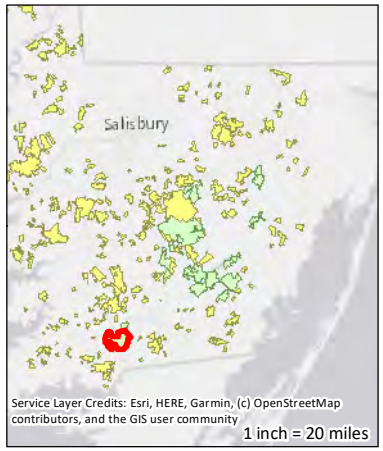
2,163.8 Acres

Public Hunting

9.0 mi boundary lines
painted 2000
from survey

1 inch = 1,980 feet





ASC-DNR Forest Service
07/2022 v5.0

P11

Evelyn Jones Summerfield

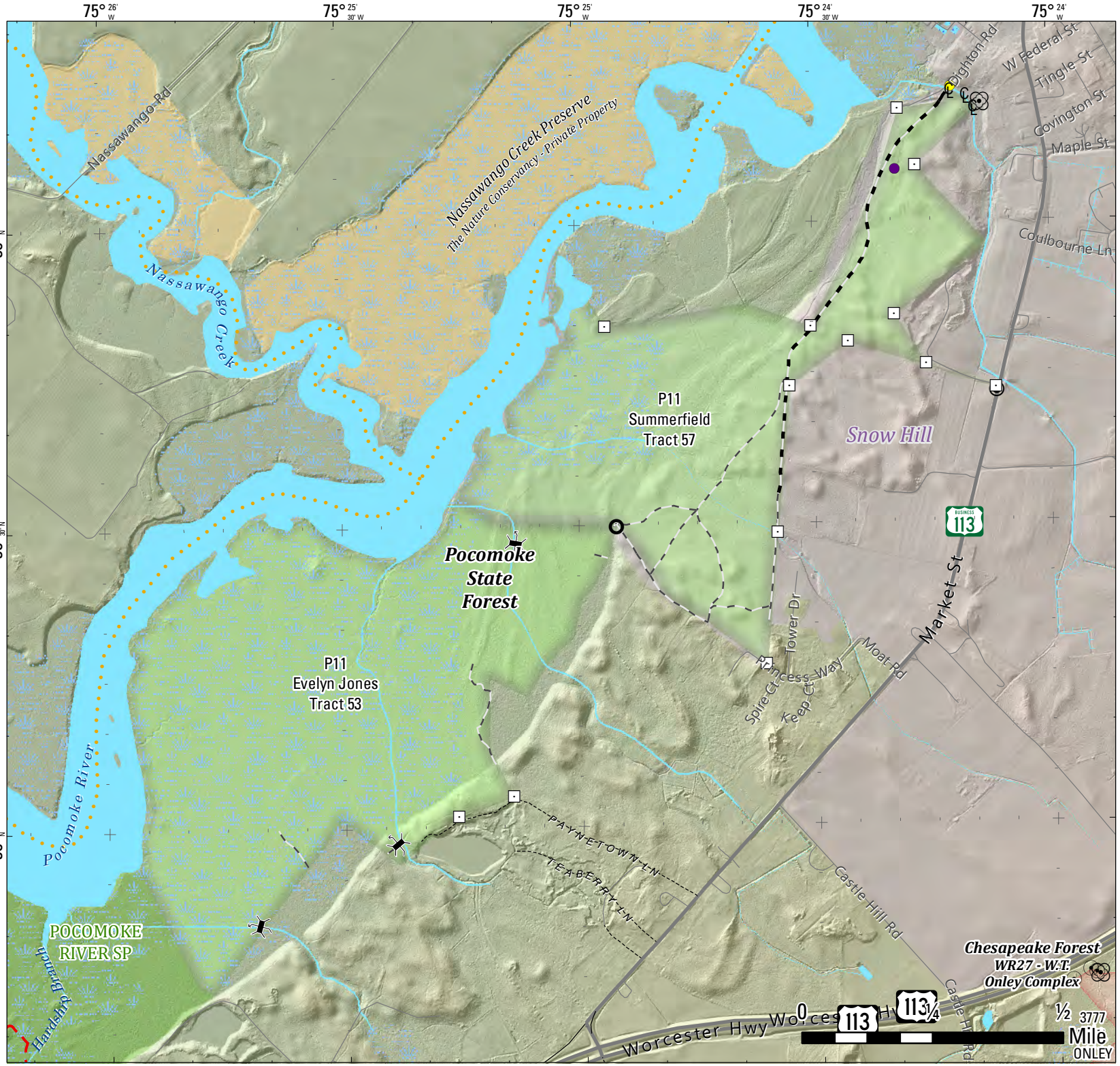
Tract 53,57

544.2 Acres

Public Hunting

