Sustainable Forest Management Plan

FOR

Chesapeake Forest Lands

Sustainable Forests for People and the Bay

MARYLAND DEPARTMENT OF NATURAL RESOURCES

FOREST SERVICE

July 1, 2007

(Revision #7,November 4, 2013)

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Preface
(Revision #7, November 2013)

The Chesapeake Forest Sustainable Management Plan that is presented within this document came together after several months of internal Departmental review, citizen advisory committee input and public comment. This resulted in the new Chesapeake Forest Sustainable plan that came out on July 1, 2007. Portions of the 2007 plan were developed from the original 1999 Chesapeake Forest Sustainable Forest Management Plan. Since that time, the 2007 plan has since gone through six revisions with the most recent version dated February 2013. Revision 6 included revised Delmarva Fox Squirrel forest management recommendations that were reviewed and approved by USFWS and Maryland DNR Wildlife & Heritage Division. Revision 5 included a new section in Chapter 2 on Climate Change and its' affect on the forest and in Chapter 3 detailed information was added concerning Old Growth Forests the goal for setting specific areas aside on CFL for future Old Growth. Changes within the fourth revision were the result of recommendations presented in the 2009 certification audit. The specific revisions to this edition included management recommendations for vernal pools and policy recommendations for determining areas of potential old growth and how these areas are managed. This new information is referenced in the table of contents. The third revision to the plan included a major redefinition of High Conservation Value Forest (HCVF) that now includes a much broader scope of sensitive species and habitat. This redefinition can be found at the end of chapter 5 on page 60 and has been incorporated throughout the entire plan. Also included in the third revision are a number of updated figures and tables that resulted from the numerous land acquisitions of the past few years. Other changes within this plan from previous revisions include land acquisitions that added over 7,000 acres of forest. These additions included the 2009 acquisition of the Foster Tract (4,900 acres) in Worcester County which was one of the largest contiguous private land holdings left on the Eastern Shore and the Sustainable Conservation Properties (1,073 acres formerly owned by Glatfelter Pulp & Paper Company) also an acquisition that should be completed in 2010 for property in Dorchester County belonging to Besley & Rodgers Inc. (1,043 acres). Previous revisions also added content relating to Forest Service policies on "Green Tree Retention" within forest harvest sites, this addition can be found in Chapter 5 of this plan.

The Chesapeake Forest which is owned by the State of Maryland and managed by the Maryland Forest Service through the Department of Natural Resources originally consisted of 58,000 acres of forest land. These lands were part of a 1999 divestment by the Chesapeake Forest Products Corporation. At that time, a partnership between the State of Maryland, The Conservation Fund, and Hancock Timber Resources Group moved to purchase the forests. The original 1999 plan was prepared by a 10-person technical team assembled by The Sampson Group, Inc. Oversight and decision making for the technical team was provided by a Steering Committee composed of representatives from Maryland Department of Natural Resources, The Conservation Fund, the Chesapeake Bay Foundation, and the local forest industry. The 2007 plan was built upon the extensive framework of resource information compiled by that group. Additionally the 2007 plan utilized the previous seven years of field work and research, including feedback provided through the SFI and FSC forest certification process to build on the original 1999 plan.

The Chesapeake Forest currently consists of 66,772 acres divided into 187 Management Units distributed across six counties. In spite of this scattered character, the forests include some of the last large segments of unbroken forest in a region that is largely agricultural in nature. Chesapeake Forest Lands include more than 6,000 acres of wetlands and comprise portions of 23 separate watersheds, many of which have been given a high priority for conservation action under the Maryland Clean

Water Action Plan. They contain established populations of threatened and endangered species, including the Delmarva fox squirrel (Sciurus niger cinereus), bald eagle, and some 150 other species that have been identified as rare, threatened, or endangered in the region. Abundant populations of deer, turkey, and waterfowl create the basis for extensive hunting opportunities and other recreational activities on the land.

For additional information about Chesapeake Forest and to provide feedback concerning management policies please visit the website at: http://www.dnr.state.md.us/forests/chesapeakeforests

Revision #1: 04/22/08
Revision #2: 03/01/09
Revision #3: 10/01/09
Revision #4: 04/07/10
Revision #5: 02/14/12 – Added Climate Change section to chapter 2
Revision #6: 03/12/13 – added revised DFS mgt recom. to chps. 5 & 8. Updated Monitoring Section & Appx. M
Revision #7: 11/04/13 - Final Delmarva Fox Squirrel management revisions, chapter 5 and 8, updated acreages

Table of Contents

CHAPTER 1 1

Chesapeake Forest Lands 1

1.1 Background and History of the Forest 1
1.2 Planning Process 2
1.3 Goals for Chesapeake Forest Lands 2
1.4 Future Land Acquisition Goals for Chesapeake Forest 3
1.5 Primary Constraints to Be Addressed In the Plan 4
1.6 Major Planning Issues 5
1.7 Achieving the Vision 6
1.8 Challenges to Modern Forest Management 6
1.9 Adaptive Management 8
1.10 What Will and Won't Change? 9
1.11 But Is It Sustainable? 10

CHAPTER 2 11

Maryland's Lower Eastern Shore - Resource Assessment 11

2.1 Maryland's Lower Eastern Shore 11
2.2 General Geology and Soils 13
2.3 Water Resources 13
Groundwater: 13
2.4 Hydrologic Modifications 16
Water Quality Indicators 17
2.5 Wildlife Resources 17
2.6 Endangered and Threatened Species of Special Concern 17
2.7 Other Federally Listed Species that Occur In Maryland 19
2.8 Plants of Special Concern 21
2.9 Plant Communities of Special Concern 22
2.10 Game Species of Special Concern 22
2.11 Migratory Birds of Special Concern 23
2.12 The Forests of the Eastern Shore 25
2.13 Forest Management on the Eastern Shore 26
2.14 The Forest Products Industry 28
2.15 People and Forests on the Eastern Shore 29
Historic Settlement and Forest Use Patterns 29
Fire and Its role In Shaping the Forests of the Region 29
Recent Population and Development Trends 31
Maintaining Working Forests in an Urban-Affected Region 31
2.16 Landscape Considerations 33
Shifting From Stands to Landscapes 33
Watersheds as a Landscape Issue 34
2.17 Water Quality Issues 35
2.18 Potential Water Quality Impacts of Forestry Operations 36
2.19 Climate Change and Maryland Forests 36
Species Migration 36
Forest-Type Changes 36
Eastern Shore 36
Western Maryland 37
Disturbance Increase 37
Increased Severe Weather 37
Sea-level Rise 37
Agency Response 38

CHAPTER 3 41

Chesapeake Forest - Resource Characterization 41

3.1 The Forests ... 41
3.2 Old Growth Forest ... 43
3.3 Forest Production ... 43
3.4 Water Quality ... 44
3.1 Watersheds ... 44
3.2 Soils ... 45
3.3 Management Areas and Units ... 47

CHAPTER 4 ... 49

Land Management Area Guidelines ... 49
4.1 Land Management Areas ... 49
4.2 General Forest Areas ... 50
4.3 Ecologically Significant Areas (ESA) ... 51
4.4 Forested Riparian Buffers ... 51
4.5 Wildlife Habitat Areas ... 51
4.6 Visual Quality Areas ... 52
4.7 Non-forested Lands ... 52

CHAPTER 5 ... 53

Forest Management ... 53
5.1 Priority Management Layers & High Conservation Value Forest (HCVF) ... 53
5.2 Forest Types & Silvicultural Practices– Chesapeake Forest Lands ... 54
Non-Forested Lands ... 54
Forested Swamps with mixed hardwoods, bald cypress and Atlantic White cedar ... 54
Mixed pine-hardwood, hardwood-pine and mixed hardwood forests ... 54
Loblolly Pine Forest ... 54
5.3 Forest Management Guidelines ... 55
General Forest Management Areas: ... 55
Ecologically Significant Areas: ... 55
Core Forest Interior Dwelling Bird Habitat: ... 56
Delmarva Fox Squirrel (DFS) Habitat: ... 56
Riparian Forest Buffers: ... 57
5.4 Management of Existing Loblolly Pine Plantations ... 57
5.5 Management Guidelines for Old Growth Forest ... 57
5.6 Other Special Management Areas ... 59
5.7 Forest Management Activities ... 59
Regeneration & Site Preparation ... 59
Vegetation Control ... 60
Pre-commercial Thinning ... 60
Commercial Thinning ... 60
Forest Buffer Thinning ... 60
Regeneration Harvest ... 61
Green Tree Retention ... 61
Prescribed Burning ... 62
Fertilization ... 62
5.8 Practice scheduling – Annual Work Plans (AWP) ... 63
5.9 Non-Silvicultural Forest Management Activities ... 63
Roads ... 63
5.10 Forest Health ... 63
5.11 Financial Returns ... 64
5.12 Forest Modeling ... 64
Modeling Long-term Sustainability ... 64
The Indicators ... 64
The Forest Planning Model ... 65
5.13 Inventory and Monitoring ... 65
Water Quality Monitoring ... 66
Timber Harvests ... 66

Fertilizer and Herbicide Applications 66
Annual Plan Performance Reporting 67
5.14 Forest Certification 67
Certification Guidelines Premise: 68
Forest Stewardship Council (FSC) – Guidelines & Principles of Importance 68
High Conservation Value Forest (HCVF) Definition Guidelines: 68
Representative Examples of Existing Ecosystems 69
Inclusion of Riparian Forest Buffers as High Conservation Value Forests 69

CHAPTER 6 71

Water Quality Areas: Riparian Forest Buffers and Wetlands 71
6.1 Introduction 71
6.2 Riparian Forest Buffers - High Conservation Value Forest (HCVF) 71
Stand Composition 72
Vegetation Management 72
Roads 72
Herbicide and Fertilizer Use 72
6.3 Non-Operational Wetlands 73
The Management Goals of wetland areas will be as follows: 73
Vegetation Management 73
Stand Composition 74
Herbicide and Fertilizer Use 74
Roads 74
6.4 Riparian Forest Buffer Delineation for High Conservation Value Forest 74
6.5 Management and Function of Expanded Riparian Forest Buffers 74
6.6 Significant Vernal Pools 75
Vernal Pool Conservation and Management Prescriptions 77
6.7 Watershed Improvement Projects 80
Watershed Improvement Project Evaluation Process 80
Watershed Improvement Practices 80
6.8 Identified Watershed Improvement Projects 81
6.9 Water Resources – Human Consumption 81

CHAPTER 7 83

Ecologically Significant Areas (ESA's) 83
6.1 Ecologically Significant Area (ESA) Defined 83
6.2 ESA Management 84
6.3 Management Zone Definitions & Prescriptions by ESA Category & Zone 85
Delmarva Bay ESAs 85
Riverine Swamp Forest ESAs 86
Estuarine Forest (limited to 1 ESA: Fishing Bay) 86
Sandpit ESAs 87
Sand Ridge ESAs 87
Emergent Wetland ESAs 88
Complex ESAs 88
6.4 Prescribed Burning within ESA's: 89
6.5 Use of Herbicides/Pesticides within ESA's: 89
6.6 Annual Work Plans: 89
6.7 Summary of Existing ESA's 89

CHAPTER 8 91

Wildlife Habitat - Protection & Management 91
8.1 Introduction 91
8.2 Riparian Forest Buffers - High Conservation Value Forest 91
8.3 Rare, Threatened, and Endangered Species 91
Delmarva Fox Squirrel (DFS) 91

DFS Core Areas (High Conservation Value Forest) ... 91
DFS Future Core Areas ... 92
Forest Management for Delmarva Fox Squirrel (DFS) ... 93
TOTAL: DFS Management Areas on CFL & PSF: 56,636 acres (Core plus Future Core) ... 93
Contribution of DFS Management towards DFS Recovery ... 94
Planning Horizon for DFS: Time to Achieve Desired Future Condition ... 94
Adaptive Management Considerations for DFS ... 95
Bald Eagle ... 95
8.4 Other Rare, Threatened and Endangered Species ... 95
8.5 Management Opportunities for other Wildlife Species ... 96
Forest Interior Dwelling Bird Species (FIDS) ... 96
Amphibians ... 97
8.6 Management Opportunities for Game Species ... 97
Northern Bobwhite Quail Management ... 97
Woodcock Management ... 98
Deer Management ... 98
Wild Turkey Management ... 98

CHAPTER 9 ... 99

Public Use & Education ... 99
9.1 Background ... 99
9.2 Current & Future Recreational Uses ... 99
Hunting ... 100
Hiking, Biking Horseback Riding and Nature Observation ... 101
Water Access for Canoeing, Kayaking and Fishing ... 101
9.3 Education and Public Outreach ... 102
9.4 Chesapeake Forest Website ... 102
9.5 Educational Material ... 102
9.6 Tours and Forums ... 102
9.7 Implementation ... 102

CHAPTER 10 ... 105

Chesapeake Forest Monitoring Plan ... 105
10.1 Introduction ... 105
10.2 Monitoring Plan ... 105
10.3 Tier I: Landscape-scale, Long-term Monitoring ... 106
Terrestrial Vegetation and Species Sampling ... 107
Stream and Water Quality Sampling, Procedures, and Progress ... 107
10.4 Tier II: Stand/Complex-level Medium-term Monitoring ... 109
Invasive Species ... 110
10.5 Tier III: Management Activity-based Short-term Monitoring ... 110
10.6 Procedures by Forest Management Actions ... 111
Harvesting (For SFI Objectives 2, 3, 4, 5, 6): ... 111
Site Preparation ... 111
Prescribed Burning ... 111
Herbicide Application ... 111
Mechanical Treatment ... 113
Intermediate Operations ... 113
10.7 Special Area Projects for Water Quality ... 113
10.8 Special Area Projects for Wildlife & Heritage ... 114
10.9 Public Use and Recreational Activity ... 114

CHAPTER 11 ... 115

The Annual Work Plan ... 115
11.1 Annual Work Plan ... 115
11.2 Annual Work Plan Timetable ... 116

11.3 Contents of the Annual Work Plan will include: 117

CHAPTER 12 119

Operational Management 119

12.1 Introduction 119
12.2 Objective 119
12.3 CHESAPEAKE FOREST REVENUE SOURCES: 119
Forest Product Sale Revenue 119
Hunt Club Lease Revenue 119
12.4 OPERATIONAL COST 120
Staffing Cost: 120
Land Operation Cost 120
Forest Certification, Inventory & Monitoring Program Cost 120
County Payments 120
Fixed Costs 121
12.5 Other Revenue/Funding Sources 121
12.6 Summary 121

Appendix A 125

Chesapeake Forest Project - Planning Organization 125

Appendix B 127

Chesapeake Forest Lands - Citizens Advisory Committee 127

Appendix C 129

FSC Principles & Criteria for Forest Stewardship 129

Appendix D 131

SUSTAINABLE FORESTRY INITIATIVE® (SFI) 131

Appendix E 135

Appendix F 141

Chesapeake Bay Critical Area - Timber Harvest Plan Guidelines 141

INTRODUCTION 141
HOW TO USE THE GUIDELINES 142
DEFINITIONS 143
Potential FIDS Habitat 143
High Quality FIDS Habitat 143
Forest Interior Habitat: 143
Coastal Plain Forest Types 143
LOBLOLLY PINE FORESTS 144
MIXED HARDWOOD-PINE FORESTS 145
UPLAND HARDWOOD FORESTS 147
RIPARIAN FORESTS 151
RIVER TERRACE/RAVINE/COVE HARDWOOD FORESTS 152
REGIONALLY RARE OR UNCOMMON COASTAL PLAIN FOREST TYPES 153
FOREST RESTORATION FOR FIDS 153

Appendix G 155

THE HISTORICAL AND ECOLOGICAL ROLE OF FIRE IN THE FORESTS OF MARYLAND'S EASTERN SHORE 155

FIRE HISTORY 155
Importance of Lightning Fire 155
Use of Fire by Native Americans 155

Role of Fire in the Colonial Era 157
Fire in the Nineteenth and Early Twentieth Century 157
THE ECOLOGICAL ROLE OF FIRE 157
Pines 157
Oaks 158

Appendix H 163

Criteria for Assessing Suitability of Tracts for Public Use 163

Appendix I 165

***Policy for SFI Management Review & Continual Improvement* 165**

Appendix J 167

Management Guidelines for the Conservation & Protection of Old-Growth Forests 167
Purpose/Vision Statement 167
Background and Summary of Current Old Growth Forests in Maryland 167
Landscape Context 168
Identifying Nearly Old-Growth Forests 169
Guidelines for Conservation of Old-Growth 170
Guidelines for Increasing Old-Growth 172
Development of Specific (Land Unit) Management Plans 173
Glossary 173

Appendix K 181

CFL – Modeling Long-term Sustainability 181
THEME 1 – Primary Forest Type 181
THEME 2 – Management Area Designations 181
THEME 3 – Thinning Status 181
THEME 4 – Regeneration Status 181
Optimizing and Constraining the Model 183
The Results 183

Appendix L 191

Land Additions and Acquisitions to Chesapeake Forest 191
Wicomico Demonstration Forest: 191
Seth Demonstration Forest: 191
Blackwater Resort Acquisition: 191
Foster Estate Property: 192
Lindner property 192
Sustainable Conservation Properties, ... 192
Besley Rodgers Inc. 193

APPENDIX M 195

Framework for Identifying Water Quality Improvements 195
Specific Project Descriptions 201
Funding 201
Completed Projects: 201

Appendix N 204

Chesapeake Forest ESA Summary 204

Tables and Figures

Table 1: Summary by County of Chesapeake Forest Lands (2013) 1
Table 2: Land use on Maryland's Lower Eastern Shore....11
Table 3: Est. % of Stream miles by Category, Fish Index of Biotic Integrity 15
Table 4: Est. % of Stream miles by category, Benthic Index of Biotic Integrity....15
Table 5: Est. % of stream miles, by category, Physical Habitat 15
Table 6: Percent of historic wetlands (hydric soils) that are mapped as unmodified wetlands 16
Table 7: Estimated percentage of stream miles with evidence of channelization....17
Table 8: Area of timberland by forest type and ownership group....25
Table 9: Population characteristics of MD/DE compared to selected Eastern Shore Counties 31
Table 10: Forest Diversity Analysis:....42
Table 11: Chesapeake Forest Lands as % of the forest area by county (2013)....44
Table 12: Lower Eastern Shore Watersheds Priority Rank....45
Table 13: Current Forest Cover by Soil Management Group (2013) 46
Table 14: Soil management groups for Riparian Forest Buffers/Wetlands (2013)....46
Table 15: Chesapeake Forest Land – Management Areas & Units (2013)....47
Table 16: Management Unit Statistics by Size 47
Table 17: Priority Management Layers (2013) 53
Table 18: Strata Identified for Long-term Monitoring in the Chesapeake Forest....107
Table 19: Synoptic Water Quality sampling on Chesapeake Forest Lands, Spring 2002....108
Table 20: Map symbols used in county soil survey reports, by soil series & phase. 138
Table 21: Silvicultural methods that are allowable in upland hardwood forests. 149
Table 22: Silvicultural methods allowable in riparian forests....152
Table 23: Summary of co-dominant species in identified old growth stands 168
Table 24: Known threats/impacts to old-growth forest ecosystems & their sources....169
Table 25: Hydro-geomorphic Content for Water Quality Improvement 197
Table 26: Chesapeake Forest ESA Management Zones and Acreages, Version 2 213
Table 27: Acreages of Chesapeake Forest Priority Management Areas 215

Figure 1: Age & Species Distribution at start of Model Run (2012) 7
Figure 2: Age & Species Distribution after 50 years (model run 2012) 8
Figure 3: A complex mix of agriculture surrounds Chesapeake Forest (2013) 12
Figure 4: White-tailed deer Harvest Trends 23
Figure 5: Hunting controls Sika deer populations....23
Figure 6: Watersheds on Maryland's Lower Eastern Shore, illustrating priority levels for restoration. (2013) 35
Figure 7: Chesapeake Forest Lands on the Lower Eastern Shore of Maryland. (2013) 41
Figure 8: Age distribution of pine plantations on Chesapeake Forest Lands, (2013) 42
Figure 9: Contribution of nitrogen & phosphorous to tidal waters from land uses in the Chesapeake Bay.... 44
Figure 10: How special areas are added to the landscape to build a complex mosaic of managed lands....49
Figure 11: Chesapeake Forest Age Distribution 2013 50
Figure 12: Vernal Pools on the lower Delmarva Peninsula and Chesapeake Forest tracts. (2010) 77
Figure 13: Amphibian buffer zone around a vernal pool 78
Figure 14: Vernal Pool connectivity zone for amphibian conservation....79
Figure 15: Delmarva Fox Squirrel Areas on Chesapeake Forest Lands &Pocomoke State Forest (2013)....92
Figure 16: CORE FID Habitat Areas (2011) 96
Figure 17: Annual Work Plan Process 115
Figure 18: Age and species distribution at the start of the model runs (2006) 184
Figure 19: Age and species distribution after 50 years. 184
Figure 20: Acres of first and second thinnings, harvests, & total area treated. 185
Figure 21: Amount of standing pine inventory & inventory available for harvest. 185
Figure 22: Est. harvest volumes of pine sawtimber & pulpwood over 50 years....186

Figure 23: Model estimates of dollar return from timber sales over 50 years. 187
Figure 24: Area of pole-sized (+10" dbh) and large (+16" dbh) pine over time. 188
Figure 25: Areas of open or early successional habitat, water & associated buffer areas. 189
Figure 26: Area of land managed primarily for wildlife habitat, trees 10" & larger. 189
Figure 27: Hydro-geomorphic regions on the lower Delmarva Peninsula.....196

CHAPTER 1

Chesapeake Forest Lands

1.1 Background and History of the Forest

On September 10, 1999, approximately 76,000 acres of forested land on the Delmarva Peninsula was sold by Chesapeake Forest Products Corporation to an innovative partnership between The Conservation Fund, the Richard King Mellon Foundation, and the State of Maryland. In addition, both Hancock Timber Resources Group and the Chesapeake Bay Foundation played significant roles in developing and supporting the acquisition by their partnership. Of the 58,400 acres purchased in Maryland approximately half of the land was acquired by the Maryland Department of Natural Resources. The Conservation Fund (TCF) purchased the remaining half of the land on behalf of the Richard King Mellon foundation they in turn then gifted these lands to the State Of Maryland in December of 2000. The division of tracts between the State and the TCF was based on a Department of Natural Resources (DNR) review that resulted in state ownership of the most environmentally sensitive tracts as well as those adjoining existing DNR properties. The balance of the Chesapeake property (18,000 acres in Delaware and Virginia) was acquired by Sustainable Conservation Inc, a non-profit subsidiary of TCF, and is outside the scope of this plan.