3.4 mi boundary lines painted 2005 from partial survey

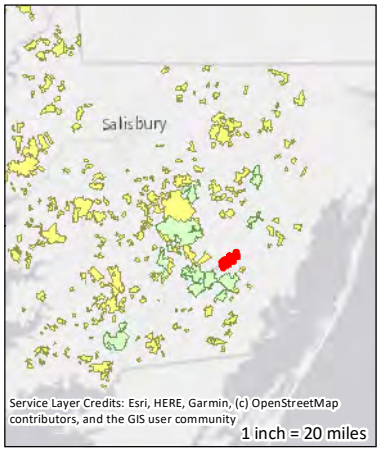
1 inch = 1,320 feet



Legend

- Pocomoke SF Tracts
- MD DNR Lands

N



ASC-DNR Forest Service
07/2022 v5.0

P12

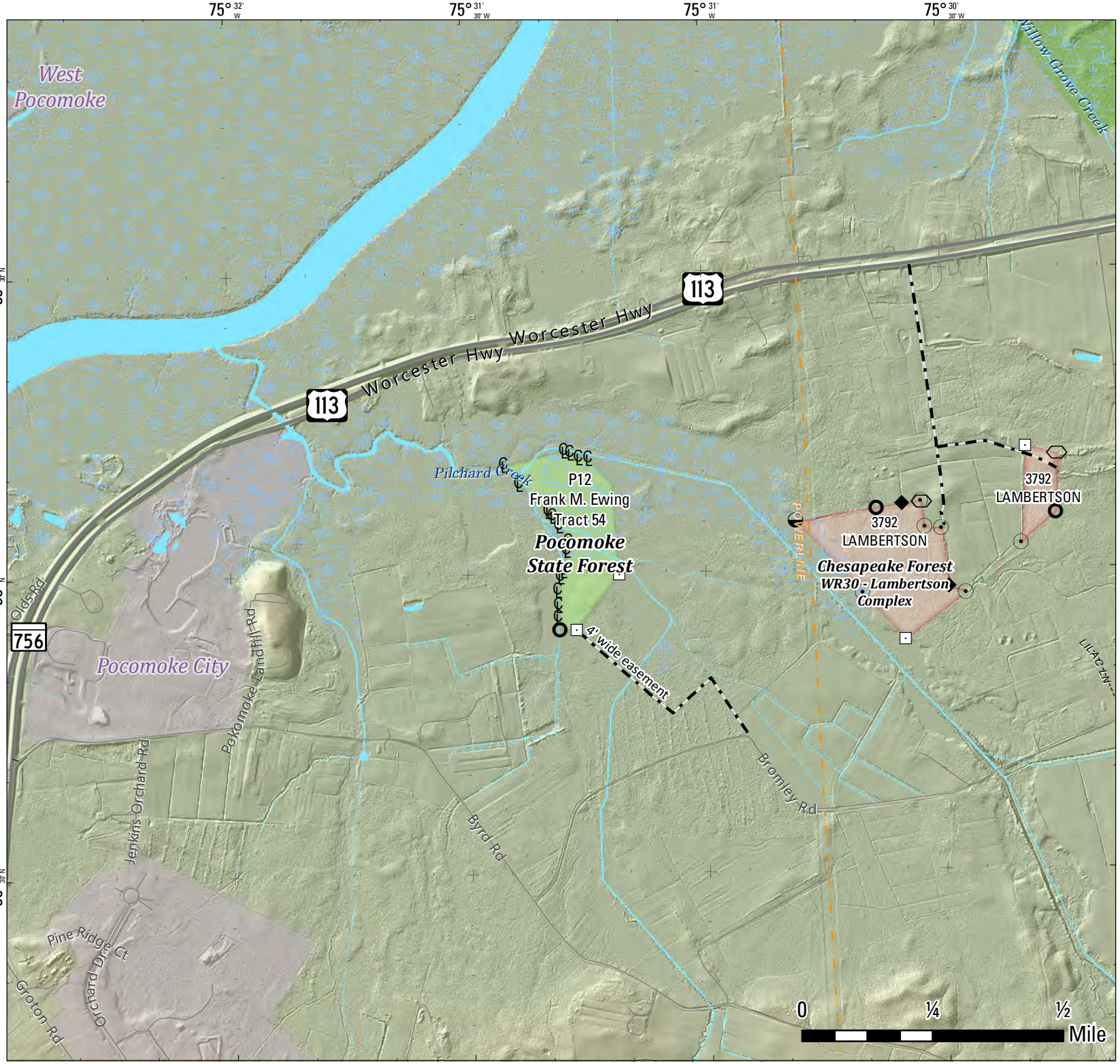
Frank M. Ewing
Tract 54

24.2 Acres

Public Hunting

0.9 mi boundary lines
painted UNK
from plat

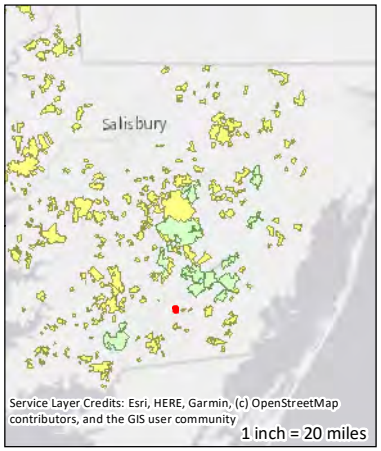
1 inch = 1,320 feet



Legend

- Pocomoke SF Tracts
- MD DNR Lands

N



ASC-DNR Forest Service
07/2022 v5.0

P13

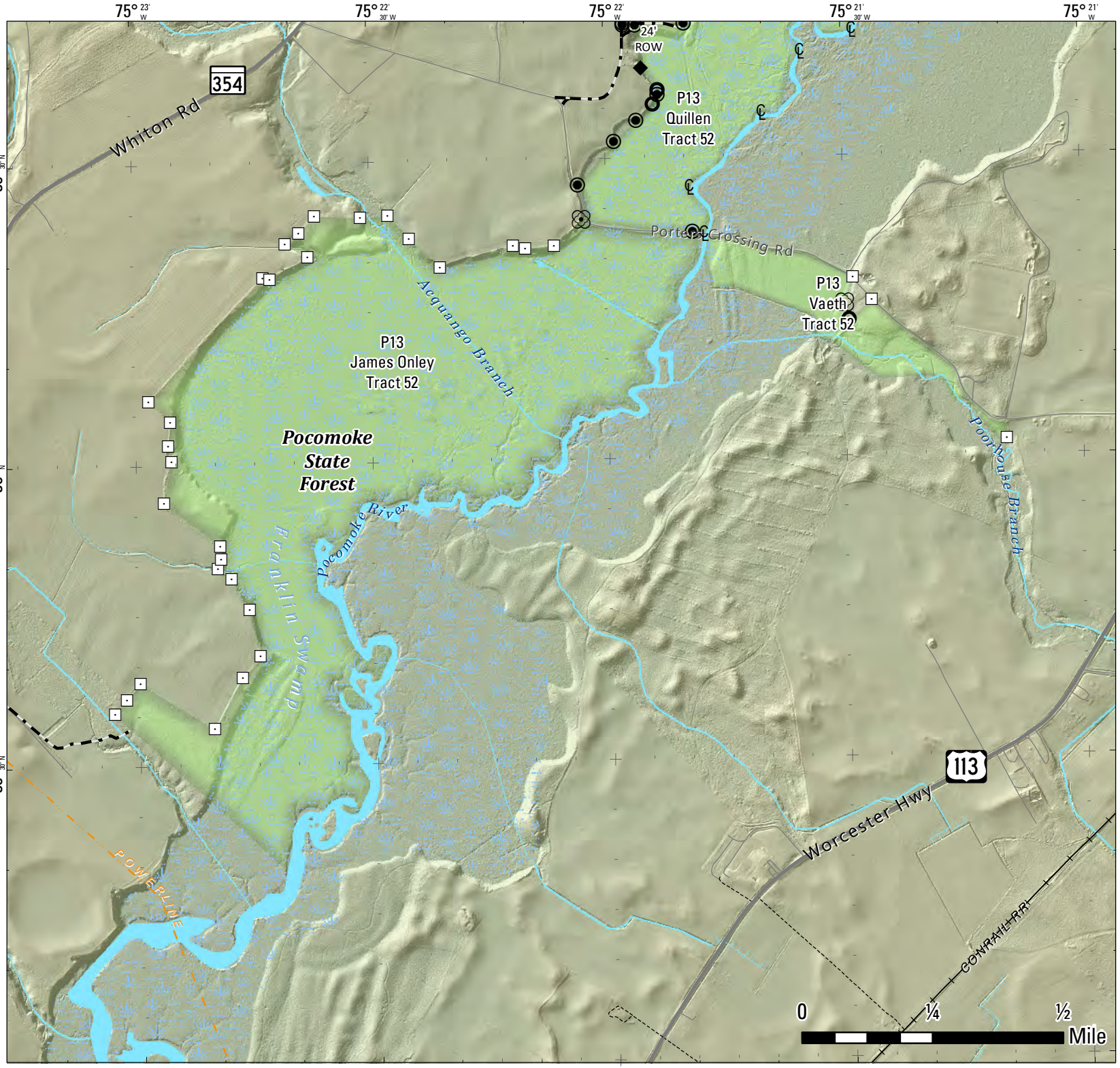
James Onley
Tract 52

402.0 Acres

Public Hunting

7.5 mi boundary lines