Since the date of the original purchase several new land acquisitions plus two existing DNR properties, Wicomico Demonstration Forest and Seth Demonstration Forest have been added to Chesapeake Forest Lands and are now covered under the Sustainable Management Plan. See section 4 of this chapter for information on land acquisition goals for Chesapeake Forest.

Table 1: Summary by County of Chesapeake Forest Lands (2013)

County	Original Chesapeake Forest		Other Lands	**TOTAL**
	TCF-Mellon – Gifted Portion	MD-DNR Purchased	Added after Purchase	
	Acres			
Talbot	0	0	122	122
Caroline	300	950	50	1,300
Dorchester	1,657	9,793	2,608	14,058
Somerset	12,660	4,491	78	17,229
Wicomico	9,834	5,984	1,571	17,389
Worcester	5,318	7,417	4,939	17,674
TOTALS	**29,769**	**28,635**	**9,368**	**67,772**

The goal of this transaction was and continues to be to retain the property as a working forest that will be managed in a conservation-minded way to provide forest products, local employment, and recreation opportunities while protecting or improving the water quality and habitat value of the lower Chesapeake Bay watershed.

To help meet these goals, The Conservation Fund contracted with the Sampson Group, Inc., under the direction of Neil Sampson, to develop a forest management plan on their 29,769 acre portion. This plan would guide the management of that portion of the forest from when it was donated to the State in December 2000 through a three-year transition period that ended December 31, 2003. This management plan also served as a guide for the management of the DNR half of the property during this transition time period. At the end of the transition period a new Sustainable Management Plan that covered the entire Forest was developed and implemented in the spring of 2004, the planning process to accomplish this is described below. Since the completion of the 2004 plan there have been a number of management revisions on the forest. This has required changes to be made to the document that includes revised chapters dealing with sensitive species management, high value conservation forest and forest modeling, in addition several new tracts of land have been added to the forest and are now covered under this latest (2007) revision to the Sustainable Plan.

1.2 Planning Process

The original forest management plan that was written for The Conservation Fund in 1999 was developed by a Planning Team assembled by The Sampson Group, Inc., under the direction of Neil Sampson, Planning Coordinator. Guidance and planning decisions were provided by a Steering Committee under the leadership of David Sutherland of The Conservation Fund, and included participation by representatives of the Chesapeake Bay Foundation, Maryland Department of Natural Resources, and the Smurfit-Stone Forest Products Corporation. That original Steering Committee and Planning Team along with a Scientific Review Team reviewed and provided input on the original TCF plan; members are listed in Appendix A.

The (2004) sustainable forest management plan went through the Department's land planning process which took almost two years to complete. As part of that process, the plan was reviewed by the Chesapeake Forest Advisory Committee, which was a group consisting of various resource professionals, private citizens, industry representatives and local political leaders (See Appendix B). This Committee review was conducted at monthly meetings that were open to the public. Based on the input provided by this committee along with updated resource information provided by DNR resource professionals, several sections of the original plan were revised and a few new chapters were added and several were deleted. Following the completion of this draft document, additional input was received at a public meeting and during a 30-day comment period. The 2004 plan is the result of this review by the Committee and the public and is based on the original plan developed by the Sampson Group. The 2007 version includes major revisions to chapter 5, Forest Modeling Guidelines and a completely revised Chapter 7, Ecologically Significant Areas (ESA). Also several other chapters had minor revisions to update with current data. This newly revised plan has gone through a similar process of reviews and approvals as previously described.

1.3 Goals for Chesapeake Forest Lands

The primary goal of Chesapeake Forest Lands is to demonstrate that an environmentally sound, sustainable managed forest can contribute to local and regional economies. The State of Maryland and The Conservation Fund have publicly committed that these forests will continue their part in a viable forest-based economy on the Eastern Shore.

This goal will be pursued subject to the following constraints:

- That the quality of the water flowing through the properties 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 the Chesapeake Bay.

- 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.

- 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 D). 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 above under the first two bullets, 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.

- That forest recreational opportunities will be provided as appropriate, and are consistent with the above goals for each site. Public use of the forest will be achieved through a combination of revenue-generating hunting leases and public access recreation. The Department will determine the appropriate level of public use for each tract as part of its ongoing evaluation and monitoring process.

1.4 Future Land Acquisition Goals for Chesapeake Forest

The original Chesapeake Forest properties were spread across a five county area in Maryland and broken down into 238 separate land parcels. The wide dispersion of Chesapeake Forest tracts creates considerable challenges to both daily and long term management activities and in meeting the goals discussed in the previous section. The addition of new parcels to Chesapeake Forest Lands could help alleviate a number of these issues and also build upon a network of well managed forest lands that would in perpetuity contribute to the goals for protecting and restoring the Chesapeake Bay.

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

1) The property is an in-holding within a Chesapeake Forest tract and/or the parcel connects additional CFL 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 (ESA's) as identified in Chapter 7, Wildlife Habitat resources described in Chapter 8, Riparian Forested Buffers 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 Chesapeake 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 Chesapeake Forest that would greatly enhance management opportunities on the forest. In May of 2007 a portion of the Blackwater Resort holdings was the first private parcel acquired. In 2006 two existing DNR properties that had been managed as State Demonstration Forest were added under the management oversight for Chesapeake Forest Lands (CFL). These properties although they have been owned and managed by the Department for a considerable time period were felt to be a better fit under the umbrella of the Chesapeake Forest Sustainable Management Plan.

Information on the two DNR properties and all new private acquisitions to Chesapeake Forest can be found in Appendix L, "*Land Additions and Acquisitions to Chesapeake Forest"*

1.5 Primary Constraints to Be Addressed In the Plan

Contributing to local economies at levels consistent with the past history will be impossible for a decade or so, due to the young age of the pine plantations, the lack of merchantable timber on the mixed stands, and the need to maintain the existing large trees on streamside management zones and special management areas.

Loblolly pine, the dominant commercial species in the area, requires adequate light for regeneration and therefore needs sufficiently large openings. Small clear cuts, while visually more acceptable than large ones, create habitat fragmentation, and so are not recommended by many wildlife scientists, who suggest that openings of 50 to 100 acres in size are more in keeping with the natural disturbance regimes needed by many species. However, clear-cut harvest sizes in excess of 40 acres are in conflict with the Forest Stewardship Council (FSC) certification standards, which the Department has committed to follow (See Appendix C). Any deviation in excess of a 40 acres harvest size must be based on forest health, economic and ecological necessity and be approved by FSC.

Other pine plantation management practices such as bedding, chemical hardwood suppression, and fertilization may be inconsistent with watershed and wildlife habitat enhancement goals, creating difficult tradeoff choices. Different management options are available in some situations, but many management methods exist today because little else worked in the past to regenerate the forest. In

the final decision, maintaining sustainable forest health may depend on doing what works best for the species and sites involved.

The timely creation of mature forests featuring large trees with some mature hardwood component and open under-story for Delmarva fox squirrel habitat depends on aggressive use of practices like thinning and prescribed fire, and the prudent use of fertilizers and herbicides. Whether the use of prescribed fire is feasible at the desired scale may be an issue, in light of local objections to fire, smoke and the number of acceptable burning days that meet burn plan requirements.

The implementation of ecosystem management that addresses landscape-level issues over a variety of unit sizes may present several problems. For example, restoration of habitat for species that need large areas of diverse conditions is feasible on some of the larger Chesapeake Forest Land management units, but may not be feasible on many of the smaller units. However many of the best water quality improvement projects are located on small or medium sized units because of their connectivity to other lands such as farms.

1.6 Major Planning Issues

The vision for Chesapeake Forests Lands is one that demonstrates a wide variety of management conditions and approaches that will result in sustainable forestry. Public interaction and interest will likely continue to be intense, all the way from the occasional roadside and/or streamside viewers and visitors to hunters, logging contractors, local businesses, industry, and government leaders. Expectations will be diverse, often conflicting, and changing. Forest industry skepticism exists about the ability of the Department to maintain timber outputs from this forest. The gap in timber outputs caused by the age class distribution of the forest and the Department's adherence to the management of endangered species habitat may be misread by forest industry as not being able to meet economic goals on the forest.

The plan and its subsequent implementation are therefore challenged to:

- Be consistent with the physical facts, biological potentials, economic constraints, and environmental conditions affecting these forests;
- Contribute to a set of public expectations that are reasonable in light of the situation at hand;
- Be open and transparent about what is most likely to result from various management options, what tradeoffs exist, and, in retrospect, what actually results from activities.

Meeting these challenges involves:

- Developing and maintaining the best resource assessment possible under the limits of time and funds;
- Assembling and updating a broad, interdisciplinary base of scientific knowledge and theory to support management decisions;
- Creating an integrated system of field data gathering, monitoring, information feedback, and data analysis that can learn from research and field experience to support constant improvement in resource assessment, scientific understanding, and management technique;
- Creating an adaptive management process that enables managers to flexibly respond to surprises and unforeseen disturbances, including a significant degree of flexibility for future plan amendments or adjustments;

- Involving third-party certification as part of the regular management regime, so that the environmental performance of field activities is evaluated regularly and management adjustments made as necessary; and,
- Creating a well-defined decision-making process, and a clear line of authority and responsibility for management of the forests.

1.7 Achieving the Vision

The Vision for Chesapeake Forest Lands is that it will become an active, working Model of certified sustainable forestry on the Eastern Shore that:

- Support abundant and diverse plant and animal life including both endangered and common species,
- Contribute to improved water quality,
- Support natural resource based economic benefits,
- Provide diverse opportunities for recreation.

The goals above translate into a vision for what the Chesapeake Forest Lands may become under this plan, and the management that results from it.

In the broad sense, the vision for the Eastern Shore is a future that has retained or enlarged the area supporting sustainable forests with abundant wildlife and biological diversity, sustained employment in timber-related industries, contributed to recovery of threatened and endangered species such as the Delmarva Fox Squirrel, improved water quality in the Chesapeake Bay, and provided high-quality recreational opportunities for people. The vision also includes the belief that Chesapeake Forest Lands will pay for itself and help support local jurisdictions.

The reality is that the 67,772 acres of Chesapeake Forest Lands is a small but in some ways crucial percentage of the total area of the Eastern Shore. Therefore this plan is presented in terms of what could be done to help achieve that broad regional vision in cooperation with other landowners, businesses, and local jurisdictions.

1.8 Challenges to Modern Forest Management

One of the most challenging aspects of modern forest management is the need to balance environmental, social, and economic goals to achieve the vision of a truly sustainable future. This plan addresses that need with guidelines based upon the character of the land itself. For general planning purposes, the plan brings together the known situation of the forest vegetation and wildlife with the available information on the soil and water resources. This has allowed identification of key areas for water quality, wildlife habitat, and other values. At the same time it also identified those areas where the production of economic timber harvests under modern management is both most economically rewarding and environmentally sound. In addition to those general guidelines, the plan calls for intensive and ongoing fieldwork to identify and manage specific areas. Some of these areas such as wetlands, Delmarva Bays, bald eagle nests, and historic cemeteries are too small to be located on large-scale maps, but they still must be managed where they exist. The Forest Managers are tasked with precisely locating these special areas with GPS equipment, and when they are found in the field their extent will be mapped and their management will reflect the special values that they possess.

With appropriate care of those key environmental values, this land can produce both timber for local industry and jobs for local workers, as well as opportunities for public recreation and enjoyment. This is envisioned to occur in a variety of ways, again guided primarily by the character of the land and forests themselves.

To help guide general decision making, the original 1999 Chesapeake Forest plan utilized a modern forest management model (HABPLAN) that allowed different options to be compared in a wide variety of ways, including costs and economic returns, production of wildlife habitat values, and the types of forest structures and diversity that will result. This model worked well in the development of the original plan. Since that time, the Maryland DNR Forest Service has studied several available forest modeling systems and ultimately chose the Remsoft Spatial Woodstock model for development of long-term projections on the Chesapeake Forest.

One of the questions that may arise is "why the emphasis on thinning the young loblolly pine stands?" The answer emerges from Figures 1 & 2, which illustrate the impact of the forest management system on the age and species distribution within the Chesapeake Forest. In 2012, the majority of the land (the y axis is acres) was in pine and the age was heavily skewed toward the 18-25 year ages. (In 1999, when the Chesapeake Forest Project was launched, the land was dominated by 12-18 year old pines. The current situation illustrates 12 years of aging plus management actions to achieve a more normal age distribution.)

Figure 1: Age & Species Distribution at start of Model Run (2012)

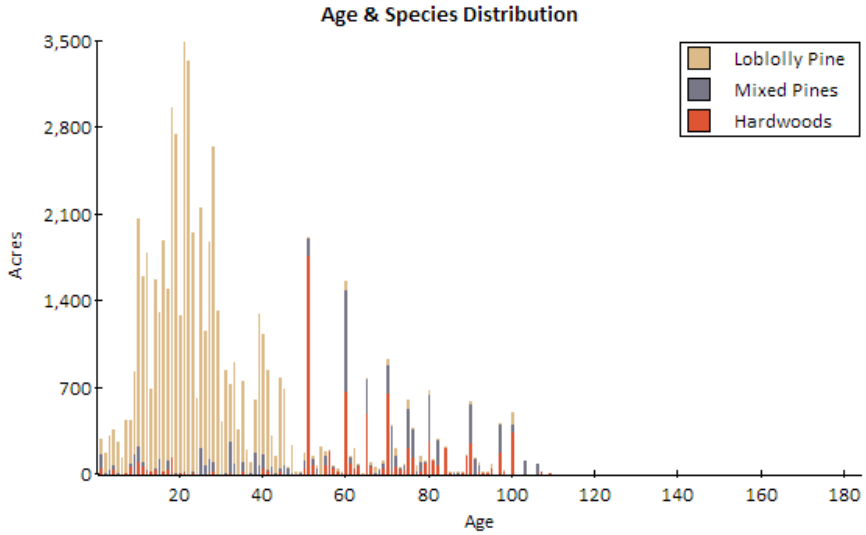


Figure 2: Age & Species Distribution after 50 years (model run 2012)

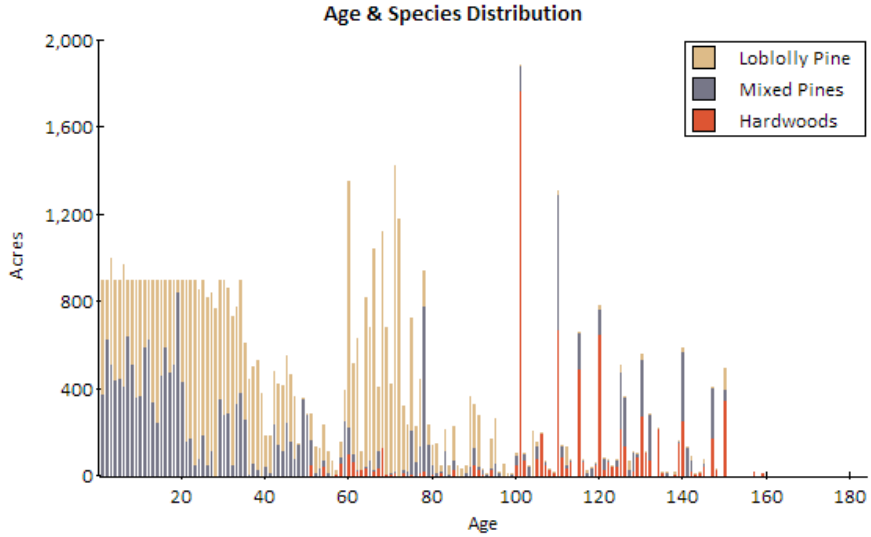


Figure 2 illustrates the impact of the 50-year management plan. The hardwoods have largely aged 50 years, since few if any have been harvested. The age distribution on the pine forests is much more "normal," with approximately the same amount of each age class. There will be a significant increase in mixed pine-hardwood forests, due to actions designed to enlarge stream buffers and convert critical habitat areas to a more mixed forest condition.

The most important decisions right now are ones of process, setting up a system that can work to meet the goals for the forest. That approach leaves the necessary room for future managers to adjust to what is learned and to react to surprises such as hurricanes, insect outbreaks, or dramatic market changes. That means that, in the eyes of some critics, the plan may lack a desired level of precision and certainty. Our best response to such critics is that this plan is a dynamic one, describing how land managers will adjust to a living, changing, and, in many ways, unpredictable system. It is not a design to be painted on the land; it is a challenge to this and future generations of Marylanders for continued, responsible, sustainable stewardship of the land and water.

1.9 Adaptive Management

One of the key concepts in this plan is that of Adaptive Management – land management that relies on good information, testing, feedback, and response to change or new learning. This plan envisions an adaptive system with feedback, learning, and the flexibility to respond to surprises. Adaptive management involves learning from one's experiences, including both successes and mistakes. The learning and adapting process must take place in real time, responding to changes in situation that can, sometimes, be unforeseen yet serious. This requires accurate data to identify baseline conditions and sound scientific theory to predict how these systems will respond to different disturbances or management actions. The fact is, there is never enough data or unquestioned scientific theory to answer every possible question, so an action plan must use the best available. The associated assumption is that continuing efforts to monitor and collect data, refine assumptions, improve models, and learn from the land itself, are essential to the implementation of this process and to achieving the vision. This is viewed as an ambitious and experimental effort, one that will challenge the Department and the Chesapeake Forest Management staff in many ways, and will also no doubt involve mistakes and future adjustments.

1.10 What Will and Won't Change?

This plan is designed to ease a transition between the former industrial forest management and the future multiple-purpose management under State ownership. Some of the changes between the former forests and the future forests will be fairly subtle, and many will take decades to emerge. So if it appears that the forests are not changing significantly in the near future, that may be the case.

The changes however, will become important over time, and they include:

- Maintenance or enhancement of water quality
- Protection of natural resources, including biological diversity
- Contribution to the local resource-based economy
- Providing opportunities for appropriate low-impact, resource-based public use
- Widening of Riparian Forest and Wetland Buffers to protect and enhance water quality, as well as provide mature forest habitat for species that need such conditions;
- More mixed hardwoods and hardwood/pine forests associated with the buffers, in which timber harvesting maintains a mature forest stand after it is achieved;
- Longer pine plantation rotations, particularly in areas where wildlife habitat relies on large pine trees. These will be harvested, but at older, larger sizes, which has implications for the future timber industry on the Shore.
- Less intensive methods of forest regeneration, including the use of natural pine regeneration whenever and wherever it can succeed. This has been shown to result in somewhat slower tree growth for the first 2-4 years compared to the more intensive methods of soil preparation and planted seedlings, but those early differences disappear later in the rotation. As a result, when forests are being managed for longer rotations, the less intensive regeneration methods should not result in a loss of productivity. They do, however, reduce up-front costs significantly as well as produce less soil and site disturbance.

Some things won't change, and other changes will take years to emerge and may be almost imperceptible for a long time. Those include:

- The planned shift to longer rotations for additional saw logs will emerge slowly as today's young stands reach larger sizes. The emphasis on thinning will produce significant amounts of pulpwood and forest-based jobs.
- The Department is committed to maintaining former levels of financial contribution to the counties so that property tax revenues are not affected. This plan will uphold that commitment. The development of riparian forest buffers in areas now planted to young pine plantations will take time. These areas must grow into buffers, so for the near future, there may be more pine pulpwood produced from buffer zones than from outside them, as additional pines are removed to create openings for hardwoods.
- Measurable improvements in stream water quality may come slowly. Much of the water flowing across these forests comes from agricultural and developed areas. Efforts will be made to create areas that can trap nutrients, but the measured progress is likely to be slow to emerge.
- Major impacts on the wildlife habitat depending on large trees will not occur until today's young forests have time to grow. Improved Delmarva fox squirrel habitat will emerge rapidly after about 20 years, but not before.

- Changing recreational patterns will require time for the Department to assess all the tracts, assure public safety and landowner relationships. Some of this assessment has already occurred and Public Use of several tracts has been implemented.

1.11 But Is It Sustainable?

Achieving sustainable forestry or any of the host of "sustainable" objectives is a matter of predicting the future. That is an exercise in which forest managers, planners and others have had great difficulty in doing. So, if we can't predict accurately, how do we assess the probable sustainability of a plan for Chesapeake Forest Lands?

First, we recognize that there is never just one way to manage a forest toward a particular vision. There are often many alternative management options for which rational arguments are made. The task in developing this plan has been to select management options that seem to offer the best balance of opportunities, within the constraints and conditions that exist on the land. Those options are presented with some humility, because nobody knows everything we need to know on how to manage these lands sustainable, and because lands with forests, waters, and wildlife are complex systems, full of surprises. Perhaps the only thing one can be absolutely sure of with forested landscapes is that the unexpected is to be expected. While this may not guarantee sustainability, it provides the best set of indicators we currently know.

What is believed that can be done with scientific integrity is to identify and monitor some indicators of un-sustainability. Ecological deterioration and damage can be avoided in this way.

The elements that should be monitored and the impacts avoided include:

- Soil Deterioration. Soil erosion, compaction, and rutting should be minimized, and, where possible, avoided. Soil nutrient and organic matter levels, as shown by soil tests, should not decline.
- Rare Species. Forest management activities should not cause the loss or serious decline of any threatened, rare, or endangered species. Where rare or sensitive ecological niches are identified, they should be managed to protect their components and processes.
- Nutrient Pollution. Monitoring should document that there is no significant increase in nutrient transport to adjacent waters due to forest management activities.
- Economic Output. To the extent feasible within existing forest and market conditions, and in keeping with protecting environmental assets and processes, there should be no significant diminution or excessive annual fluctuations in the flow of jobs created, products sold, and revenues realized from these forests.
- Special Areas Protected. No area identified as an Ecologically Significant Area, Natural Heritage Area, or other similar distinction, should be damaged or lost due to forest management activities.

- Community Acceptability. People should understand and accept the results they see on Chesapeake Forest Lands. Obviously, not everyone will be satisfied all the time. Evidence of significant community dissatisfaction will be dealt with pro-actively to seek management changes that result in community acceptance.

CHAPTER 2

Maryland's Lower Eastern Shore - Resource Assessment

(Five County Area: Caroline, Dorchester, Wicomico, Worcester, Somerset)

2.1 Maryland's Lower Eastern Shore

The Lower Eastern Shore of Maryland, as described in this assessment, consists of 5 Maryland Counties (Caroline, Dorchester, Somerset, Wicomico, and Worcester) 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 2 Virginia counties on the South (See Figure 3). 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 high 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 impact 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 2 and Figure 3 show that land use patterns within the five lower shore counties are dominated by, water, wetlands, forests and farmland. Taken together, water areas and wetlands make up almost 40 percent of the area within the boundaries of the region.

Table 2: Land use on Maryland's Lower Eastern Shore

Major Land Cover Category	Total Area	Percent
Urban or Built-up	95,481	5.12%
Agriculture	471,175	25.25%
Forest	**554,577**	**29.72%**
Water	557,544	29.87%
Wetland	184,489	9.89%
Other	3,025	0.16%
TOTAL	**1,866,291**	**100.00%**

Source: U.S. Geological Survey, 1999

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 raising 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 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.

USGS LAND COVER

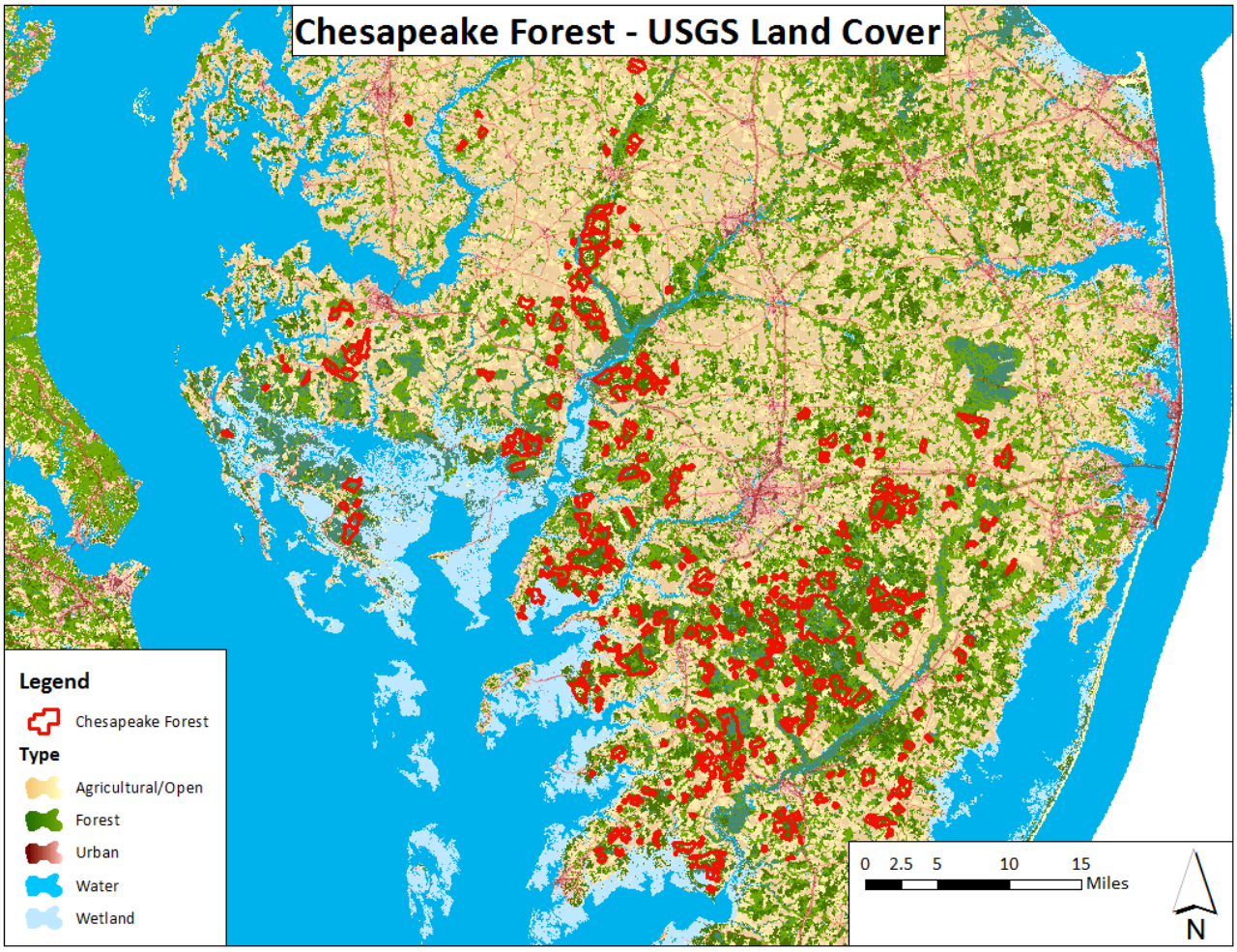


Figure 3: A complex mix of agriculture surrounds Chesapeake Forest (2013)

Large forest blocks are valued as contributors to the Maryland State Smart Growth objectives, as stated by Maryland's leaders while they were developing the plan to purchase the Chesapeake Forest lands. Taking these lands into state ownership was 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 was 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.

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 which 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 depress ional 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).

Wetlands**:** Relative to the rest of Maryland, wetlands is abundant on the lower Eastern Shore occupying approximately 10% of the area. Dorchester County alone accounts for 28 percent of the state's wetlands. 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 Chesapeake 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.

***Streams*:** There are approximately 750 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 each of the major river stream basins (Choptank, Nanticoke/Wicomico, and Pocomoke). Based on those results, Tables 3, 4, and 5 indicate the biological and physical conditions estimated to exist in the streams sampled in the region.

For the purposes of this resource assessment, results for the Choptank watershed, which was sampled two years as opposed to one for the other watersheds, were averaged evenly between the two years. 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 3: Est. % of Stream miles by Category, Fish Index of Biotic Integrity

River Basin	Good	Fair	Poor	Very Poor
Choptank	24.1	43.5	11.6	5.2
Nanticoke/Wicomico	3.9	69.6	18.1	0
Pocomoke	12.5	48.1	9.7	0
Statewide	19.5	25.7	14.5	14.0

Table 4: Est. % of Stream miles by category, Benthic Index of Biotic Integrity

River Basin	Good	Fair	Poor	Very Poor
Choptank	5.3	17.9	30.6	46.2
Nanticoke/Wicomico	12.3	27.7	26.4	33.5
Pocomoke	0.3	11.5	18.5	69.2
Statewide	10.8	37.7	25.7	25.3

Table 5: Est. % of stream miles, by category, Physical Habitat

River Basin	Good	Fair	Poor	Very Poor
Choptank	45.4	13.2	20.8	20.7
Nanticoke/Wicomico	6.5	16.8	26.4	50.3
Pocomoke	1.8	43.3	35.5	19.4
Statewide	19.9	28.5	29.1	22.4

***Tidal Waters*:** The vast majority of the lower Eastern Shore of Maryland flows to the Chesapeake Bay through four major tributaries (Choptank, Nanticoke, Wicomico, and Pocomoke Rivers) with the western portion of the region flowing toward Chincoteague Bay. Within the Chesapeake

watershed, all but the Choptank flow first through Tangier and Pocomoke Sounds, which traditionally have been two of the most critical fish and shellfish habitats in the Bay.

2.4 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 6). 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 6: Percent of historic wetlands (hydric soils) that are mapped as unmodified wetlands

Watershed	% Of Unmodified Historic Wetlands
Lower Wicomico	19.4
Lower Pocomoke	23.7
Upper Pocomoke	17.2
Marshyhope	21.4
Wicomico River Head	3.3
Wicomico Creek	25.4
Manokin River	42.5
Nanticoke River	44.7
Transquaking River	73.9
Big Annemessex	31.8
Pocomoke Sound	31.5
Nassawango Creek	24.6
Dividing Creek	31.9
Fishing Bay	87.8
Monie Bay	49.8

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 7). Historically, dredging and straightening to facilitate 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 7: Estimated percentage of stream miles with evidence of channelization

River Basin	Percent of Stream miles
Choptank	36
Nanticoke/Wicomico	52
Pocomoke	81
Statewide	17

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 or 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 also for other water quality issues as well.

2.5 Wildlife Resources

Chesapeake Forest wildlife habitats occur within a landscape that has been heavily fragmented by agricultural and residential development. The Chesapeake Forest lands, themselves, have been heavily fragmented through decades of intensive timber management, road building and conversion of native hardwoods to pine plantations. Management opportunities for wildlife on Chesapeake 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 Chesapeake Forest are forest obligates. Viability of forest obligate populations depends solely on the characteristics of these forestlands. Populations of other species of wildlife found on Chesapeake Forest are more affected by the characteristics of adjacent wetland or agricultural habitats. Chesapeake lands in those cases will contribute to, but not insure, species viability.

2.6 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 a publication by Maryland DNR, 12/03. 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 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 Chapter 8, shows DFS sites on or in near proximity to Chesapeake 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 on the average be expected to support 1 DFS per 10 acres, 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 threaten 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 1800's, people began to clear parcels of land for farm and agricultural use thereby impacting eagle nesting areas. With the development of chemical pesticides in the late 1950's, 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.

The Chesapeake Bay watershed provides the open marsh, undisturbed shoreline habitat that eagles need for nesting, roosting and feeding. Chesapeake Forest Lands have several Bald Eagle nesting sites, which are monitored annually by the Department.

2.7 Other Federally Listed Species that Occur In Maryland

Besides Bald Eagle and DFS, animal species listed by the USFWS as threatened or endangered that occur in Maryland, but are not believed to occur on Chesapeake Forest properties include:

- E -- Bat, Indiana (Myotis sodalis)
- T -- Beetle, northeastern beach tiger (Cicindela dorsalis dorsalis)
- T -- Beetle, Puritan tiger (Cicindela puritana)
- E -- Darter, Maryland (Etheostoma sellare)
- T – Plover, piping (Charadrius melodus)
- T -- Turtle, bog (Muhlenberg) (Glyptemys muhlenbergii)
- E -- Wedgemussel, dwarf (Alasmidonta heterodon)

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

Maryland DNR Wildlife & Heritage Division provided a summary of current and historical rare, threatened and endangered animal species potentially found on or within ¼ mile of Chesapeake Forest Lands they would include:

Species	Counties of Occurrence
Eastern Tiger Salamander	Caroline, Dorchester, Somerset
Henslow's Sparrow	Caroline, Dorchester
Barking Tree Frog	Caroline
Carpenter Frog	All CFL counties except Somerset
Sedge Wren	Dorchester
Eastern Narrow-Mouthed Toad	Dorchester, Somerset, Worcester
Rare Skipper	Dorchester
Swainson's Warbler	Wicomico, Worcester
Palamedes Swallowtail	Somerset, Worcester
Northern Pine Snake	Worcester
Red-cockaded Woodpecker	Dorchester, Worcester
Red-bellied Water snake	Dorchester, Somerset, Wicomico, Worc

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.

Henslow's Sparrow – Breeding habitat of Henslow's Sparrow includes neglected weedy fields (especially broomsedge), wet marshes, and salt marsh edges. Dense herbaceous vegetation, moderate amounts of moisture, ground litter, and singing perches are all special habitat requirements (DeGraaf and Rudis 1986).

Barking Tree Frog – According to TNC, the barking tree frog spends most of its time in trees feeding on insects. During cold or dry weather, it will burrow into the ground for refuge. In spring,

the barking tree frog breeds in temporarily flooded ponds beneath open forest canopies. Range of the frog includes the coastal plain from Louisiana to New Jersey.

Carpenter Frog – According to the Georgia Museum of Natural History, the Carpenter Frog breeds from March to August in permanent water. This frog is nocturnal and very secretive. It eats small insects and other small invertebrates. There has been some work that suggests that water snakes of the Genus *Nerodia* prey heavily on this species. The Carpenter Frog prefers slow moving or standing water with a great deal of aquatic vegetation. Throughout it range, it is associated with acidic waters of bogs, swamps and back-water rivers. Its color blends well with these waters.

Sedge Wren – As its name suggests, the Sedge Wren prefers sedge meadows, shallow sedge marshes with scattered shrubs and little or no standing water, coastal brackish marshes (DeGraaf and Rudis 1986).

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.

Rare Skipper – According to the U. S. Geological Survey (USGS), rare skipper adults feed on nectar from flowers of pickerelweed and swamp milkweed. Habitat includes brackish river marshes and abandoned rice paddies. The range of rare skippers includes isolated populations along the Atlantic Coast from southern New Jersey and Maryland south to coastal Georgia.

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.

Northern Pine Snake – According to the New Jersey Division of Fish and Wildlife, Northern Pine Snake are found in dry pine-oak forest types growing on very infertile sandy soils. Within these generalized habitats, pine snakes select open sandy clearings with little ground cover for nesting. Summer den sites are also typically located in clearings near fallen logs. Winter hibernacula are located in nearby areas providing more vegetation cover and leaf litter. The greater spatial frequency and temporal persistence of clearings within sandy, infertile soils may partially account for association of pine snakes with these soils. Soil texture may also be important because pine snakes are among the only snakes known to excavate their own hibernacula and summer dens. This species is considered historical, as no verified records exist for extant populations.

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 Chesapeake Forests. The Department has no immediate plans to reintroduce the species. CFL lands will be of critical importance to any reintroduction effort in the future. Critical habitat for Red-cockaded Woodpecker is pine savannah.

2.8 Plants of Special Concern

Swamp Pink – According to the USFWS, the Swamp Pink usually is one of the first wildflowers to bloom in the spring. The plant usually blooms from March to May. Its fragrant flowers are pink and occur in a cluster of 30 to 50. Its dark evergreen, lance-shaped, and parallel-veined leaves form a basal rosette, which arises from a stout, hollow stem. New Jersey supports the largest and most numerous populations of the species with 68 existing sites spread over 12 southern counties in the Coastal Plain area. Most of the populations are located along the Pinelands fringe in the Delaware River Drainage. Besides New Jersey, six other States support populations including Delaware; Maryland; Virginia; North Carolina; South Carolina, and Georgia. In Maryland's Coastal Plain, six plant populations are located on privately owned lands in Anne Arundel, Cecil, and Dorchester Counties. One other population has been extirpated. Swamp Pink occurs in a variety of wetland habitats. These include Atlantic white-cedar swamps; Blue Ridge swamps; swampy forested wetlands, which border small streams; meadows, and spring seepage areas. The plant requires habitat, which is saturated, but not flooded, with water. Swamp Pink is commonly associated with evergreen trees such as Atlantic white cedar, pitch pine, American larch and black spruce. The species appears to be somewhat shade tolerant and to need enough canopies to minimize competition with other more aggressive species. In areas with fewer canopies, deer are more likely to eat the plant's flowers, leaves, or shoots. The loss of wetlands to urban and agricultural development and timbering operations originally was the primary threat to the species. Now, State wetland and Federal endangered species protection laws have slowed the loss of wetlands, and the major threat to the Swamp Pink is habitat degradation caused by off-site disturbances. Some of these impacts include off-site water withdrawal for irrigation or crop production; discharge from sewage treatment plants; increased siltation from the inadequate control of soil erosion; and the introduction of excess nutrients or chemicals into the water. To alleviate the impacts of off-site disturbances, buffer zones may be established around protected habitat.

Sensitive Joint Vetch – Sensitive joint-vetch is native in freshwater to slightly brackish tidal marshes of the Mid-Atlantic States. It prefers the lower edge of the inter-tidal marsh zone, receiving daily inundations. The soil may be mucky, sandy or gravelly. Historically, sensitive joint-vetch was known from New Jersey, Delaware, Pennsylvania, Maryland, Virginia, and North Carolina. It is no longer found in Delaware or Pennsylvania. The Department reports sensitive joint vetch is found in Somerset and Wicomico Counties.

2.9 Plant Communities of Special Concern

***Xeric Sand Dunes**:* very well drained sand ridges deposited by historical flood tides. Sand Ridges support a variety of rare and threatened insect and plant species.

Delmarva Bays and associated life zones: isolated depressional wetlands that serve the needs of wetland breeding animals and support several species of rare plants

Riparian Swamps (Bald Cypress, Atlantic White Cedar)

Vernal Pools and Seasonal Wetlands: temporary wetlands present in late winter and spring that support amphibian reproduction

2.10 Game Species of Special Concern

Maryland first began licensing hunters in 1916, with hunting license sales peaking at 180,000 in the early 1970's. 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.

Approximately half of the Chesapeake Forest acreage is leased to hunt clubs. Club membership varies from a couple of people to greater than 30 people. Club leases are primarily for deer hunting. Other lease opportunities, depending upon the site, include waterfowl and quail hunting.

Wild Turkey – Wild turkey populations were established in the 5 County CFL areas within the last few decades. Turkey numbers increased steadily through the 1990's in the 5-county region that contained Chesapeake Forestland. In 1990 only 12 turkeys were harvested, that figure rose to nearly 1,000 in 2001 and has remained near or exceed 1,000 turkeys each season 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 CFL 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 5-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 5-county region. A coalition of federal, state and private partners have under taken 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 5-county region, Caroline, Dorchester, Wicomico, Worcester & Somerset (Figure 4). 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.

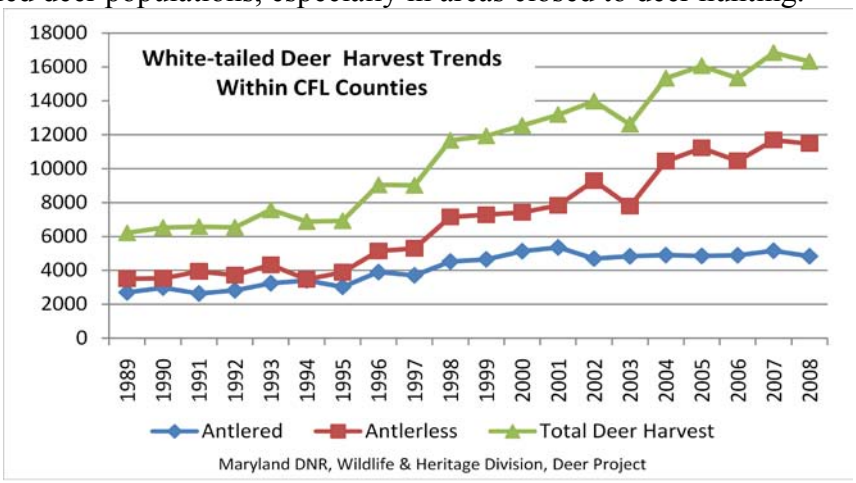


Figure 4: White-tailed deer Harvest Trends

White –tailed deer are a popular game species, but can over whelm their habitat unless populations are kept in check.

Sika Deer – Sika deer, a native deer of Asia introduced to Maryland in the early 1900's, inhabit marshes, swamps and associated Chesapeake Forest woodlands in Dorchester County (populations are also present on Assateague Island in Worcester County). The population appears to be stable and is controlled through hunting (Figure 5).

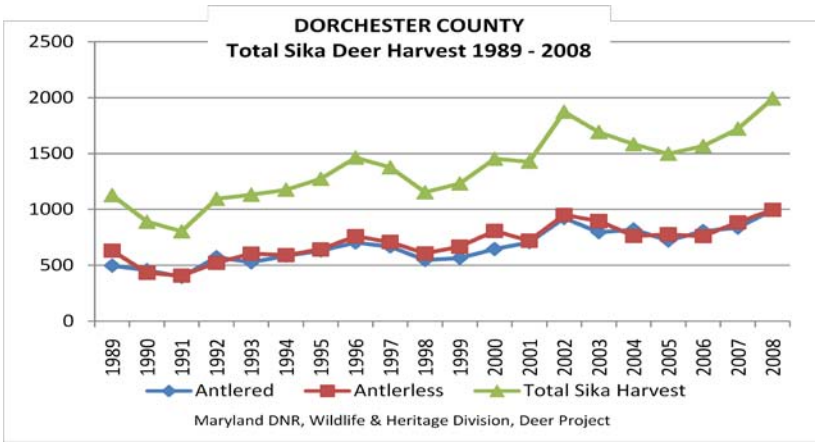


Figure 5: Hunting controls Sika deer populations.

2.11 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.

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 Chesapeake 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. Chesapeake Forest lands are important to woodcock as breeding and nesting areas. However, Chesapeake 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 Chesapeake 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 intensity of management on CFP 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 Chesapeake 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 flycatch, Worm-eating Warbler, Eastern Wood-pewee, and Louisiana Waterthrush. 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. Chesapeake Forest has 8,513 acres 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. Chesapeake Forest has 25,682 acres 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.