painted UNK
from survey

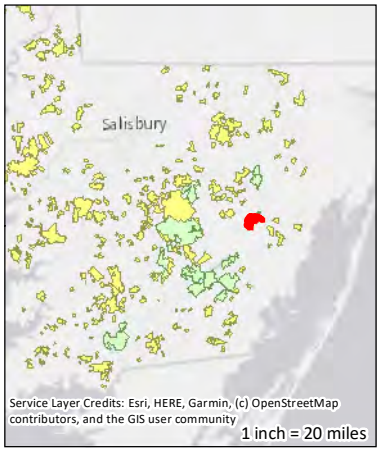
1 inch = 1,320 feet



Legend

Pocomoke SF Tracts

N



ASC-DNR Forest Service
07/2022 v5.0

P13

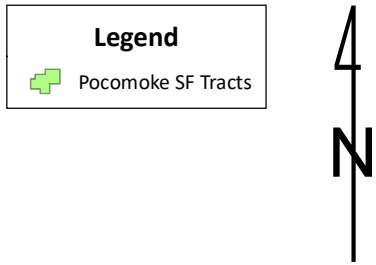
Quillen
Tract 52

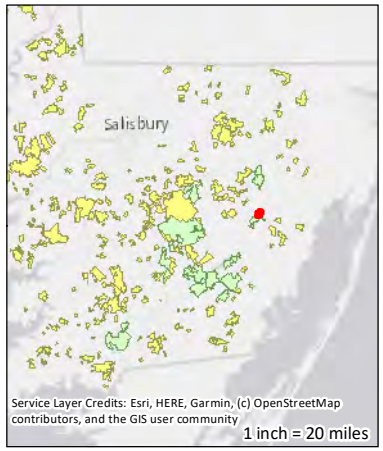
90.3 Acres

Public Hunting