2.12 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 and 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 8 illustrates, non-industrial private owners own the majority of the forests on the Eastern Shore. With about 70 thousand acres moving from the "industry" column to the "public" column as a result of the Chesapeake Forests transaction, the industry share will decline significantly in the near future. If the Chesapeake Forests remain in sustainable forest production, the impact will be minor. If they were removed completely from production, it would be a significant local impact.

Table 8: Area of timberland by forest type and ownership group

		Eastern Shore			
Forest Type	**2**	**All Owners**	**Public**	Industry	NIPF*
			(Thousands of Acres)		
Loblolly& shortleaf pine		224.2	5.9	80.1	138.2
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
2	**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

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, 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 Chesapeake land 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 1989 the number of private forest owners grew from 95,800 to 131,000, increasing by about 2.7% per year. That calculates out to about 2,600 more owners each year. In 1976, 55% of the owners held less than 10 acres of forest; by 1989 that proportion had grown to 65%. What can be inferred from these trends is that over 2/3 of the forestland owners in the area are now essentially large-lot 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, as well.

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, there are several private consulting foresters who 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 use to bring just a few years prior, pulpwood prices however have remained stable.

The area now covered by Chesapeake Forest Lands supplied as much as 17% of the available annual pine harvest in the past, generating more than $2 million in internal return annually from harvesting about 3,000 acres / year. With multiplied values created by wood manufacturing facilities present in the area, this translates into $42 million in local forest-related outputs. This level of forest-related activity encourages private owners to keep land in forests because it provides reliable income for taxes and other land care costs. Conversely, the loss of such activity opens the field to competing land uses such as development.

The Department of Natural Resources will obviously have management approaches that differ from those of the previous industrial owner. There's likely to be more thinning and less commercial harvest to increase diversity, open up stands and create special conditions for wildlife. There will be more spent on special land treatments, monitoring and demonstration to meet the objective of serving as an example of state- of- the- art forest management.

Providing a level of harvests, even though heavy toward thinning remains an important activity for supporting a viable forest economy. The ability to sell wood is a major source of income for private owners who hold most of the Eastern Shore land. If markets for forest crops are present, owners have economic incentives to keep their land in forests. If not, they are motivated to look for other uses such as development, and then many key environmental functions of their forests are lost. Such an outcome, over time, could offset many of the environmental benefits of the Chesapeake Forest.

2.15 People and Forests on the Eastern Shore

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 (see above).

The first English settlers arrived in the mid-1600 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.

Fire and Its role In Shaping the Forests of the Region

The average pre-European-settlement fire frequency was on the order 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 (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 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

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.

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 Caroline county, which adjoins Sussex County, Delaware, and 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 9).

Table 9: Population characteristics of MD/DE compared to selected Eastern Shore Counties

STATE	Population 1990	Population 2000	Increase %	Age–19 or less % of total, 2000	Age– 20 to 64 % of total, 2000	Age– 65 + % of total, 2000
Delaware	666,000	759,000	14.0%	26.2%	60.8%	13.0%
Maryland	4,780,750	5,244,450	9.6%	27.9%	60.6%	11.5%
DELAWARE & MARYLAND	5,446,750	6,003,450	10.3%	27.0%	60.7%	12.2%
E. SHORE COUNTIES						
Caroline, MD	27,030	30,600	13.2%	28.3%	58.0%	13.7%
Dorchester, MD	30,230	30,350	0.4%	26.0%	56.9%	17.1%
Somerset, MD	23,440	25,000	6.7%	23.5%	61.3%	15.2%
Sussex, DE	113,800	143,000	25.6%	25.9%	55.0%	19.1%
Wicomico, MD	74,340	83,400	12.2%	29.1%	58.0%	12.9%
Worcester, MD	35,030	43,300	23.6%	23.6%	57.4%	19.0%

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. But 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 and 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 Chesapeake Forests can resist the pressures to be converted to other uses due to their conversion to 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 can't 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 the 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 condos 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 gets 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 five Maryland counties where Chesapeake Forest is located, populations are older and less affluent than the averages for their respective States (U.S. Census, 1998). This sets the stage for significant amounts of land turnover, fragmentation, and land use change in the coming decades. And 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

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 independent 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 Fox Squirrel 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.

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.

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 chapter 3, for additional characterization of Watersheds on Chesapeake Forest.

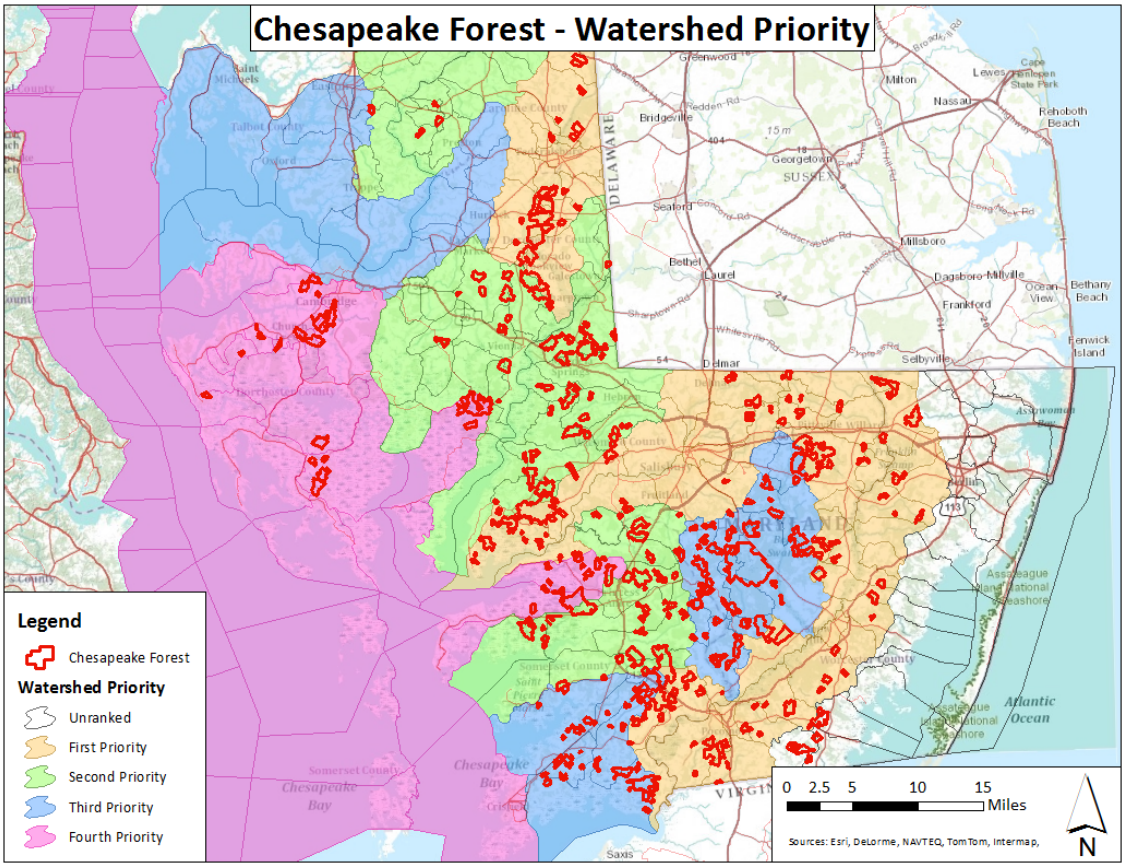


Figure 6: Watersheds on Maryland's Lower Eastern Shore, illustrating priority levels for restoration. (2013)

2.17 Water Quality Issues

Chesapeake Forest Lands play 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, Chesapeake Forest Lands contain a substantial amount of the industrial forestlands on the lower Eastern Shore and therefore are 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 Chesapeake 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 Chesapeake Forest lands are 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 Chapter 3 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. Chapter 5 has 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).

Species Migration

According to some of these studies, there are two major forest-related shifts that 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 more moist 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.)

Forest-Type Changes

The forest-type distribution in Maryland varies greatly--from the coastal plain to the Allegheny Mountains, ecosystems are quiet 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).

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 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 and others.

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.)

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 effect forest management on the Pocomoke State Forest and Chesapeake Forest Lands, affectively 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.

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 which 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 (DNR website)
http://www.dnr.state.md.us/climatechange/

Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change Phase I: Sea-level rise and coastal storms (July 2008)
http://www.mde.state.md.us/assets/document/Air/ClimateChange/Chapter5.pdf

Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change, Phase II: Building societal, economic, and ecological resilience (Jan 2011)
http://www.dnr.state.md.us/climatechange/climatechange_phase2_adaptation_strategy.pdf

CHAPTER 3

Chesapeake Forest - Resource Characterization

Chesapeake Forest Lands comprise approximately 67,772 acres of land involving some 454 original ownership tracts in 187 contiguous land parcels scattered across 6 counties on the Middle and Lower Eastern Shore of Maryland (Figure 7).

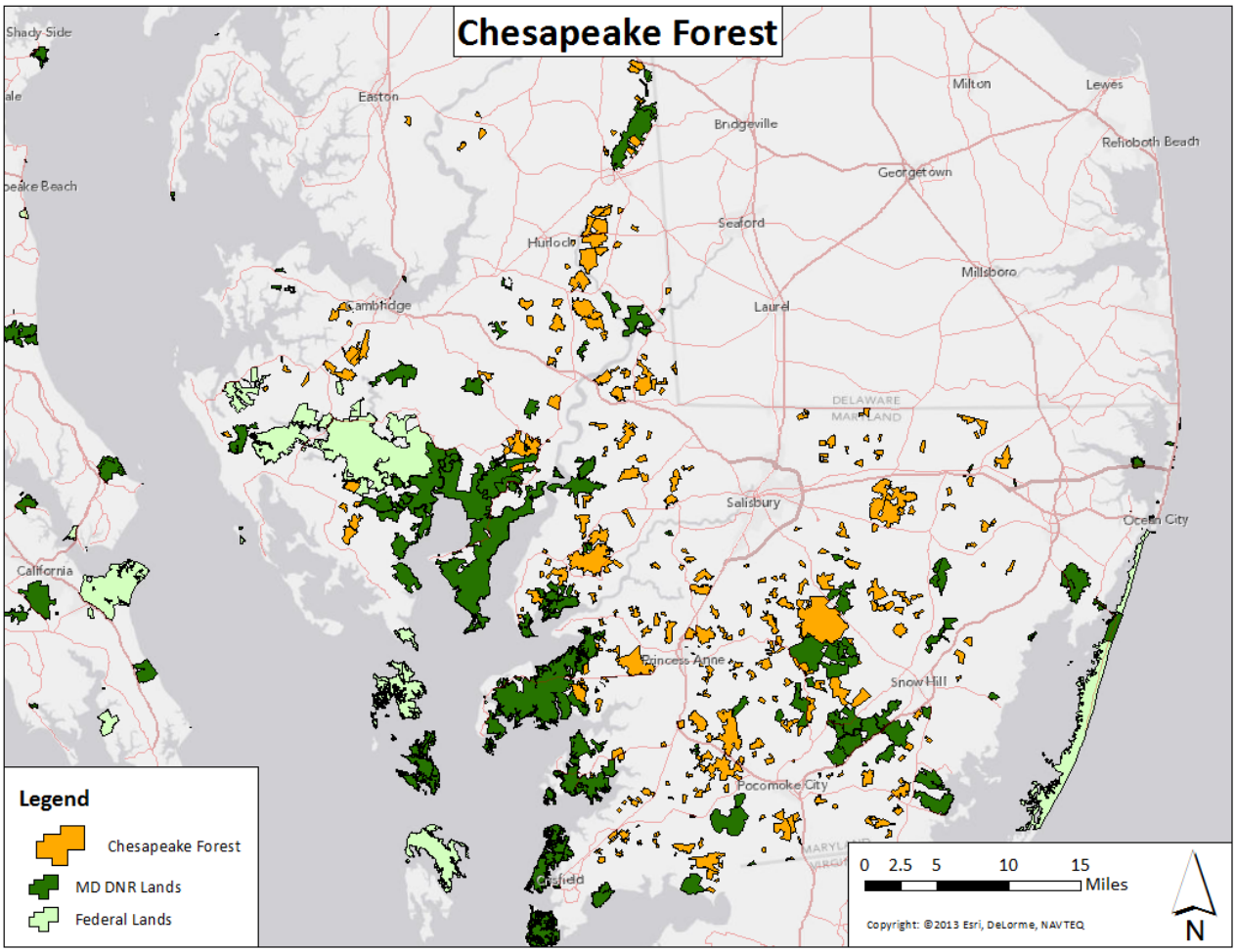


Figure 7: Chesapeake Forest Lands on the Lower Eastern Shore of Maryland. (2013)

3.1 The Forests

Young loblolly pine forest, mostly established since the early 1980's are what characterize a high proportion of Chesapeake Forest Lands, this is illustrated in Table 10. Mixed pine and hardwood forests still occupy some of the lands, and many riparian areas and flood plains contain stands of mixed hardwoods. In general, the mixed pine-hardwood and hardwood stands are older, mature forests. Table 10 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.

Table 10: Forest Diversity Analysis:

Acres of forest type and forest structure by structural groups, with percent of total area in each forest type/ structure group combination. (2013)

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 - 40 yrs	41 - 60 yrs	61+ yrs		
Atlantic White Cedar	4	2	1	0	0	0	0	**7**
(Percent)	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%
Loblolly Pine	635	7,322	20,141	14,812	5,177	702	555	**49,344**
(Percent)	0.94%	10.80%	29.72%	21.86%	7.64%	1.04%	0.82%	72.81%
Mixed Pine/Hardwood	591	447	304	748	1,147	4,611	14	**7,862**
(Percent)	0.87%	0.66%	0.45%	1.10%	1.69%	6.80%	0.02%	11.60%
Mixed Hardwoods	189	290	290	109	2,247	5,171	12	**8,308**
(Percent)	0.28%	0.43%	0.43%	0.16%	3.32%	7.63%	0.02%	12.26%
Marsh/Field/Power lines	2,251	0	0	0	0	0	0	**2,251**
(*Percent)*	3.32%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	3.32%
Total	**3,669**	**8,061**	**20,736**	**15,669**	**8,571**	**10,484**	**581**	**67,772**
(Percent)	***5.41%***	***11.89%***	***30.60%***	***23.12%***	***12.65%***	***15.47%***	***0.86%***	***100.00%***

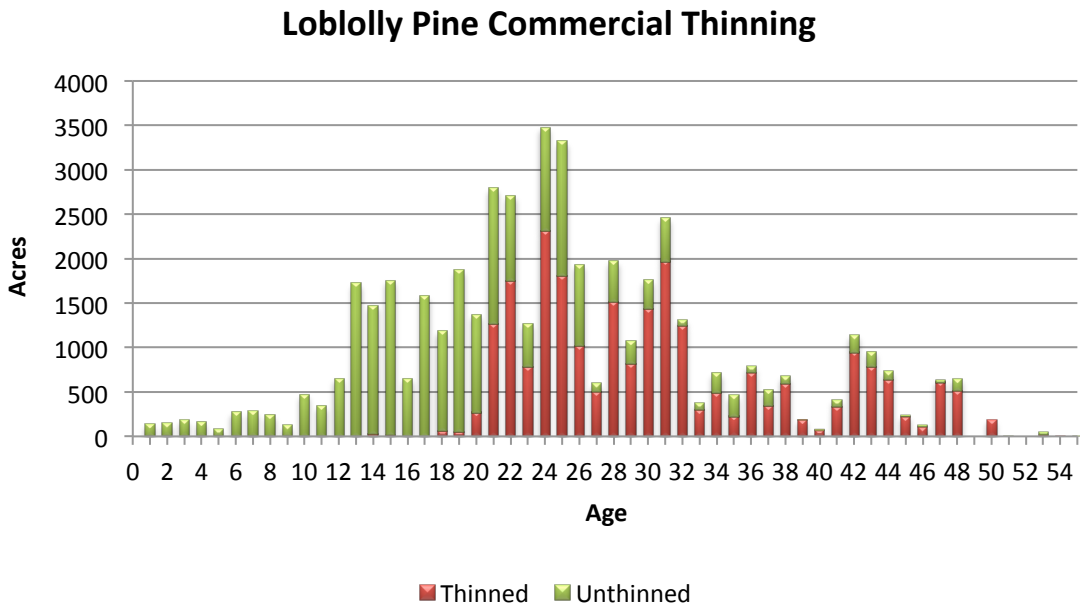


Figure 8: Age distribution of pine plantations on Chesapeake Forest Lands, (2013)

Figure 8 shows in the older age classes within the next 15 years, there would be some modest acreage of loblolly pine available for final harvest. First thinning of pine plantations is usually scheduled around age 14 to18 and the chart shows there are still several hundred acres eligible for first thinning. This trend should continue into the near future as younger stands move into this age class. A majority of the pine stands will now be held for longer rotations, and with second thinning generally occurring in the 25 to 35 year age range, a fairly significantly increase in this practice will occur 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.

Chesapeake Forest Land has no identified Old Growth stands, however on the recently acquired Foster Tract in Worcester County areas of "nearly old growth forest" may exist. The portion of the Foster Tract where these stands may exist has been set aside as a candidate Old Growth Management Area. This "candidate" old growth management area will be inventoried in the near future to determine if stands of nearly old growth exist. If areas of potential old growth are located they will be mapped and then surrounded by a 300 foot buffer.

The goal on Chesapeake Forest is to provide areas for future Old Growth Forest by managing the riparian forest buffers as described in Chapters 5 & 7. Where possible these Riparian Forest buffers will be connected to larger areas (Old Growth Management Areas) that contain the identified nearly old growth forest. This process is fully described in Appendix J *"Management Guidelines for the Conservation and Protection of Old-Growth Forest"*. Also see Chapter 5 for management guidelines for the identified "nearly old growth forest areas.

3.3 Forest Production

The original Chesapeake Forests Land holdings had been managed for industrial forest production for decades, and were a major contributor to the region's forest products industry. Now under sustainable management by the State, these lands will continue to provide a significant amount of forest products to these local industries. Currently there are five Pine Sawmills and two pulpwood-chipping operations that provide an outlet for timber from local forests, which are largely isolated from outside markets by water and distance.

Chesapeake Forest covers approximately 11% of the productive forests in the 6 counties (Table 11). In the past these lands produced about 15% of the annual timber harvest in the region, mostly in the form of pulpwood. In 2011 the combined Chesapeake and Pocomoke State Forest produce 25% of the total harvests that occurred on the lower six counties of the eastern shore, a significant number that the Department will endeavor to maintain in order to support local economies.

Table 11: Chesapeake Forest Lands as % of the forest area by county (2013)

County	*Total Area acres	*Total Forest acres	Chesapeake Forest acres	CFL as % of Total Area	CFL as % of Total Forest
Caroline/Talbot	377,200	107,300	1,422	0.4%	1.3%
Dorchester	356,900	137,600	14,058	3.9%	10.2%
Somerset	209,400	87,800	17,229	8.2%	19.6%
Wicomico	241,400	115,400	17,389	7.2%	15.1%
Worcester	302,900	156,700	17,674	5.8%	11.3%
Totals	1,487,800	604,800	67,772	4.6%	11.2%

*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 9). The Chesapeake 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.

3.1 Watersheds

Chesapeake Forest Lands contribute to 23 watersheds draining into the Chesapeake Bay, and comprise 10 to 25% of the forestland within many of the drainages identified as high priority for conservation action by the Maryland Clean Water Action Plan (Table 12).

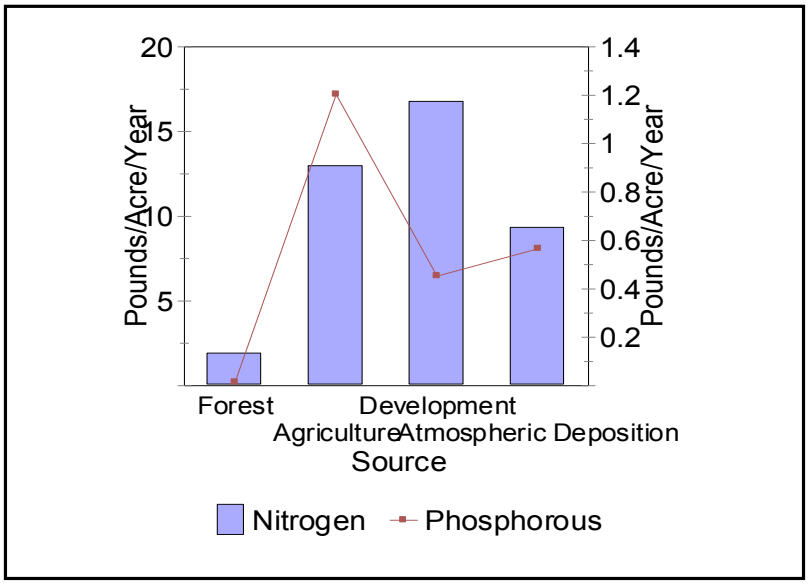


Figure 9: Contribution of nitrogen & phosphorous to tidal waters from land uses in the Chesapeake Bay. Source: EPA

Table 12: Lower Eastern Shore Watersheds Priority Rank - % Forest Cover & % of Forest Cover on CFL (2013)

Watershed	Rank*	Forest Area	Total Area	% of WS in forest	Chesapeake Forest Acres	CF as a % of forest
Marshyhope Creek	1	29,751	78,727	38%	6,040	20%
Lower Pocomoke River	1	57,456	101,315	57%	6,716	12%
Upper Pocomoke River	1	50,770	95,550	53%	5,876	12%
Wicomico River Head	1	10,395	24,941	42%	772	7%
Lower Wicomico River	1	27,914	79,771	35%	4,343	16%
Upper Choptank	2	48,790	163,447	30%	322	1%
Manokin River	2	27,577	74,312	37%	5,861	21%
Nanticoke River	2	47,569	127,594	37%	8,713	18%
Wicomico Creek	2	10,753	19,963	54%	1,375	13%
Transquaking River	2	24,529	70,933	35%	1,319	5%
Nassawango Creek	3	31,376	43,877	72%	6,886	22%
Big Annemessex River	3	9,424	29,819	32%	737	8%
Dividing Creek	3	31,112	39,700	78%	5,811	19%
Pocomoke Sound	3	14,926	46,061	32%	3,784	25%
Lower Choptank	3	29,431	195,690	15%	150	1%
Fishing Bay	4	40,307	130,088	31%	4,482	11%
Little Choptank	4	23,734	69,683	34%	1,230	5%
Monie Bay	4	9,924	29,580	34%	2,182	22%
Chincoteague Bay	0	17,478	89,300	20%	1,173	7%

- 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.

3.2 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 for forestry activities is seldom a problem, given reasonable management care. Seasonally wet conditions affect the timing and type of forest management activities. For management activities on the Forest, the soils in the region were classified into 5 Soil Management Groups (SMG), based on soil characteristics. (*See Appendix: E 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 (SMG's) 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 was utilized from the USDA Natural Resources Conservation Service for Talbot, Caroline, Dorchester, Wicomico, Worcester, and Somerset Counties. Soil layers for Caroline County were digitized under contract

with Towson University. Tabular data from the USDA NRCS was used in Caroline County to supplement the digitized layer.

When the current land cover was compared to the soil survey data, it was clear that the majority of Chesapeake Forest Lands occur on SMG's 1 and 2 (Table 13). 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 Forest, 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 (2013)

SOIL MANAGEMENT GROUP	CURRENT COVER - ACRES						
	Loblolly Pine	Mixed Pine/Hdwd	Hardwood	Cutover	Other	Non-Forested	Total
0 - Not Rated	2	0	11	0	0	99	112
1 - Wet, firm sub-soils	24,016	2,990	2,448	42	348	439	30,283
2 - Wet, non-firm sub-soils	17,101	3,706	2,831	184	7	194	24,023
3 - Most favorable	3,172	217	464	14	2	202	4,072
4 - Sandy, dry	3,978	642	507	25	62	94	5,307
5 - Very wet, floodplains	1,075	307	1,432	2	205	955	3,975
TOTALS	49,344	7,862	7,692	267	624	1,984	67,772

Another cross-comparison was done to see how well the current identification of riparian forest buffers and wetlands 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 14). 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 Riparian Forest Buffers/Wetlands (2013)

Soil Management Group	Current Identification - Acres		
	Not rated	Riparian Forest	Wetland
0 - Not Rated	74	24	15
1 - Wet, firm sub-soils	27,291	786	2,206
2 - Wet, non-firm sub-soils	21,060	1,202	1,761
3 - Most favorable	3,255	243	574
4 - Sandy, dry	4,693	326	288
5 - Very wet, floodplains, etc	2,672	814	489
Total (includes roads, etc.)	59,044	3,395	5,333

3.3 Management Areas and Units

To facilitate management planning of Chesapeake Forest Lands, the properties were grouped into Management Areas and Management Units. A Management Area is defined as the geographic area within the boundaries of a county. Within each of these management areas, management units were defined as contiguous properties made up of formally individually deeded CFL tracts plus any newly acquired properties 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 15 reflects the identification of the 6 Management Areas and 187 Management Units.

Table 15: Chesapeake Forest Land – Management Areas & Units (2013)

Management Area	Individual Deeded CFL Tracts	Management Units	Total Acres	Loblolly Pine Acres
Caroline	10	7	1,300	920
Dorchester	59	29	14,058	9,467
Somerset	167	54	17,229	14,576
Talbot	1	1	122	32
Wicomico	166	53	17,389	13,367
Worcester	61	43	17,674	10,983
Totals	**464**	**187**	**67,772**	**49,344**

One of the management challenges inherent in the land base is that, in spite of the attempts to create the most manageable units, there are many small, isolated properties. There are 62 management units that are 99 acres or less in size (Table 16).

Table 16: Management Unit Statistics by Size (2013)

Size Class	Count	Ac Sum	Ac Avg.	Min	Max
0-49	26	898	34.5	8	49
50-99	36	2,644	73.5	51	99
100-149	26	3,162	121.6	101	149
150-249	33	6,157	186.6	153	243
250-499	33	11,836	358.7	251	487
500-999	17	11,128	654.6	506	940
1000-1999	12	17,413	1451.1	1045	1968
2000+	4	14,534	3633.6	2686	4940
Total	187	67,772	362.4	--	--

Eighty-eight (88) of the management units on Chesapeake Forest are less than 150 acres in size. Most of these areas adjoin or are surrounded by agricultural or developed land.

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 number of small parcels and their inter-relationship with adjacent private landowners will combine to make their management very comparable to that which is experienced by many non-industrial private landowners. The Department must weigh the effects of various management activities as they may affect adjoining properties and seek to always 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 that Chesapeake Forest plays in transferring technical knowledge to private forest land owners. Maintaining these working landscapes contributes to the survival of the Forest Products industry, local markets and other infrastructure (logging crews, mills, etc.) and keeps resources available to private landowners thus reducing the need to convert land to uses.

CHAPTER 4

Land Management Area Guidelines

4.1 Land Management Areas

Due to the large size and diverse landscape of the lands in this project, this plan will not make specific prescriptions for every Chesapeake Forest parcel. Rather, the planning team identified specific areas based on physical attributes that need to dominate future management decisions.

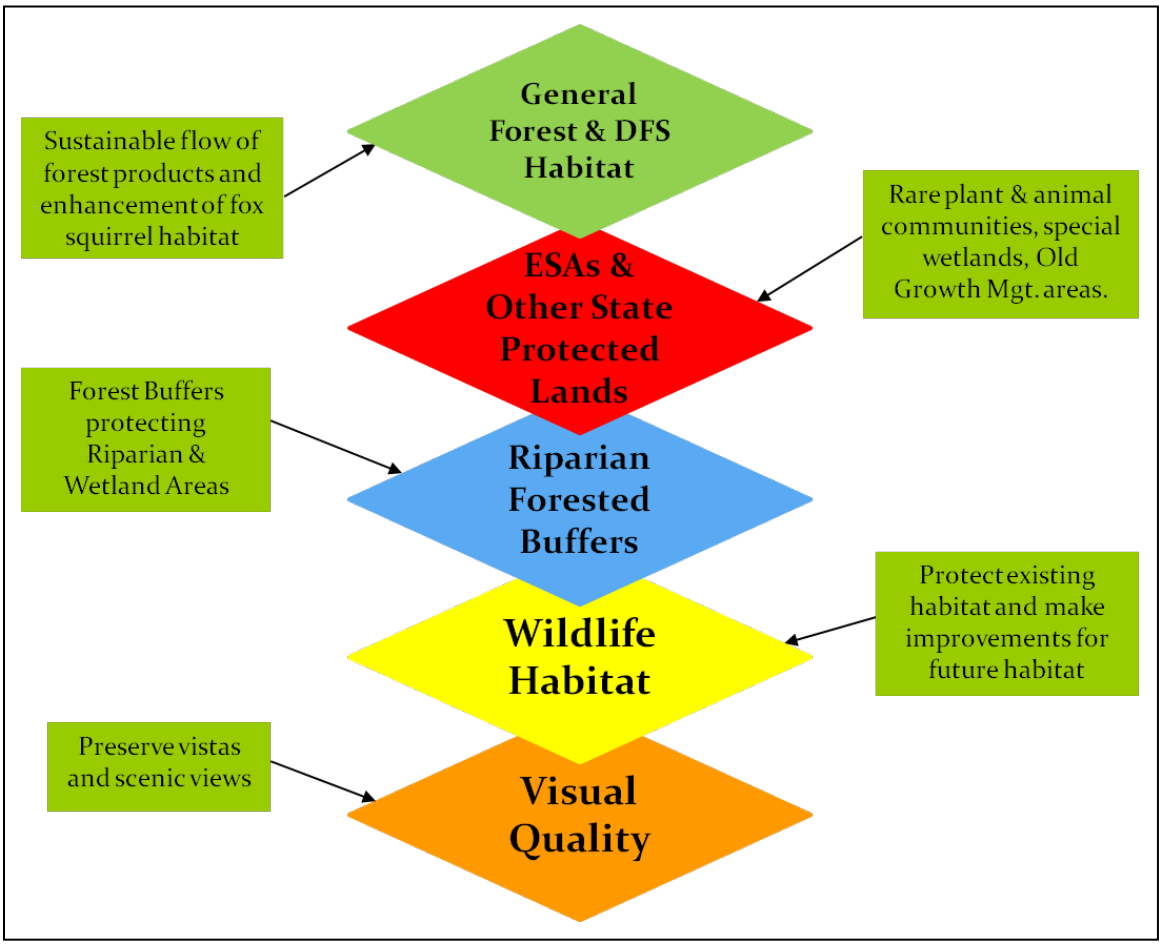


Figure 10: How special areas are added to the landscape to build a complex mosaic of managed lands.

Figure 10 illustrates the sequence of identifying these areas for planning purposes, many of which overlap each other. Beginning on top, the general forest management area is first constrained by identifying the ecologically significant areas (ESA's) 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 on the basis of 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 chapter 5 for additional information.

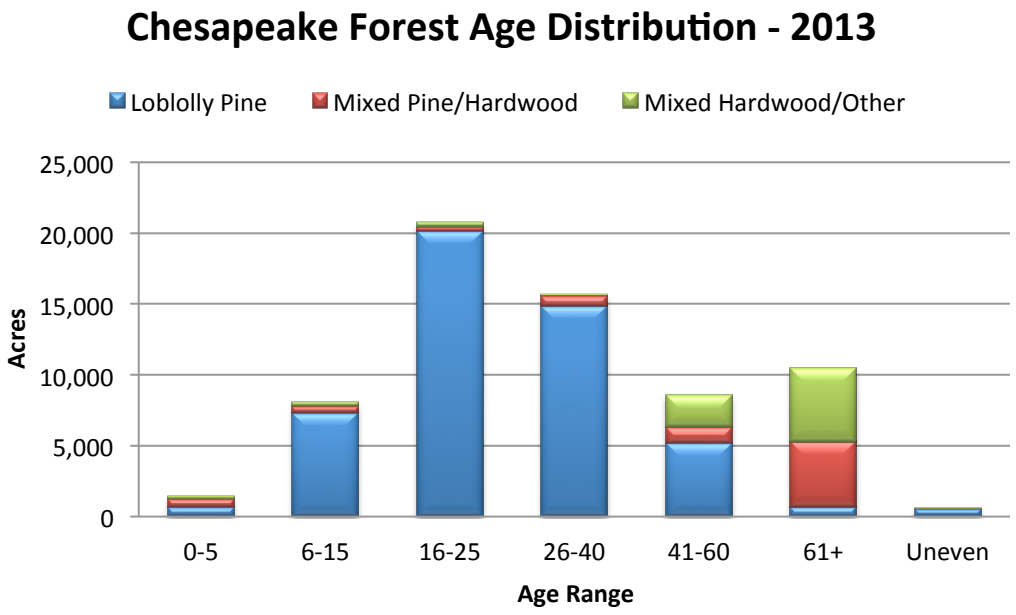
4.2 General Forest Areas

One of the goals of this project is to maintain an economically sustainable forest and contribute to the local economy through providing forest-related employment and products.

At the time of the land transfer in 1999-2000, the Chesapeake Forest Lands had a high proportion of pine plantations—80% of the entire forest. The majority of these plantations were very young (47% under the age of 15 years, and 80% under 25). This meant that much of the early-year management was limited to mid-rotation thinning and vegetation control. Increasingly, as these stands have aged, additional opportunities for second thinning and some final timber harvest have become possible, and will become more common in the future (Chapter 5). One of the problems this age distribution has created, however, is that with final harvest levels so low for several years, site preparation and planting work was also minimal. What that means is that we are creating another "age gap" that will plague future managers. Part of that has been addressed by forcing some early harvests as a means of getting new stands started, but working to even out these age gaps is a continuing challenge.

At the current time, the two largest age ranges are 16-25 and 26-40, the prime age for commercially thinning the pine stands. (Figure 11) With over 35,000 acres in these two age groups, it will require some 2,500 – 3,000 acres of thinning each year to catch these stands before they begin to experience stress from density.

Figure 11: (MFS 2013)



While most of the general forest lands are in loblolly pine plantations, there are also areas of mixed hardwoods, cutover stands with some merchantable trees remaining, and some mixed pine-hardwood stands within the general forest management areas (Chapter 5). As it becomes feasible, these areas will be worked toward pine or pine-hardwood stands that can contribute to future management goals.

4.3 Ecologically Significant Areas (ESA)

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 Heritage Division. A breakdown on the locations and description of the special sites that have been identified on the Chesapeake Forest Lands can be found in chapter 7.

4.4 Forested Riparian Buffers

Three hundred foot (300ft.) 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 these 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 the Chesapeake Forest Lands, from endangered Delmarva Fox Squirrels (DFS) 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 a 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 (FID's) and Delmarva Fox Squirrels (DFS). Timber harvesting, when conducted, will be done by selection harvests designed to maintain adequate canopy cover and relatively undisturbed forest conditions. Chapters 6 and 8 outlines the goals and guidelines for these areas.

4.6 Visual Quality Areas

These are areas that 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 4% of Chesapeake Forest Lands. They consist primarily of roads, railroads, transmission lines, agriculture fields, legal drainage ditches and their access roads. In addition a large proportion of the area is in open Marshes. The latter 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 and trees can sometimes be provided through agreements with hunting club licensees or contractors. Roads that are not needed for fire or emergency access should be considered for closure.

These open areas are the most susceptible to invasion by exotic species. Forest management personnel need to be watchful for such invasions and, where possible, eradicate them as soon as they are found.

CHAPTER 5

Forest Management

The main objective for Forest Management on the Chesapeake Forest is to maintain a sustainable and economically self-sufficient forest. This is to be achieved by including objectives that provide for clean water, soil stabilization, support for populations of native plants and animals, protect areas with critical functions or habitats, sustain compatible economic uses and provide for scenic, recreational and educational values. Accomplishing these objectives will be done through implementation of the Annual Work Plan.

5.1 Priority Management Layers & High Conservation Value Forest (HCVF)

In order to meet the objectives stated above, a determination had to be made on the various levels of forest management activities that could occur across the entire Chesapeake Forest. To accomplish this goal DNR Wildlife & Heritage Service completed a GIS analysis in January 2006 detailing all the special habitat areas on the Forest. This process resulted in the identification of four priority management/HCVF areas, they are in priority order: Ecologically Significant Areas (ESA), Riparian Forest Buffers which are 300 foot stream buffers, Core Forest Interior Dwelling Bird habitat (FID) areas including Core Delmarva Fox Squirrel habitat (DFS) and five potential DFS translocation sites. *Note: The term "CORE" is defined as area that contains the species to be protected.*

The concept for HCVF is to insure that existing fragile and unique ecosystems are managed to maintain their indentified conservation attributes. The identification of the unique values of each priority management/HCVF area along with the prescriptive management protocols was a collaborative effort between the DNR - Forest Service and the Wildlife and Heritage Service. Within ESA areas only zones 1&2, the Core FID's and in the DFS areas only DFS Core & potential translocation areas will be include in the HCVF designation, see chapters 6 & 7 respectively for additional details. In most cases, these special habitat\HCVF areas do not prohibit timber harvest activities, but instead utilizes forestry management operations to enhance the habitat.

Table 17: Priority Management Layers (2013)

Management Layers		
	Total CF Forest Area	
Designation	Acres	%
ESA Zone 1 & 2, G3 Comm.	7,807	11.5%
Forested Riparian Buffers	3,562	5.3%
Core FIDS & DFS Core	20,339	30.0%
DFS Future Translocation	3,628	5.4%
ESA Zone 3	5,895	8.7%
DFS Future Core	7,647	11.3%
General Mgt. Area	18,894	27.9%
TOTAL	**67,772**	**100.0%**

In Table 17, the acreage listed for each area is based on the priority of that management layer. For example, ESA areas zone 1 & 2 have the highest priority for habitat management, a specific ESA area may also contain some Core DFS or FID's habitat acreage and Forested Riparian Buffers, but the priority for management is for that ESA species. On the contrary the acreage listed for Forested Riparian Buffers may contain Core FIDS & DFS Core, but will not include any ESA zone 1 & 2 acreage. The acreage listed for General Mgt. Area in Table 17 is for acreage on the forest that is not impacted any of the six listed priority habitat areas.

5.2 Forest Types & Silvicultural Practices– Chesapeake Forest Lands

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

Non-Forested Lands

Included in the non-forested types, are 1,145 acres of open marsh & swamps, and 636 acres of power lines, agriculture fields, PDA right-of-ways. Ecosystem restoration harvests that will be maintained as brush or open cover comprise 237 acres of the Chesapeake Forest. The Chesapeake road system comprises 360 miles of main access roads and side feeder roads, which amounts to approximately 45 acres of open land. Road edges & roadside ditches will be maintained in herbaceous vegetation with mowing and control of invasive species occurring on two to three year intervals. Approximately 3.1% of the forest is in this forest type.

Forested Swamps with mixed hardwoods, bald cypress and Atlantic White cedar

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 such as Atlantic White Cedar. There is 2,528 acres in this forest type or 3.7% of the forest area.

Mixed pine-hardwood, hardwood-pine and mixed hardwood forests

These forest types will be managed toward mature stands of mixed hardwoods and pine. This will be done with commercial thinning, selection harvesting and small-opening harvests designed to encourage regeneration of desired native species, such as oaks, loblolly pine and short-leaf 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, and fertilizers will not be used outside of test plots where mixed forest is the management objective. Prescribed burning may be used to manage for a specific species. Natural regeneration will be the preferred method used to reestablish the forest after harvesting. There is 13,715 acres in this forest type or 20.2% of the forest area. 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.

Loblolly Pine Forest

This forest type is made up of loblolly pine plantations and naturally regenerated loblolly pine forest. Other tree species mixed in this forest type are a variety of gums, maples, oaks, Virginia pine and some Short leaf pine. There is about 49,466 acres in this forest type or 73% of the forest.

The loblolly pine plantations will be intensively managed to maintain an annual flow of forest products. Silvicultural activities will involve Commercial thinning operations followed by a Clear-cut Regeneration Harvest or a 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 naturally occurring loblolly pine and mixed pine stands will be managed to maintain the naturally occurring species mix. Silvicultural activities will involve commercial thinning operations followed by regeneration harvesting either by the seed tree, shelterwood or clearcut method. In order to maintain and or reestablish certain pine species such as short-leaf pine, prescribe burning may be used to manage for this species. In most cases natural regeneration will be the preferred method to reestablish the stand, some hand planting of shortleaf pine may be done to insure the species mix in this forest type is maintained.

5.3 Forest Management Guidelines

The above four forest types have been categorized into five different management classifications. These different management classifications take into account all ecologically significant areas on the forest. Acreages listed under the different classifications are only estimates that will change over time as field reviews add or remove areas for one management classification to another. The management areas are as follows: 1) General forest management areas; 2) Ecologically Significant Areas (ESA); 3) Core Forest Interior Dwelling Birds (FIDS) areas; 4) Delmarva fox squirrel (DFS); and 5) Riparian Forest Buffers.

The following are the management guidelines for the 67,772 acres of Chesapeake Forest Lands, see table 15 at the end of Chapter 7 for acreages.

General Forest Management Areas:

General Forest Management areas are those sites unconstrained by other more demanding management restrictions. It is important to note that production of forest products in no way precludes the contribution from these lands to other forest functions such as recreation, habitat, and water quality. In the general management areas, the loblolly pine forest will be managed on a 30-40 year rotation for a mixture of saw logs and pulpwood. In the early years of implementing this plan, it may be necessary to harvest some younger stands, as this is the only way to re-distribute stand ages so that the current preponderance of 5-25 year-old stands does not become a recurring problem in future management rotations.

Loblolly pine forest within the general 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. In this forest type, wildlife habitat will be early and mid-succession habitat that provides structural diversity within the array of mixed forest stands and riparian, wetland, and wildlife buffers.

Ecologically Significant Areas:

Portions of a number of the ESA management areas overlap DFS, 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 Chapter 7 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 zone 1 & 2 areas have been designated as High Conservation Value Forest (HCVF).

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 to 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 singletree 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 FID areas have been designated as High Conservation Value Forest (HCVF).See Chapter 8 and Appendix F: FIDS/Forestry Task Force Timber Harvest Guidelines for more detailed explanations.

Delmarva Fox Squirrel (DFS) Habitat:

DFS Core Areas are defined as a complex of Chesapeake Forest Lands currently occupied by Delmarva Fox Squirrels. DFS Future Core areas are defined as a complex of Chesapeake Forest and Pocomoke State Forest lands where location, vegetative composition and structure appear suitable for translocation of DFS. *(Note: The majority of Pocomoke State Forest (PSF) is located in Worcester County where it adjoins several Chesapeake Forest (CFL) parcels. Currently there have been no sightings of DFS on Pocomoke State Forest in Worcester County, however PSF is managed under the same sustainably guidelines and standards as CFL and so has been included as a valuable addition to DFS Future Core recommendations. The Pocomoke State Forest Sustainable Management Plan contains the same DFS Core & Future Core management guidelines as noted below.)*

In all 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 are held on the landscape for a longer period of time. 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 being designated to meet the 50% suitable habitat requirement will be marked and tracked within the stand table database for Chesapeake Forest. A final harvest cannot be carried out within these designated areas until they reach a stand age of 60 years and there is 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 Future Core management areas must maintain a minimum of 800 acres of suitable DFS habitat within a 1,600 acre area at all times for future translocations. The 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 also provide sufficient habitat for potential translocation sites.