2.1 mi boundary lines
painted UNK
from survey

1 inch = 1,320 feet





ASC-DNR Forest Service
07/2022 v5.0

P14

Banks

Tract 50

337.6 Acres

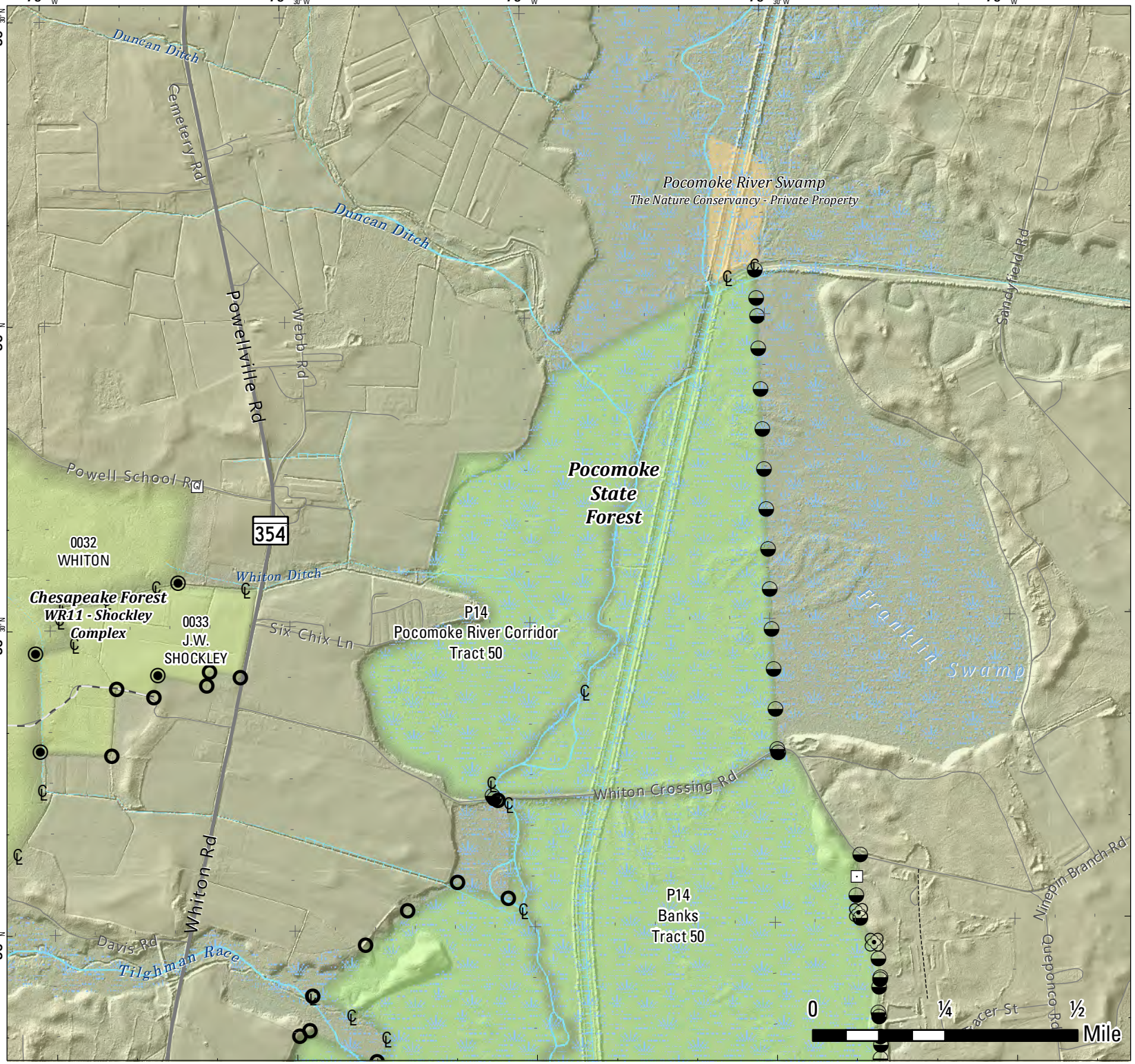
Public Hunting

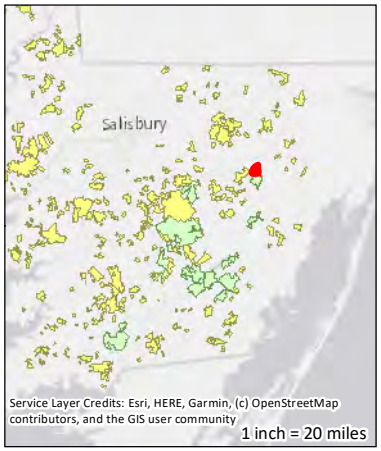
3.3 mi boundary lines painted Incomplete from partial survey