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 for critical habitats and other functions that enhance water quality, riparian buffers have been designated as High Conservation Value Forest (HCVF). See Chapter 6 Water Quality Areas: High Conservation Value Forest for specific guidelines on the functions of the various water quality and habitat zones that comprise the expanded stream buffer.

5.4 Management of Existing Loblolly Pine Plantations

The General Forest Management area will have management activities geared towards maintaining the various stages of succession for loblolly pine, utilizing natural regeneration where appropriate to increase species diversity within plantations. With plantations in the other four management areas described above, natural regeneration will be a major factor in restoring key areas to natural forest cover.

5.5 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 Chesapeake Forest Lands no Old Growth Forest exist, however there is one area on the recently acquired Foster Tract along with the Cox Farm tract that may contain areas 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 J 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 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 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 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.

On Chesapeake Forest Lands there are two "Candidate" Old Growth Management Areas that have been identified. The two candidate old growth management areas cover a total of 1,502 acres. Of that amount 211 acres are on the Cox Farm tract in Worcester County and is part of a larger area that falls on the adjoining Pocomoke State Forest. The other site containing 1,291 acres is located on the Foster Tract also in Worcester County. 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 areas 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 J) 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, road less areas greater than 500 acres or that have unique attributes, and primary forests.

5.6 Other Special Management Areas

A number of special areas on the Chesapeake Forest lands 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 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.

5.7 Forest Management Activities

Regeneration & Site Preparation

Either natural regeneration (seeding from remaining seed trees or adjacent stands) or artificial regeneration will be used to re-establish loblolly pine stands in accordance with Maryland's pine tree reforestation law. Both methods of regeneration will seek to reduce soil disturbance associated with site preparation practices, such as shearing, piling, bedding, ditching, etc. Bedding will be avoided in soil management group 2. 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 will improve seedling growth and survival. In the past shear-pile-bed followed by artificial regeneration was used on approximately 75% of the regeneration acres. Currently, the practice is rarely used and is slated for acreage where no other alternative is available to re-establish a productive forest. The overall goal is to continue to reduce and eventually phase out the use of shear-pile-bed in favor of other forest management practices, such as prescribed fire, natural regeneration and or straight planting, herbicides and other less intensive mechanical prescriptions.

Vegetation Control

Outside of ESA, Core FID, DFS and 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.

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.

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 will be a crucial tool in areas managed for Delmarva Fox Squirrels (DFS). Thinning from below in these areas will result in bigger trees over the life of the stand. Thinning operations should leave a minimal residual basal area of about 70 to 80 sq. ft. per acre unless another management target is prescribed for a specific habitat or silvicultural goal. Any such change in a DFS management area must be approved by the DNR interdisciplinary team through the annual work plan (AWP) process.

On all Thinning operations excessive rutting shall be minimized. Thinning operations should be suspended when wet soil conditions cause rutting in excess of 8 inches over more than 5% of the corridors. See the State Forest Policy Handbook for detailed information on Rutting Guidelines for Forest Operations.

Forest Buffer Thinning

Riparian and wetland forest buffers (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 buffers 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.

Regeneration Harvest

Loblolly pine is intolerant of shade, and regeneration is best on sites with exposed mineral soils and full sunlight. Clear-cut harvesting provides the optimum conditions for subsequent stand establishment. Clear-cut harvesting on upland loblolly pine forest 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: Plantations,* and will include "Green Tree" retention areas in keeping with Forest Stewardship Council (FSC) standards. Guidelines for clear-cut harvest 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. Clear-cut harvests will not be done until adjacent stands have reached the age of 3 years or an average tree height of six feet, in keeping with the SFI standard. Regeneration harvest in Delmarva Fox Squirrel (DFS) management areas must follow the specific management guidelines outlined in Chapter 8.

On all regeneration harvest excessive soil rutting shall be minimized. On sites where soil rutting can cause erosion or sedimentation ruts should not to exceed twelve (12) inches in depth on average, over a distance of 50 feet. 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. See the State Forest Policy Handbook for detailed information on Rutting Guidelines for Forest Operations. For harvesting on any wetland soils, high floatation equipment should be used in place of conventional harvesting equipment. Also 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.)*

Green Tree Retention

During the original development of the Sustainable Forest Management Plan in 1999 and over the following years forest managers used a locally developed practice Habitat Retention Areas (HRA) to define forested areas and or single trees that were set aside for long-term protection within a regeneration harvest. This revision to the 2007 Sustainable Management Plan is intended to clarify this practice and to replace the phrasing *Habitat Retention Area* utilizing the widely 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 the Chesapeake 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 be 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 steams 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 then 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 an area to persist in until the surrounding landscape is able to regenerate.

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 G). 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 Chesapeake Forest lands 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. In implementing these projects, close collaboration between the DNR Land Manager and the Contract Land Manager can result in training for fire management staff, use of specialized equipment, and reduction of costs. 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 BMP's.

Fertilization

All lands are required to have nutrient management plans before fertilization can occur. As part of nutrient management, all loblolly pine forest considered for fertilization will have soil tested, and the amount, content, and chemical formulation of fertilizers will be based on soil and plant needs to minimize the chance for over-application. Fertilizers will be only be used in the General Forest Management areas on a very limited basis, as part of the effort to improve forest health and economic return, and will be accompanied by monitoring of growth, soil fertility, ground water

nutrients, and surface water impact. They will not be used on areas designated as High Conservation Value Forest, special management areas, or on the mixed forests. If water quality monitoring shows that fertilization of certain soils creates a meaningful increase in N or P to adjacent waters, those soils will be added to the areas where fertilization will not be used.

5.8 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, both in scheduling harvests and for thinning operations that are listed in the annual work plans (chapter 11).

5.9 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 be done 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 insure 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). In addition a variety of Watershed improvement projects will be implemented to improve water quality, restore wetland functions and create habitat for wildlife (See Chapter 6).

For a variety of legal, environmental, safety, and operational reasons, access to Chesapeake Forest roads along with permitted activities on the Forest will be controlled in accordance with Chesapeake Forest regulations that have been developed and are listed under DNR COMAR title 08.01.07. Gates will be installed, maintained, and well marked. Incursions on Chesapeake Forest land (such as dumping or unauthorized construction of temporary structures) will be monitored and dealt with promptly using legal sanctions if necessary.

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 Chesapeake Forest Lands, any road construction (even temporary access trails) will follow State BMP guidelines. 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 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, which includes the DFS habitat areas, should provide sustainable economic performance as well as contribute to water quality protection and wildlife habitat enhancement. Over the next decade, financial returns from timber will be fairly low. This is due only to the young age of the plantation stands, and is not a function of the management plans approach to environmental protection or sustainable forests. 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

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.

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 and maintenance of relatively stable economic flows back to the state and counties.

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. 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 data base can be maintained to serve ongoing forest planning, management, and information needs. The model runs 50-year projections within the estimated 250-year life span of the main tree species involved. Longer projections are possible, but at somewhere between 80 and 100 years, the capacity of ordinary office computers is reached with a model of this size and complexity.

Modeling the Chesapeake Forest Management Plan 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 and, because the management plan depends heavily on thinning young loblolly pine stands to maintain forest health and achieve rapid growth, it is necessary to know when and how each stand is thinned. The model also differentiates between natural and planted loblolly stands because they have different treatment needs. A detailed Forest Model on Chesapeake Forest Lands that contains a number of graphs based on the indicators listed in this section can be found in Appendix K.

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 (*See Chapter 10 - Chesapeake Forest Monitoring Plan*). An inventory and monitoring program is also one of the important aspects of the Forest Certification program (*See Forest Certification below*).

In 2004 a forest inventory was completed on Chesapeake Forest that established baseline information using the methodology for Continuous Forest Inventory developed for State Forest lands in Maryland. From this data various forest models were run to determine long-term sustainability of the various management practices. Future inventories of the forest will be done on a ten year cycle. One of the goals of the inventory and monitoring program is that Chesapeake Forest will be utilized as a living laboratory that will provide insight on the health and vigor of local forests, measure the effectiveness of various management approaches, and provide useful data for future planning and management. See Appendix K on Modeling Long-Term Sustainability.

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, 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, Section 10. *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 or species increases or declines can be detected. Because of the heavy emphasis on providing additional habitat for Delmarva fox squirrel, particular attention should be paid to the impact of these activities on those populations.
- 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.

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, special efforts will be made to utilize the Chesapeake Forests Project as a learning laboratory on these matters. Part of that effort will involve seeking out independent third-party partners such as Universities and non-profits like Chesapeake Bay Foundation, to share in the monitoring effort, conduct research, and utilize the management actions on the land as an ongoing scientific experiment.

Timber Harvests

As part of the adaptive management program for Chesapeake Forest Lands, the land manager will ensure that for each harvest operation a pre-harvest plan is developed and a post harvest BMP inspection report is prepared and maintained on file. An important aspect to protect water quality on timber harvest sites is to insure a certified Master Logger carries out the harvest operation. Chesapeake 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 water courses 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.

Fertilizer and Herbicide Applications

As part of the adaptive management program for Chesapeake Forest Lands, the land manager will maintain records of tree growth, application rates, soil nutrient levels, and vegetative community to track the effect of fertilizer and herbicide applications. If streams\blue line ditches occur within 300 feet of the spray or fertilized site, periodic stream monitoring upstream and downstream of the target stand will be carried out both before and after the treatment.

Minimum effective levels of herbicide application have been evaluated to determine useful rates for managing for mixed pine-hardwood stands. The region has abundant regeneration of sweet gum 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 also are favored for their mast-bearing ability and wildlife habitat desired for current wildlife habitat objectives. Vision Forestry, LLC conducted an herbicide rate trial on E. Mace Smith tract for determining effect of reduced spray rates on hardwood regeneration, to determine if spray rates used would produce the desired goal of retaining oaks and suppressing the gum and maple less desired for wildlife habitat or

products. Baseline data was collected on tree and seedling composition in thinned tract where five rates (control, 7, 8, 10, and 12 oz./acre) of herbicide were applied to blocks of the tract. The 12 oz. rate was the previous standard used on Chesapeake Forest prior to the trial. The 8 oz. rate is now more commonly used, based on these experiences of fairly good suppression of the more susceptible maples and gums and only moderate damage to oaks, desired for long-term wildlife habitat. The sample blocks were partially burnt in a wildfire, precluding long-term analysis of the site.

The typical application method on CFL for herbicides is aerial spraying of an Arsenal tank mix, leaving 150 foot or larger spray buffers around waterways. Water sample testing was used on the Smullen tract to insure that the 150 foot spray buffers provided adequate protection in preventing herbicide introduction into water bodies. On this tract, lower rates of herbicide where used along with standard aerial application methods including GPS registration of the spray block. Water samples were collected within one day and then two weeks of herbicide spraying on October 3, 2003. USGS procedures manuals were used for sampling protocols, and samples were labeled and transported on ice. Analysis was conducted at the Maryland Department of Agriculture, Maryland State Chemist's Lab in Annapolis. Quality assurance steps were followed to insure that any possible contamination of the field samples could be detected. This included filling blank samples with distilled water in the field to insure that chemical contamination was not occurring through field procedures, transport or handling. The results on the Smullen tract showed no trace of imazapyr, which is the active ingredient in Arsenal. These results include the four sample locations on the day after spraying and at two of the locations for the two-week sampling period the other two areas no longer had surface water present.

Annual Plan Performance Reporting

Monitoring and reporting of annual plan implementation should occur at several levels. All silvicultural activities will be recorded, including acreage treated, costs, starting and ending dates for the activities, and any outputs of wood or other products. This information is critical for monitoring contract compliance, adherence to planned activity levels, cost reporting, and as a source of feedback for operational and strategic planning efforts. For the Contract Land Manager the data will be summarized and included, along with a complete financial report, in quarterly reports. The Department's Land Manager will be responsible for producing an annual report that summarizes all activities on the Forest. The results of other monitoring efforts, for example water quality, wildlife trends, or soil fertility levels will be reported periodically, and a report on annual monitoring activities, their costs, and important findings, will be included in the fiscal year annual report developed by the Department's Land Manager.

5.14 Forest Certification

A primary objective of Chesapeake Forest Lands is to become a national model of certified sustainable forestry. To meet that objective Chesapeake Forest Lands combined third-party certification under both the Sustainable Forestry Initiative (SFI) standard and the Forest Stewardship Council (FSC) standard. In the spring of 2005 dual certification under these two standards was achieved for the entire Chesapeake Forest, compliance with certification is monitored through annual audits. See Appendix: C & D for details on the two certification programs.

Certification Guidelines Premise:

It is the Department's belief that an independent review and certification of the Chesapeake Forest management plan 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/SFC certification process was on the gifted portion of the Chesapeake Forest utilizing the management plan that came as a condition of the gift. Combined certification on this portion of the forest was obtained in the spring of 2004. In 2004 planning efforts began to bring the entire property under dual certification through a redeveloped Sustainable Management Plan. By the spring of 2005 the effort was completed when dual certification was achieved for the entire 59,000 acre forest. In June of 2007 and again in February of 2009 the previous certification was modified during the annual audit to include additional acreage identified in this current version of the Sustainable Forest Management Plan. As part of the process in maintaining the dual certification, follow-up annual audits/inspections will continue. An annual Senior Management Review will also be conducted, as per SFI requirements (see "Appendix I – Policy for SFI Management Review and Continual Improvement"). The Chesapeake Forest project remains committed to resolve any audit issues that hinder us in obtaining and or maintaining SFI/SFC certification.

Forest Stewardship Council (FSC) – Guidelines & Principles of Importance

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 in to the CFL 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.

High Conservation Value Forest (HCVF) Definition Guidelines:
Three of the six types of High Conservation Value Forests as identified within FSC Principle 9 will constitute the definition for HCVF on Chesapeake Forest. They are:

- (HCV1) Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values (e.g. endangered species on CFL are ESA Zone 1&2).
- (HCV3) Forest areas that are in or contain rare, threatened or endangered ecosystems. (Core Delmarva Fox Squirrel and Core Forest Interior Bird habitat)
- (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 C.

The Chesapeake 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 CFL\PSF citizen advisory committee. A summary of activities completed in HCVF can be found on the CFL website under the monitoring tab as "Activity Summary by AWP".

Representative Examples of Existing Ecosystems

In Chapter **5.3**, there are five identified management areas on Chesapeake Forest that 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) are listed in Chapter 7, the Core Forest Interior Dwelling Birds and the DFS Occupied Sites 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 FID's areas, management of the natural forest will focus on creating old growth stands.

Inclusion of Riparian Forest Buffers as High Conservation Value Forests

Including riparian areas as HCVF clarifies protection and future management regimes for areas that are crucial to water quality, habitat diversity and the connectivity of wildlife habitat and hydrology. The definition was derived from both Maryland's most prominent natural feature, the Chesapeake Bay, and from the original goal for acquiring the Chesapeake Forest (SFMP page 1), which states: *"The goal of this transaction was and continues to be to retain the property as a working forest that will be managed in a conservation-minded way to provide forest products, local employment, and recreation opportunities* ***while protecting or improving the water quality and habitat value of the lower Chesapeake Bay watershed****."*

The Department of Natural Resources recognizes the important role that these riparian forests play in the protection and conservation of our treasured Chesapeake Bay. Furthermore, it is DNR's ultimate goal to positively enhance the Chesapeake Bay and its associated local economies through the conservation of these important forest lands. The riparian forests provide a connective link between many other protected and sensitive areas (ESA, DFS, FIDS, etc.) on Chesapeake Forest. Approved management activities and restrictions can be found in Chapter 6 of the SFMP: *Water Quality Areas: Riparian Forest Buffers and Wetlands*

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's for these reasons that these areas have been designated as High Conservation Value Forest (HCVF) since they provide connectivity from the Chesapeake Forest Lands through other public and private forestlands to the Chesapeake Bay. The identification and maintenance of High Conservation Value Forest fall under Principle 9 of the Forest Stewardship Council (FSC) guidelines see appendix "C" for information on this certification program.

There are approximately 6,000 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 RFB's, mark boundaries, and provide GPS coordinates for updating the GIS data system.

By and large, 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 the Chesapeake Forest Project lands. 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.

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.

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; following best management practices (BMPs) and complies with all state and local regulations.

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 BMP's 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.

Herbicide and Fertilizer Use

No fertilizer or aerial application of herbicides should be permitted within riparian forests. If aerial spraying or fertilizing 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 Chesapeake Forest Project 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 E)*. 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)

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 (BMP's) and comply with all state and local regulations.

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.

Herbicide and Fertilizer Use

No fertilizer or aerial application of herbicides will be done within wetlands. If aerial spraying or fertilizing is planned for stands adjacent to a riparian forest, 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.

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 BMP's 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 blue line streams as indicated on the USGS maps. Establishment of additional 300 foot buffers will include other riparian areas that once examined through field review are determined based on evidence of stream function 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 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 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. The first 50 feet from the stream bank is a no-cut area regardless of current species composition, to avoid destabilizing stream banks. The remaining 250 feet 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 and 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 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 also 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 (Fig. 12) 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. 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).

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.

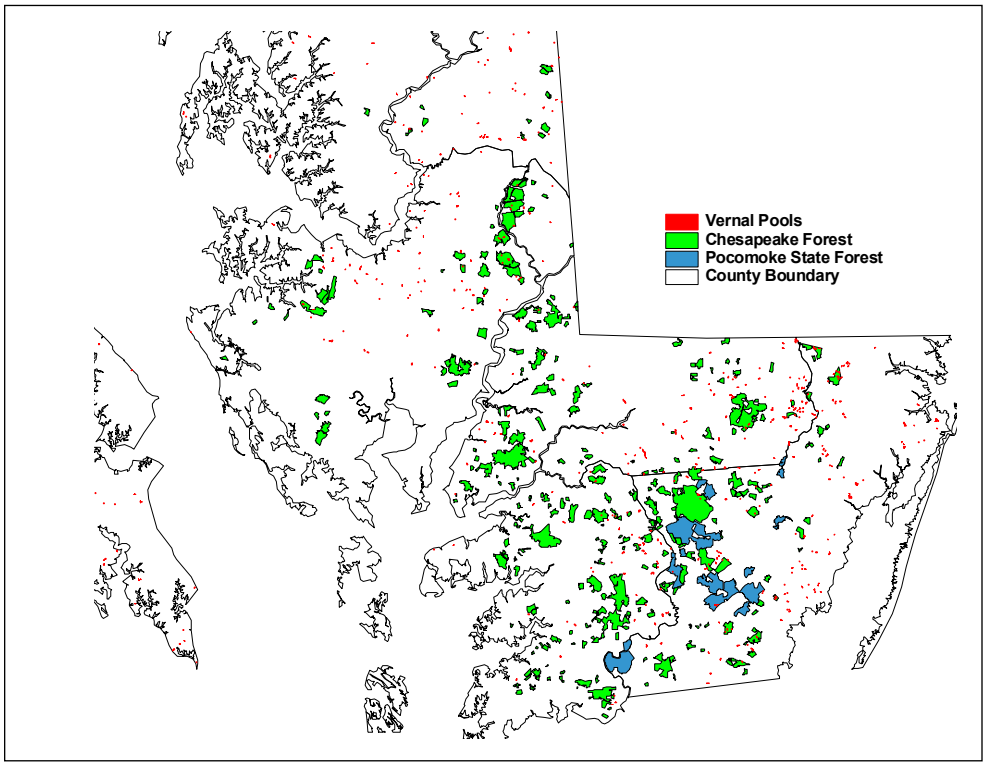


Figure 12: Vernal Pools on the lower Delmarva Peninsula and Chesapeake Forest tracts. (2010)

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.

Vernal Pool Conservation and Management Prescriptions

Due to their complex bi-phasic life history, vernal pool breeding amphibians are biologically
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** (Fig. 13)**.**

***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 Heritage with possibility of a "one-time only" harvest of some areas by Forestry, but this will be on a case-by-case basis.

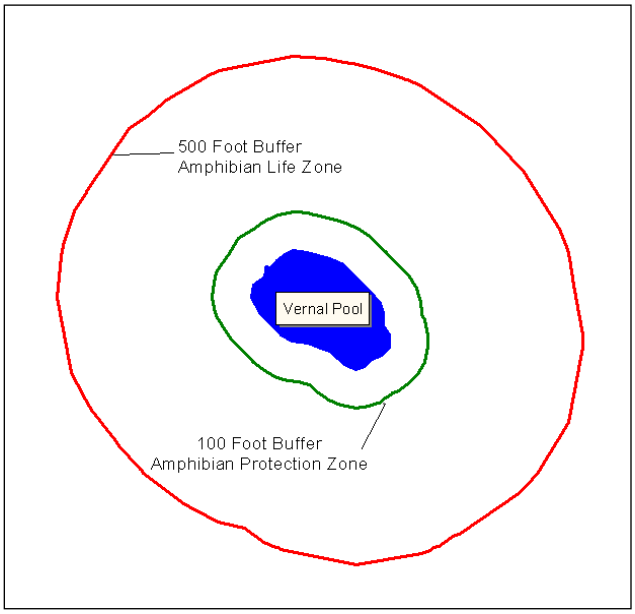


Figure 13: Amphibian buffer zone around a vernal pool

Zone 2 (Forestry responsible for management with input from Heritage): This area will be called **Amphibian Life Zones** (Fig. 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 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 Heritage): This will be called the **Vernal Pool Connectivity Zone – Special Case** (Fig. 14): 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 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.

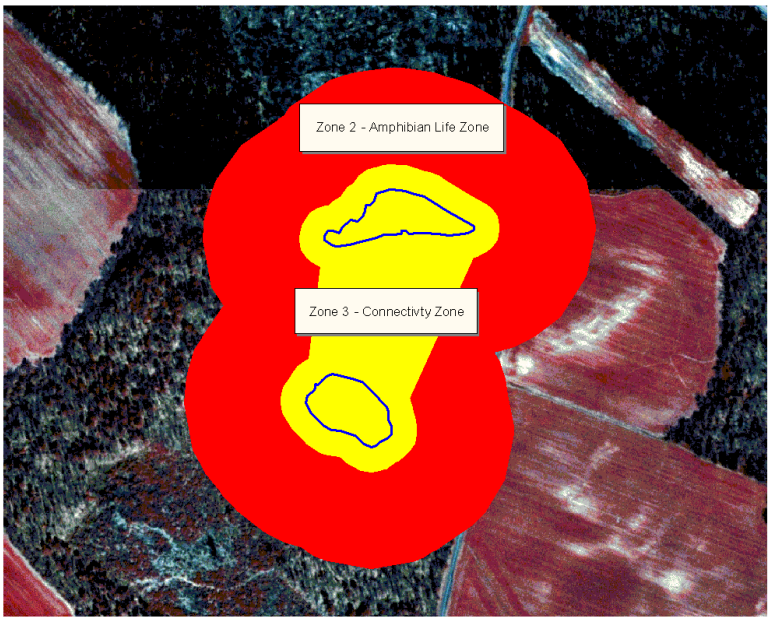


Figure 14: Vernal Pool connectivity zone for amphibian conservation

6.7 Watershed Improvement Projects

One of the primary objectives for Chesapeake Forest Lands is to ensure that clean water flows out of the forest, which in turn will help to improve water quality flowing to the Chesapeake Bay. In addition, Chesapeake Forest provides opportunities to improve water quality with its connectivity to other land uses, such as agricultural land or developed land, that generally produce greater amounts of nutrients, sediments, and other substances that can harm aquatic ecosystems. By restoring altered stream and wetland hydrology, re-establishing connections between streams and floodplains, and enhancing stream habitat, pollutants can be filtered before entering downstream aquatic systems. See Appendix L "Framework for Identifying Water Quality Improvements" and for a listing of all proposed and completed projects.

Watershed Improvement Project Evaluation Process

1) A Watershed Improvement Project (WIP) evaluation process was developed to identify specific locations and features within Chesapeake Forest that potentially provide opportunities for watershed improvement. This process consists of the following steps:
2) A preliminary analysis was done through reviewing 1999 aerial photographs and tract maps, along with GIS maps of streams, ditches, and wet areas. This evaluation resulted in an identification of potential watershed improvement projects and their location.
3) A group of resource professionals with expertise in the area of watershed improvement and wetland creation was developed to evaluate the feasibility of potential watershed improvement projects.
4) Using the preliminary list of projects as a guide, this group has been conducting field reviews to determine if and what type of watershed improvement project is feasible. Factors such as the effect on neighboring properties, soil type, topography, and access are considered in this evaluation.
5) If the field review determines that a project warrants further consideration demonstrates merit, a conceptual design is developed for review by the interdisciplinary (ID) team as part of the Annual Work Plan process or, if necessary, as a separate review.
6) If the ID team is supportive of the concept, a detailed design is developed and reviewed by the ID team.
7) Following this approval, permits and funding are secured and the project is implemented.

Watershed Improvement Practices

The following practices will be the primary watershed improvement techniques used to enhance pollutant removal capabilities and improve aquatic habitat on the Chesapeake Forest Project lands:

1) **Low berm** – a low earthen berm constructed across a ditch to restore or enhance natural hydrology in order to maximize water detention time thereby increasing the retention of sediment, wetland diversity, and denitrification. Low berms will be targeted for forest ditches with connections to existing stream or wetland systems and agriculture ditches. In order to hold water, the berms must be constructed of fine-grained material and therefore will be limited to Soil Management Groups 1 and 2.
2) **Ditch plug** – where ditches exist in coarse-grained material, ditch plugs can be constructed by collapsing ditch banks and filling the ditch with the excavated material. The ditch plug will restore the natural hydrology to the area increasing the time and frequency of saturation and reducing flow velocity. This will increase denitrification and the retention of sediment as well as increase vernal pools. Ditch plugs will be constructed on forest ditches with connections to existing stream or wetland systems and agriculture ditches.

3) **Woody debris** – In channelized streams lacking sufficient woody debris, root-wads, tree trunks and large limbs may be added to increase structural diversity to enhance aquatic habitat and to provide opportunities for the retention of sediment.
4) **Riparian planting** – where adequate riparian vegetation or diversity of understory species does not exist along streams, native riparian communities will be established to improve in-stream habitat, to stabilize stream banks and to increase surface roughness to encourage sedimentation.
5) **Storm water wetland** – an excavated area adjacent to channelized streams into which storm flows are directed by a flow splitter or a diversion structure. The purpose of the storm water wetland is to retain storm water flows to encourage the retention of sediment, plant uptake, and denitrification, as well as create wetland habitat. Excavation activities will be coordinated with harvesting and thinning operations to avoid unnecessary clearing. The storm water wetlands will be designed to hold storm water flows without affecting overall discharge rates or upstream drainage. A key consideration in the planning of storm water wetlands is proper disposal of the excavated material.
6) **Water control structure** – a structure place in a channelized stream or ditch to impound water to a certain height and then release it downstream. Installation of water control structures in entrenched streams and ditches will create pools to encourage the retention of sediment and denitrification. Water control structures will be used in selective occasions as a last resort and only under appropriate circumstances.

6.8 Identified Watershed Improvement Projects

As part of the effort to improve water quality and aquatic habitat on Chesapeake Forest Lands an evaluation process was followed and resulted in the identification of several feasible projects as well as a number of potential projects. A listing of the proposed improvements projects can be found in Appendix L of this document.

- All proposed projects are located on Chesapeake Forest lands the work involves the restoration of former wetland areas, the enhancement of existing wetland and stream restoration. This will be accomplished by reestablishing and enhancing, wetland and stream function. The primary goal of each of these projects is to improve the quality of waters leaving Chesapeake Forest property. The secondary goal of these projects is to enhance wildlife habitat.

6.9 Water Resources – Human Consumption

The Department recognizes that while water is the keystone of healthy natural ecosystems, it also contributes to the economic prosperity and social stability of human communities. Based on this recognition, the Department is currently developing a policy on leasing State-owned water resources. This policy will address municipal, agricultural and recreational uses for water withdrawn from State land, and should be followed when considering such requested uses of water withdrawal from Chesapeake Forest land.

Literature Cited for Vernal Pools *(Section 6.6)*

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CHAPTER 7

Ecologically Significant Areas (ESA's)

6.1 Ecologically Significant Area (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. ESA's are areas that harbor or could potentially harbor rare, threatened or endangered (RTE) species and/or unique natural community types.

On Chesapeake 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.*

In addition to the main criteria (RTE species and unique natural communities) used for establishing ESAs, other criteria were also used to assist in determination of ESA boundaries. These included: topography and geomorphology (based on U.S. Geological Survey topographical quads and geology maps); hydrology (based on National Wetland Inventory and State wetland maps); soil types (based on U.S. Department of Agriculture soil surveys); expanded stream buffers for Forest Interior Birds (FIDS), Delmarva Fox Squirrels (DFS) and water quality; expanded wetland buffers for conservation of amphibian life zones; existing Wetlands of Special State Concern (WSSC) and associated buffers; existing Natural Heritage Areas (NHAs) as designated by state law; surrounding land uses (houses, farms, etc.); and wildlife travel corridor linkages.

Following a thorough analysis, ESA boundaries were delineated using ArcView, a geographic information system (GIS) software program. Digital geo-referenced layers for most of the above criteria were used. The ESA boundaries are now a part of the CF database used for planning and review purposes. In addition to the GIS exercise, a wide range of species experts also evaluated the alignment of the established ESA network to ensure that the ecological criteria were accurately applied. Since the initial GIS effort for the original Chesapeake Forest Sustainable Forest Management Plan (MDNR 2005), the Natural Heritage Program conducted an exercise to develop management zones and prescriptions for ESAs (Smith & Knapp 2006) to simplify management designation for each acre of CF so that each management category on the entire CF would have distinct, non-overlapping map units (Table 20). We also conducted an exercise to integrate GIS maps of all expanded stream buffers, core FIDS management areas, DFS management areas, and general management zones into an overall map for the entirety of CF, which will be discussed in more detail in the next section.

ESAs presently comprise approximately 14,063 acres or about 21.1% of the entire forest (Table 27, page 199). Some ESA boundaries will expand over time or entirely new ESAs will be delineated, both based on the discovery of new rare resources. Conversely, some ESAs may be removed from the list based on new knowledge or changed legal status of a particular species. ESA boundaries in many cases overlapped FIDS and DFS management zones, so part of the 2006 project was to define discreet, non-overlapping map units where ESAs, FIDS, DFS, or expanded stream buffers took management precedence. Timber management is still possible in most ESAs, but in some cases (Zones 1 and 2; expanded stream buffers) may be a "one-time only" occurrence or irregularly timed

and only in the context of managing for sensitive resources. We believe implementation of this management regime will achieve the definition of a sustainable forest, providing balanced ecological and economic benefits.

6.2 ESA Management

The goal of ESA management is not only the maintenance of existing rare species habitat, but 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 RTE's. 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 hydroperiods 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) **Estuarine Forests**, limited to Fishing Bay ESA in Dorchester County, which include naturally occurring (vs. planted) loblolly pine forests bordering tidal marshes. This ESA is also a NHA and supports DFS.
4) **Emergent Wetland:** typically seasonally flooded wetlands dominated by herbaceous vegetation that include RTE plants, reptiles and amphibians.
5) **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.
6) **Sandpit:** man-made basins that due to hydroperiod and other factors support RTE plant communities.
7) **Complex**, for those ESAs including >1 major natural community or ESA type.

Management zones (**1, 2 or 3**) within ESAs were delineated in Arc View GIS 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 (Heritage, Forestry or both) responsible for implementation of management. The resulting ESA management zone boundaries and expanded stream buffers within ESAs were clipped in Arc View so there were distinct, non-overlapping map units. ESAs were then clipped to CF boundaries, so the GIS product would only display management areas on CF. Additionally, outside of ESAs all expanded stream buffers, core FIDS management areas, and DFS management areas were clipped into non-overlapping map units (following hierarchy of stream buffer=FIDS>DFS) within CF. 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.

Zone 1: contains RTE species and high quality natural communities plus buffer.
This area is usually to be managed by Heritage, with site-specific restoration plans developed and implemented. However, at times Heritage will identify specific areas within Zone 1 where

Forestry can conduct an economic harvest, typically on a "one-time only" basis. This zone should not be included in sustainable forestry acres.

Zone 2: used solely to describe a secondary management area for Delmarva Bays, i.e., "life zones" for amphibians (Semlitsch 1998). 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 management of this zone with input from Heritage.

Zone 3: ***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 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 Heritage, the Forest Manager and the State Nursery Manager.

6.3 Management Zone Definitions & Prescriptions by ESA Category & Zone

Delmarva Bay ESAs

Zone 1 (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 Non-tidal Wetlands of Special State Concern under MD Non-tidal Wetland Protection Act of 1990 (COMAR 08.05.04.01.23). Note: there is one exception to this rule: Seth Forest ESA. Zone 1 was extended to all of the property except for a loblolly pine plantation in the upper northeast corner (this latter area became Zone 2) due to the presence of a G1 species in the seasonal wetlands there and most of the property already is high quality natural hardwood forest, a rarity on CF.

Management: Site-specific restoration plans developed by Heritage. Heritage may allow "one-time only" harvest of some areas by Forestry, on a case-by-case basis.

Zone 2 (Forestry responsible for management with input from Heritage): Amphibian Life Zones – from Zone 1 to 500 feet from the wetland edge (based on Semlitsch 1998).

Management:
1) Saw timber rotations. Natural regeneration is the preferred method; however the planting of native genotype hardwoods and pines (preferably pond, pitch and/or short-leaf pine), where appropriate, may be conducted after consultations between the Forest Manager and 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% or more 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.

Zone 3 (Forestry responsible for management with input from Heritage):

Management:
1) Saw timber rotations with the preferred regeneration harvest being clearcuts.
2) Natural regeneration is the preferred method; however the planting of a mixture of native genotype hardwoods and pines (preferably pond, pitch and/or short-leaf pine), where appropriate, is permitted after consultations between the Forest Manager 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.

Riverine Swamp Forest ESAs

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 (see CFL Sustainable Forest Management Plan); also Chesapeake Bay Critical Area Commission 1986, 1999; U. S. Fish and Wildlife Service 1993).

***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). Loblolly pine plantation 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 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; the only exception being if cutting is necessary to control insect outbreaks after consultation with MDA Forest Pest Specialist and Heritage. *There is no Zone 2 or 3 for this ESA Category*.
NOTE: This management prescription should be followed for expanded stream buffers on all of CF as specified in the SFMP (MDNR 2005).

Estuarine Forest (limited to 1 ESA: Fishing Bay)

Zone 1 (no management). Consists of the Savannah Lake NHA and a WSSC, based on these state regulations this is a no-cut zone.

Zone 3 (Forestry responsible for management): remainder of ESA.
***Management*:** follow the SFMP (MDNR 2005). Maintain a minimum of 50% of the area as suitable DFS habitat. *There is no Zone 2 for this ESA Category.*

Sandpit ESAs

Zone 1 (Heritage +/or Forestry responsible for management): extends to 100 feet from the high-water mark (based on WSSC regulations).

***Management*:** 100-foot no-cut buffer measured from high-water mark, except for potential "one-time only" harvest of some areas by Forestry, on a case-by-case basis. *There is no Zone 2 for this ESA Category*.

Zone 3 (Forestry responsible for management with input from Heritage):

Management:
1) Saw timber rotations with the preferred regeneration harvest being clearcuts.
2) Natural regeneration is the preferred method; however the planting of a mixture of native genotype hardwoods and pines (preferably pond, pitch and/or short-leaf pine), where appropriate, is permitted after consultations between Forest Manager 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.

Sand Ridge ESAs

Zone 1 (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 only. No site preparation. No hardwood control except as recommended by Heritage. Planting of native genotype short-leaf, pitch and pond pine, and/or selected hardwoods is possible.
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. *There is no Zone 2 for this ESA Category.*

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

Management:
1) Saw timber rotations with the preferred regeneration harvest being clearcuting.
2) Natural regeneration is the preferred method; however the planting of a mixture of native genotype hardwoods and pines (preferably pond, pitch and/or short-leaf pine), where appropriate, is permitted after consultations between the Forest Manager 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.

Emergent Wetland ESAs

Zone 1 (Heritage +/or Forestry responsible for management): wetland supporting RTEs plus a 100-foot buffer.

***Management**:* Site-specific restoration plans developed by Heritage. Heritage may allow "one-time only" or continual harvest of some areas by Forestry, on a case-by-case basis. This ESA type requires maintaining early successional habitats. *There is no Zone 2 for this ESA Category*.

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

Management: Shorter rotations to maintain early successional habitats.
1) Pulpwood rotations with a first thinning (age 15–19 years) and a final regeneration harvest at 25-35 years. The shelterwood or seed-tree harvest method may also be used to aid in pine regeneration.
2) Natural regeneration is the preferred method; however the planting of a mixture of native genotype hardwoods and pines (preferably pond, pitch and/or short-leaf pine), where appropriate, is permitted after consultations between the Forest Manager and Heritage on species selection during the Annual Work Plan review process.
3) There will be no mechanical site preparation, prescribe burning will be allowed as a management tool.

Complex ESAs

Zone 1 (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 and legally mandated NHAs.

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

Zone 2 (Forestry responsible for management with input from Heritage):

Management:
1) Saw timber rotations. Natural regeneration is the preferred method; however the planting of native genotype hardwoods and pines (preferably pond, pitch and/or short-leaf pine), where appropriate, may be conducted after consultations between the Forest Manager and 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% or more 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.

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

Management:
1) *Designated Pulpwood Management Areas:* Pulpwood rotations with a first thinning (age 15–19 years) and a final regeneration harvest by 25-35 years. The shelterwood or seed-tree harvest method may be used to aid in pine regeneration.
2) *Designated Saw Timber Management Areas:* saw timber rotations with the preferred regeneration harvest being clearcutting.
3) Natural regeneration is the preferred method for both designated management areas; however the planting of a mixture of native genotype hardwoods and pines (preferably pond, pitch and/or short-leaf pine), where appropriate, is permitted after consultations between the Forest Manager and Heritage on species selection during the Annual Work Plan review process.
4) There will be no mechanical site preparation, however prescribed burning will be allowed as a management tool.

6.4 Prescribed Burning within ESA's:

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 Heritage for recommendation as to type and location of fire lines Forestry will contact Heritage within 48 hours preceding a prescribed burn on an ESA.

6.5 Use of Herbicides/Pesticides within ESA's:

As a policy, chemicals will not be used in Zones 1, 2 or 3 to control hardwoods; exceptions to this policy will be done only after consultation between the Forest Manager and Heritage. The use of chemicals to control other invasive species within each Zone would be allowed after consultation between 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 is 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.

6.6 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 ESA's will be considered.

6.7 Summary of Existing ESA's

The majority (83%) of the 55 ESAs delineated were either identified as Emergent Wetlands (44%), Riverine Swamp Forest (18%) and Complex ESA's (18%), (Table 27, page 199). ESAs comprise 14,063 acres or 21.1% of the Chesapeake Forest, which also includes Seth Demonstration Forest and Wicomico Demonstration Forest (see Tables 27 and 28, page 210). Limited Forest Management can occur within ESA Zones 1 and 2 which total 7,723acres or 11.7% of Chesapeake Forest (Table 28). Within the three ESA zones, expanded stream buffers total 410 acres (0.6%) and

outside of the ESA zones the expanded stream buffers total 3,524 (5.3%). The area within the entire Chesapeake Forest that is available to limited forest management (ESA Zones 1 & 2, expanded stream buffers) is 11,657 acres or 17.5%, (Table 28, page 210).

ESA Zone 3, which is available for sustainable forest management, totals 5,936 acres or 9%. This Zone is subdivided into pulpwood management areas 3,303 acres (4.9%) and saw timber management areas 2,633 acres (4%). Areas available for sustainable forestry with varying management prescriptions include ESA Zone 3, Core FIDS management areas outside of ESAs 6,544 acres (9.8%) and DFS management areas outside of ESAs 23,541 (35.3%). Additionally, the remaining acreage on Chesapeake Forest 19,045 acres (28.5%) is designated as the General Management Zone. The General Management Zone is where high production loblolly pine silviculture is appropriate. Thus**,** a total of 55,061 acres or 82.5% of Chesapeake Forest is available for sustainable forestry, (Table 28 page 210).

These results should allow DNR Forestry to successfully model the economic sustainability of Chesapeake Forest Lands. Following the management zones and prescriptions described in this chapter and in the rest of the Sustainable Plan should result in the ecologic sustainability of the Chesapeake Forest. Implementation of the management prescriptions for each Zone and ESA categories will require close coordination between Heritage and Forestry. Heritage will still need to produce restoration and management plans for Zone 1 in most ESAs. However all the acreage within the ESA's except for some of Zone 1 areas now have management prescriptions. Forestry should 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 should follow those in other sections of the Sustainable Plan. The AWP review process will allow Heritage as well as the entire CFL Interdisciplinary Team the opportunity to refine proposed forest management activities to fulfill these prescriptions.

See "Appendix N" page 203, for a listing of all currently identified ESA's located on Chesapeake Forest Lands.

CHAPTER 8

Wildlife Habitat - Protection & Management

8.1 Introduction

There is a rich diversity of wildlife species located within the Chesapeake Forest Lands (CFL), which is enhanced by the adjoining lands of the Pocomoke State Forest (PSF). They range from endangered Delmarva Fox Squirrels (DFS) to recreational game species, and this requires Forest Managers to use 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. For example, Forest Interior Dwelling Birds species (FIDS) habitat and riparian forest buffers also provide habitat and corridors for DFS recovery efforts. These habitat functions on CFL are also enhanced by the complement of Pocomoke State Forest lands which provide additional habitat in these landscapes. Managing forest so they provide multiple benefits to several species, will enable the best combination of wildlife habitat needs be realized on the ground. 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 mature riparian forest habitat that is important for many wildlife species (see Chapter 6). All blue-line streams on CFL & PSF will have stream buffers that extend 300 feet from the stream bank on either 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 wildlife 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

Delmarva Fox Squirrel (DFS)

U. S. Fish and Wildlife Service Endangered Species personnel have reviewed the DFS recommendations described in this document which were developed by the Maryland DNR. They have concurred with the locations indentified for each DFS management area, along with the forest management prescriptions which were found to be complementary to DFS recovery efforts.

DFS Core Areas (High Conservation Value Forest)

(24,343 acres CFL and 305 acres PSF)- Total DFS Core 24,648 acres

DFS Core Areas are defined as a complex of Chesapeake Forest Lands currently occupied by DFS. Core areas are to be managed primarily for DFS suitable habitat and to function as a source population of DFS for the surrounding landscape. These areas meet our definition under *(HCV3-Forest areas that are in or contain rare, threatened or endangered ecosystems.)* for High

Conservation Value Forest (HCVF). There are twelve DFS core areas on Chesapeake Forest Lands with the majority of DFS core acreage occurring in Somerset County and Dorchester County. (Figure 15)

DFS Future Core Areas

(19,189 acres on CFL and 12,798 acres on PSF) - Total DFS Future Core 31,988 acres

DFS Future Core areas are defined as a complex of Chesapeake Forest Lands and\or Pocomoke State Forest (PSF) tracts that contain areas where sufficient habitat can be maintained for potential DFS translocations. There are four designated DFS Future Core areas that contain five potential translocation sites which are located on Chesapeake Forest & Pocomoke State Forest (Figure 15). Within DFS future core areas, forest tracts will be managed for sawtimber, but in addition there are specific sites that will be managed primarily for DFS suitable habitat. The expectation is that these areas would function as a location for future translocations and then a source population of DFS for the surrounding landscape. Should one of these areas become occupied with DFS then that area will be managed as Core DFS.