1 inch = 1,320 feet

Legend

Pocomoke SF Tracts





ASC-DNR Forest Service
07/2022 v5.0

P14

Banks
Tract 50

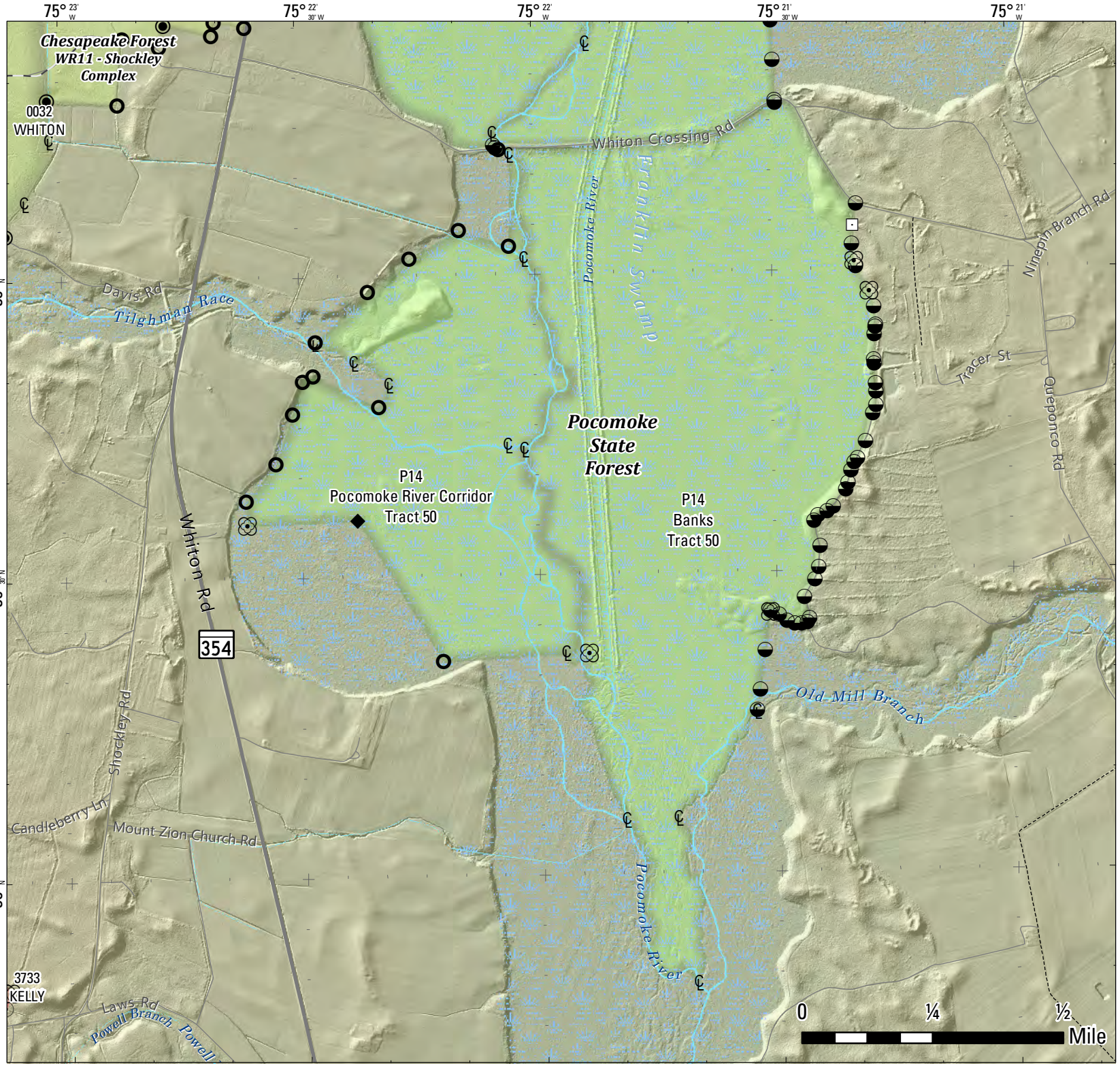
636.6 Acres

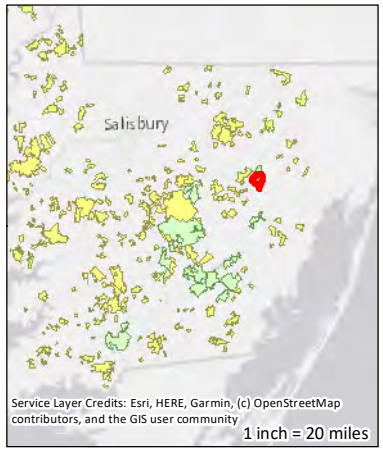
Public Hunting

5.5 mi boundary lines painted Incomplete from partial survey

1 inch = 1,320 feet

Legend
Pocomoke SF Tracts





ASC-DNR Forest Service
07/2022 v5.0

P15

Whaley's Crossing

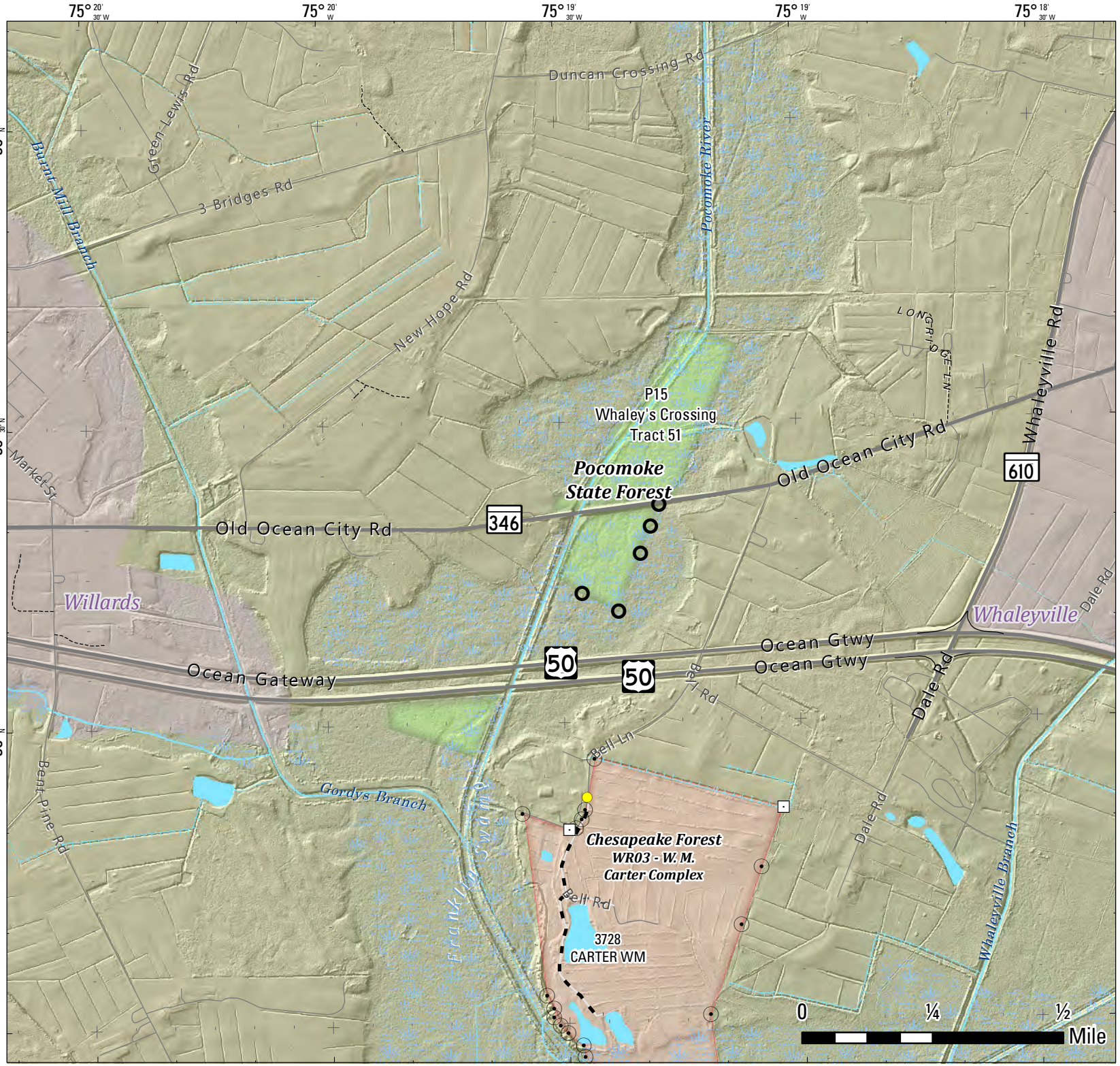
Tract 51

58.4 Acres

Public Hunting

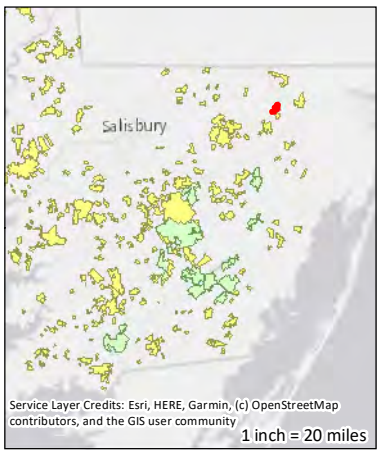
2.3 mi boundary lines
painted UNK
from part survey

1 inch = 1,320 feet



Legend

- Pocomoke SF Tracts



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P16

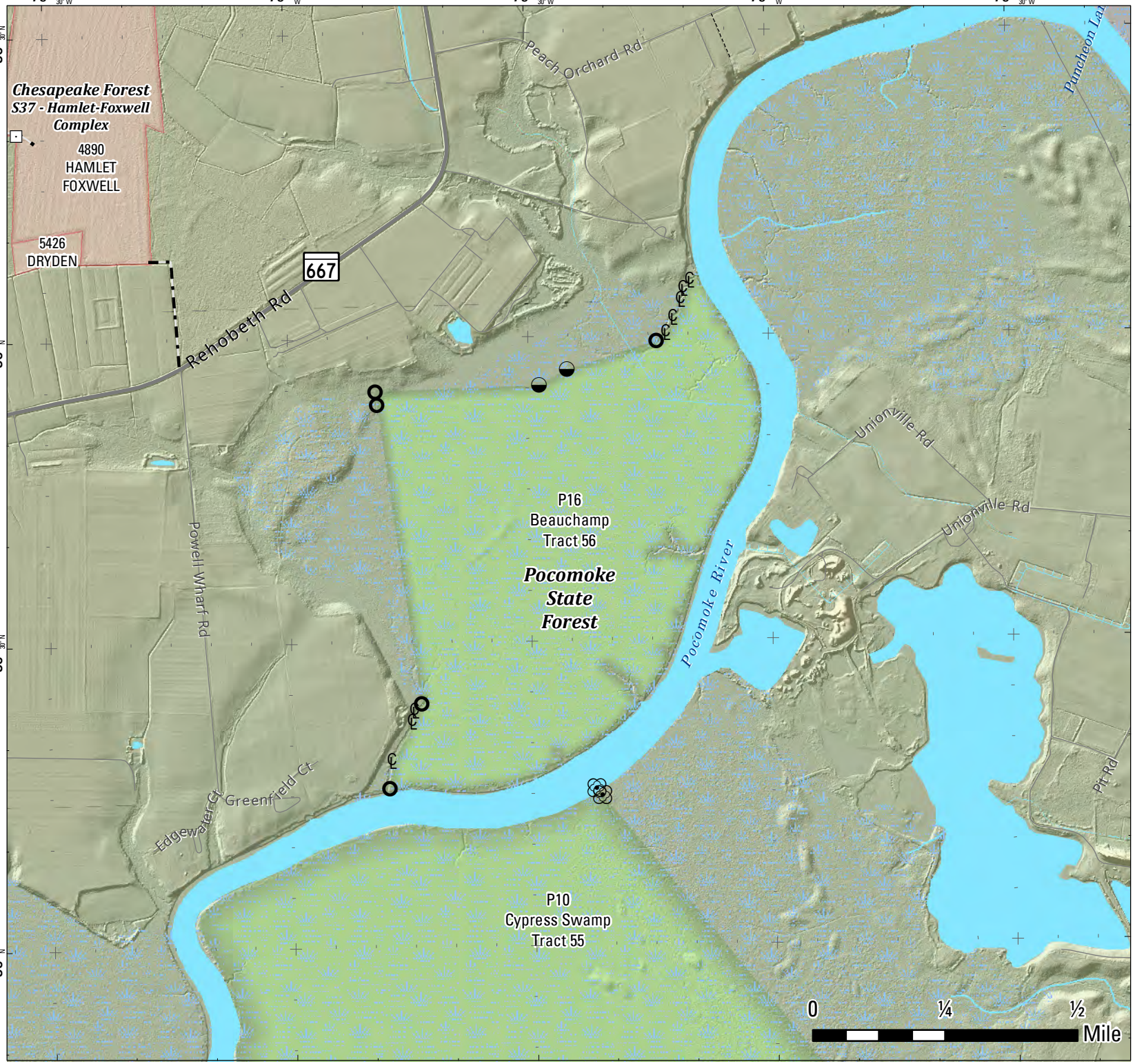
Beauchamp
Tract 56

281.7 Acres

Public Hunting

3.6 mi boundary lines
painted UNK
from survey

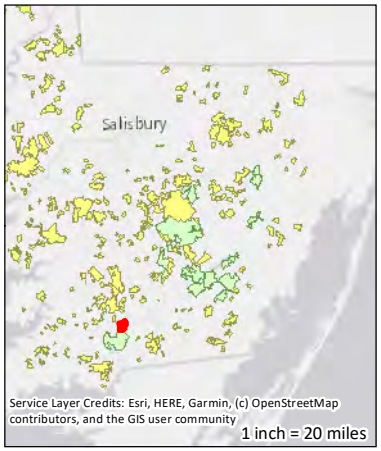
1 inch = 1,320 feet



Legend

Pocomoke SF Tracts

N



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