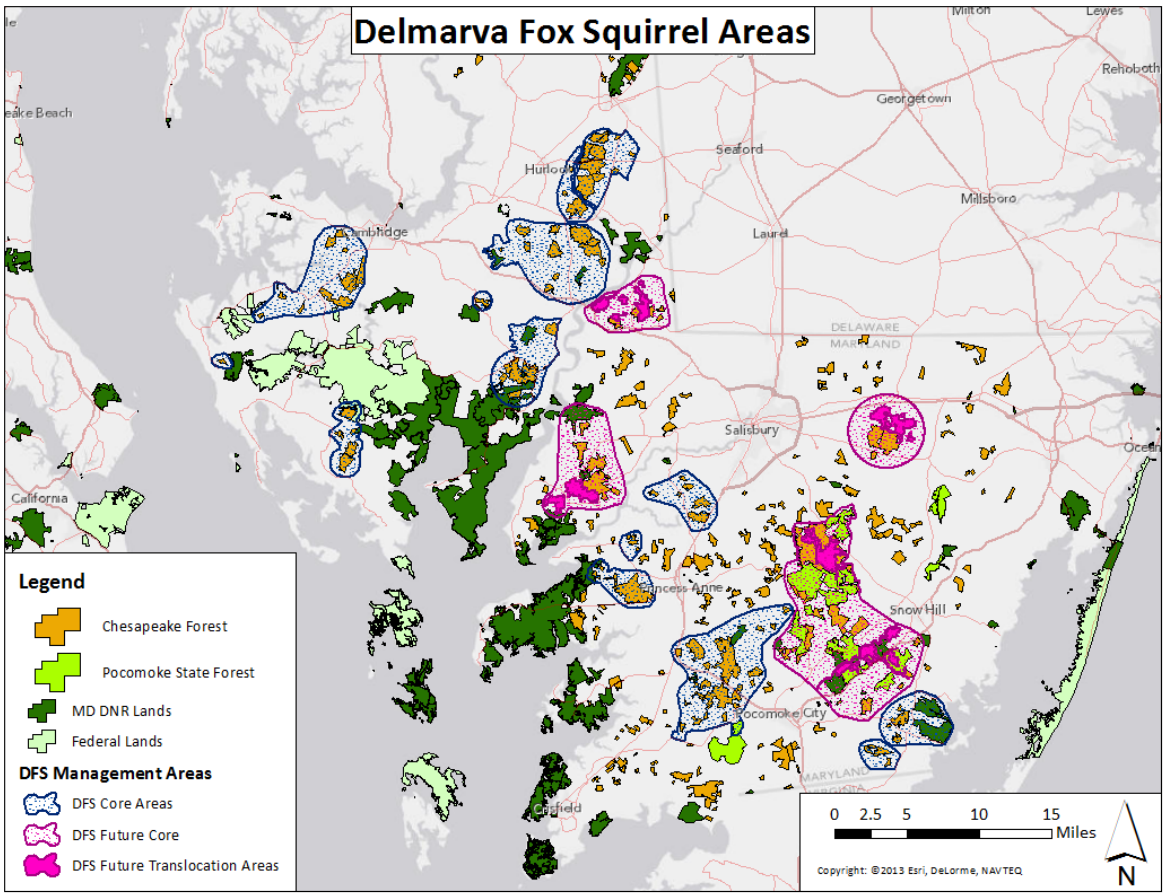


Figure 15: Delmarva Fox Squirrel Areas on Chesapeake Forest Lands &Pocomoke State Forest (2013)

Identification of DFS Management Areas

The acreage that defines each DFS management area is comprised <u>only of the forested acreage</u> from each CFL tract\complex located within the boundaries of the management area. In a few cases, some restoration practices for State Listed Sensitive Species and/or habitats might conflict with DFS management guidelines. In these cases this acreage would not be included in the total acreage for the DFS management area. All restoration practices are reviewed and approved by the DNR

interdisciplinary team through the annual work plan (AWP) process, and any conflicts with overlapping sensitive species areas would be resolved during this process. An example of a sensitive habitat restoration project would be Delmarva Bays.

Forest Management for Delmarva Fox Squirrel (DFS)

TOTAL: DFS Management Areas on CFL & PSF: 56,636 acres (Core plus Future Core)

Most of the DFS management areas on Chesapeake Forest Lands are dominated by Loblolly pine stands that contain low volumes of scattered mixed hardwoods, with some hardwood pockets as the result of past management practices. On lower wet sites, the hardwoods are a mix of sweet gum, red maple and wetland varieties of oaks. On the higher dry sites in addition to the gum and maple there is a mix of the upland oaks, American Beech and few other upland hardwood species. However gum and maple are the primary hardwood species found mixed in with the pine on all sites.

Longer rotations between regeneration harvests will be used to achieve and sustain suitable DFS habitat. 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, the 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 Chesapeake Forest.

Intermediate Thinning & Regeneration Harvest within DFS Areas

In the development cycle of a new forest, intermediate thinnings such as "pre-commercial thinning", 1st and 2nd thinning operations along with prescribe 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 thinnings will generally focus on opening up the stand for in-growth of hardwood species and improved growth for residuals. Second thinnings will generally focus on improving growth of dominate 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 insure 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 Chesapeake 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 both 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 by its use. Also 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 harvest on Chesapeake Forest are limited to a maximum of 40 acres in size based on the Forest Stewardship Council (FSC) standards. When regeneration harvest 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.

Contribution of DFS Management towards DFS Recovery

The Recovery Plan for DFS (USFWS 1993) documents that **DFS can be reclassified to threatened status when:**

1. Enough is known of DFS to allow effective management,
2. Benchmark populations are stable or expanding and
3. Ten trans-located colonies are established throughout the historical range.

De-listing of DFS will be considered when:

1. Five additional colonies are established outside of the remaining natural range,
2. Trans-located colonies are stable or expanding, and
3. Enough suitable habitat is protected in perpetuity to allow new populations to expand and intermingle with existing populations.

DFS management on Chesapeake Forest Lands will protect 12 known existing populations (Core Areas) of DFS, barring some unforeseen catastrophe, in perpetuity. DFS management will create suitable habitat for the establishment of 5 potential new populations within the four Future Core Areas. Management of designated DFS areas will allow populations to expand and intermingle, and is intended to result in range expansion. DFS management on Chesapeake Forest Lands will also benefit Federal management actions on Blackwater National Wildlife Refuge.

Planning Horizon for DFS: Time to Achieve Desired Future Condition

At the time of the Chesapeake Forest acquisition in 1999 over 50% of the DFS Core areas were in stands less than 15 years of age. Table 17a shows current age class\acreage distribution of forested stands in the DFS Core areas on CFL and PSF as of 2013:

Table 17a: (stand data for DFS Core 2013)

Age	Acres	%
0-5	753.8	3.2%
6-15	2,233.8	9.4%
16-25	7,693.5	32.5%
26-40	6,031.4	25.5%
41-60	2,692.5	11.4%
61+	4,235.4	17.9%
Total	**23,640.2**	**100.0%**

Table 17a demonstrates that within the next fourteen years about 55% of the Core Areas will have achieved DFS suitable habitat. A pro-active thinning regime which began at the time of the acquisition has been and will continue to be a major factor in allowing these areas to grow into the desired condition of suitable DFS habitat.

Note: *The acres in this table do not add up to 24,648 acres of DFS Core, because fields, marsh, water, roads, etc. were not used in total acres, only actual forested acreage are shown in the table.*

Table 17b: (2013 stand data for DFS Translocation sites located on CFL & PSF)

Locations	Wicomico Northwest Rt. 50	Wicomico Southwest	Wicomico Demo Forest	Worcester Northwest PSF	Worcester PSF Rt. 113	TOTALS	
Age	Acres	Acres	Acres	Acres	Acres	Acres	%
0-5	7.2	3.4	39.6	0	0	**50.2**	**0.6%**
6-15	15.4	170.2	43.9	0	0	**229.5**	**2.5%**
16-25	805.1	840.6	750.7	0	4.1	**2400.5**	**26.4%**
26-40	165.7	267.2	542.9	12.1	53.4	**1041.3**	**11.4%**
41-60	604.3	82.1	249.1	57.5	25.6	**1018.6**	**11.2%**
61+	49.4	434.4	215.9	1849.4	1809.3	**4358.4**	**47.9%**
Total	**1647.1**	**1797.9**	**1842.1**	**1919.0**	**1892.4**	**9098.5**	**100%**

The table 17b shows the current age class\acreage distribution of forest stands for the five potential DFS translocation sites. Most sites already have or are near the 800 acre target of suitable DFS habitat. 59% of the total area is in DFS suitable habitat.

Adaptive Management Considerations for DFS

Specific descriptive or prescriptive habitat management requirements for DFS are still the subject of considerable scientific scrutiny. Therefore, the land managers of Chesapeake Forest Lands should expect that the demonstrated preference or acceptance by DFS for habitats created on the forest might eventually drive future habitat management considerations. While the guidelines listed above represent the best currently available science, they are likely to change as more is learned of the species. Monitoring of DFS populations and habitat use is critical to successful long-term planning. Experimental manipulation of stand conditions to better describe DFS critical habitat needs is also strongly recommended.

Bald Eagle

At time of acquisition in 1999, there were 17 eagle nests located in or near Chesapeake Forest Lands. 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 the 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:

1) No land use changes, including development or timber harvesting, in Zone 1;
2) 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;
3) Selective timber harvesting may be done in Zone 2, but clear cutting should be avoided; and,
4) No construction or timber harvesting activities should occur within the protection zones during the eagle-nesting season, which is from December 15 through June 15.

8.4 Other Rare, Threatened and Endangered Species

Other than DFS and Bald Eagles, another 101 species considered as rare, threatened, or endangered by the Department are currently found on or near CFL tracts. These species are located or within sites called Ecologically Significant Areas (ESA) comprising a total of 12,949 acres on Chesapeake Forest Lands (see chapter 7). The number of species and/or Ecologically Significant Areas (ESA's) is subject to change and it is up to the Land Manager in conjunction with the DNR Heritage

Ecologist to monitor and report these changes if and when they happen. Samples of the types of areas and management prescriptions that might be needed are included in Chapter 7 of this document.

8.5 Management Opportunities for other Wildlife Species

Forest Interior Dwelling Bird Species (FIDS)

CORE areas are designated as High Conservation Value Forest (HCVF)

General Objectives for Forest Interior Dwelling Birds (FIDS)

Habitat Management DNR Non-game and Heritage personnel were consulted on FIDS management. 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. In most cases these prescriptions overlap with the management of the Delmarva Fox Squirrel (DFS) habitat areas and Riparian Forests. On all DFS areas, management for FIDS habitat will be considered in conjunction with the goals for DFS recovery. Optimal Core FIDS habitat comprising 6,600 acres has been identified on Chesapeake Forest Lands (See Figure 16) and will be managed according to FIDS guidelines, except where ESA areas overlap then ESA management takes priority.

Timber Harvest Plan Guidelines for FID's

Maryland Wildlife and Heritage Service published a set of guidelines entitled "FIDS Timber Harvest Guidelines" and dated (Appendix F). These guidelines will be utilized within the DFS and CORE FIDS areas on Chesapeake Forest Lands.

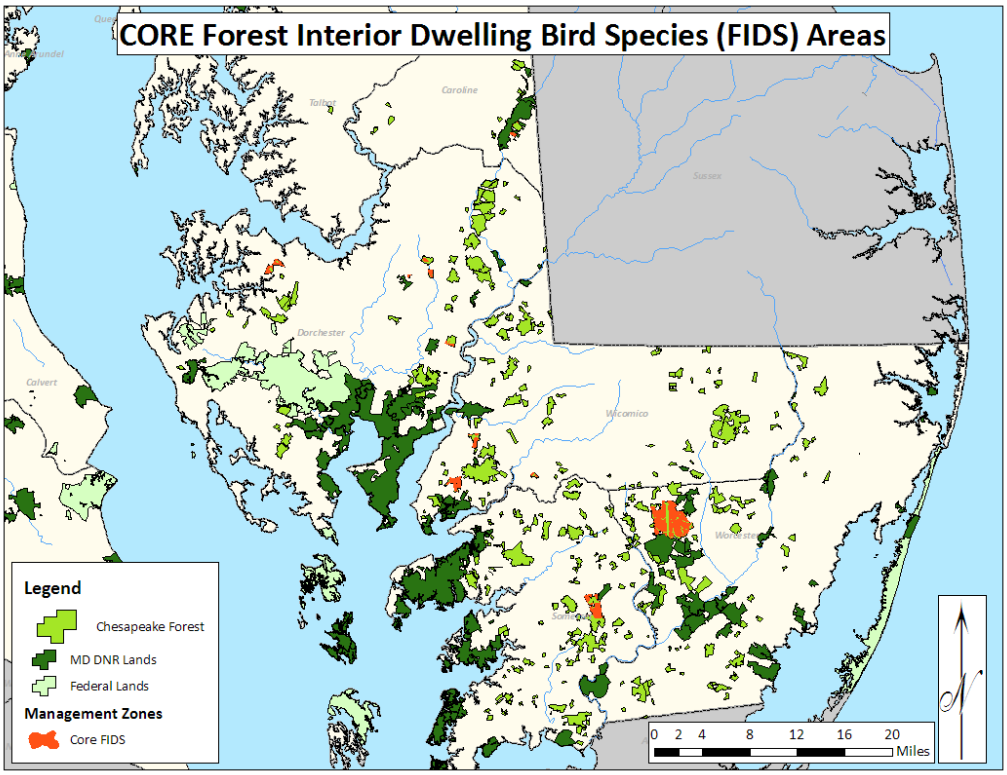


Figure 16: CORE FID Habitat Areas (2011)

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 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.

8.6 Management Opportunities for Game Species

Personnel with MD DNR Wildlife and Heritage Division 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 Chesapeake Forest Lands 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 Chesapeake Forest, opportunities for quail habitat management should be identified and prescribed for within the General Timber Management land classification. Also, 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, FID 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. The herbaceous condition can be maintained by periodic controlled burns and/or disking. Quail benefit from periodic disturbances to their habitat. 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 harvest 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 heavy 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.

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 Chesapeake Forest Lands 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 a combination of public and club hunting (Chapter 9).

Wild Turkey Management

Although wild turkeys are thriving on the lower Eastern Shore of Maryland, CFL 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.

CHAPTER 9

Public Use & Education

9.1 Background

The Chesapeake Forest Lands have traditionally, been hunted (primarily for deer) by over 200 organized hunt clubs, many of these Clubs have continually leased these lands since the 1960's. The Department chose to continue this use during the transitional period that lasted for three years and which recently ended in December of 2003. These clubs had permission to hunt individual tracts for a period of three years under a right-of-entry (ROE) agreement that was developed by the Department. The agreements identified the terms, under which the tracts could be hunted, specified a cost for this privilege and conditions of use which need to be followed. When the Chesapeake Forest lands were acquired, there were 223 ROE agreements on a total of 54,962 acres of Chesapeake Forest (94.4% of the total land area). Of these, 141 agreements totaling 29,448 acres were on the gifted lands managed by Vision Forestry through a contract with the Department. The remaining 82 ROE agreements totaling 25,514 acres were on lands managed by the Department of Natural Resources (DNR).

These ROE agreements have provided an important source of revenue (estimated to be $350,000/year), which helped support management and payments to local governments. The hunt clubs have also provided important services in terms of land management, such as maintaining roads and trails, minimizing trespass, reporting illegal dumping or other activities, etc. All of these ROE agreements expired in the spring of 2004.

9.2 Current & Future Recreational Uses

Recreational surveys both nationwide and locally indicate that outdoor recreational activities such as hiking, camping, wildlife viewing, hunting, fishing, canoeing and kayaking continue to be popular and their pursuit continues to play a major role in Maryland's economic growth and tourism industry. Based on this information and the intent of the acquisition, the goal for public use *"is to provide opportunities for the enjoyment of the natural resources of the Chesapeake Forest lands by making appropriate areas available for resource-based, low impact recreation and environmental education for a variety of user groups provided this use is compatible or does not conflict with the other goals of the project."* Therefore, all future public use proposals will be evaluated 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 Chesapeake Forest lands include activities such as hiking, hunting, fishing, birding, horseback riding, nature/wildlife observation, environmental education, primitive camping, trapping and access for canoeing and kayaking. In select cases, minimal development may be undertaken to provide picnicking, camping at primitive sites, bike trails and recreational opportunities targeted for seniors and the disabled.

Hunting

As mentioned earlier, deer populations must be managed to ensure a healthy forest. Therefore, hunting opportunities will be provided to limit population growth and ensure the protection of the forest and other habitat areas. This plan attempts to identify the proper combination of public and limited-access hunting of the forests by private hunt clubs as well as other appropriate recreational uses. There are strong constituencies and feelings on all sides. Now that the lands are in public hands, there are many people who feel that the public should have access. Others recognize that the services provided by the hunt clubs save the Department money through their activities involving road maintenance, gate installation, trash pick-up, or boundary line marking and posting. Many of these benefits were identified by the clubs at a series of three public meetings conducted by the Department in April 2000. Approximately 680 people (primarily hunt club members) attended these meetings and provided a wealth of information. Based on this input and discussion with staff, the Department developed a set of criteria to use to evaluate the suitability of the Chesapeake Forest tracts for public use, including hunting (Appendix H).

In 2002, the Department began a public planning process by forming a Citizens Advisory Committee. This group consisting of diverse representatives from the forestry, conservation and recreational community began to develop a Plan for Chesapeake Forest by reviewing the Sustainable Forest Management Plan (SFMP) developed by the Sampson Group. The SFMP for the gifted lands did not address the issue of public access to the Chesapeake Forest lands. However, the terms of the "Acceptance of Gift" agreement did include, among other obligations that "*the existing hunting licenses, which shall be renewed annually for three (3) terms of one-year each in order to transition the Property from private to public use through a planning process."* These ROE agreements on the gifted lands, along with the remaining 82 ROE agreements on the 25,514 acres of DNR purchased lands were extended in 2001 to June 30, 2004, as a way to maintain a consistent approach. In addition, at their second monthly meeting, the Citizens Advisory Committee agreed that hunting was a traditional and appropriate use of Chesapeake Forest and approved the public use suitability criteria.

In 2002, while the Department's planning process was still underway, the Maryland General Assembly enacted SB 599, Natural Resources-Hunting and Licenses and Stamps, which was amended (on the recommendation of Delegate Kenneth Schisler, District 37B) to include Section 3: *"(1) it is the intent of the General Assembly that, in accordance with Sections 10-209 and 10-308.1 of the Natural Resource Article, the Department of Natural Resources utilize special fund revenue generated as a result of the licensing fee increases under this Act, as appropriate, in order to open to public hunting at least half of the total acreage that is leased for hunting to private individuals on the properties known as the Chesapeake Forest lands by the 2005-2006 hunting season."*

As a first step in meeting the requirements of SB-599, the Department opened several tracts during 2002 for public use. These tracts include, the Ventor and Lathrop tracts, which comprise 455 acres in Wicomico County. They encompass a hiking trail that demonstrates various forest practices; however this area is not open to public hunting, due to possible conflicts in use.

The DeWolf, Osborne, and Mansion Farm tracts in Dorchester County, the Cordrey and Whitesburg tracts in Worcester County, which total 1,553 acres, were open to public hunting as well as other uses. The Buck Harbour tract in Worcester County totaling 318 acres was also opened for hunting but is restricted to wheel chair access through an agreement with the Wild Turkey Federation. In this first year, the Department had decided not to impact any existing club agreements, so no hunt clubs occupied any of the tracts identified above.

In the 2004 Legislative Session, two additional bills relating to hunting on Chesapeake Forest were introduced and ultimately failed. As a result of the legislative and public deliberations, a consideration of numerous alternatives and in accordance with the intent of SB 599, the Department decided to implement a hunting program that is a combination of public and club hunting. Using the approved suitability criteria, tracts suitable for public use were identified. These tracts were opened over a two-year period in order to have sufficient time to develop parking areas, mark boundaries and install gates. During the 2004/2005 hunting season 12,178 acres were opened and an additional 13,897 acres were opened for the 2005/2006 hunting season. On the remaining tracts, the hunt clubs that previously had ROE agreements were offered an opportunity to enter into a State lease for the same tracts for a five-year period which the vast majority of the Clubs did. As Clubs decide to give up their lease, these Chesapeake Forest tracts will go into a lottery system to be made available to other Hunt Clubs. At the end of that five year lease period Hunt Clubs that have satisfactorily met all the conditions of their lease were again offered an additional five year lease renewal many of which did so.

In preparation for the expiration of all current leases in June of 2014, the leased hunting program was re-evaluated in the Spring of 2013. All tracts were reviewed once again to determine if they should remain in the lease program and a new evaluation was done of the current leasing structure. The end result is that a few tracts will move back over to the Public Hunting side and tracts that are to remain in the lease program will be offered to current clubs at a new lease rate in the Spring of 2014. Should the club decide not to continue leasing the tract it will be placed into an new web based Hunt Club lottery system. The new web-based lottery system greatly simplified the process for awarding tracts to new clubs.

Hiking, Biking Horseback Riding and Nature Observation

Although hunting is anticipated to be the most popular activity, the extensive forest road system that currently exists on the Chesapeake Forest offers ample opportunities for hiking, biking, horseback riding and nature observation. These activities will be encouraged on the tracts opened for public use provided there are not user conflicts and all the other forest management goals are being met. There is an existing forest demonstration trail on the Tommy Tyler Complex (Ventor/Lathrop tracts) across the river from the Town of Vienna. The tracts of Chesapeake Forest surrounding and including Wicomico Demonstration Forest also present opportunities to extend the existing trail system. Trail Grant funding will be utilized to improve and expand on the existing network of trails throughout the CFL system. New trial system proposals will be submitted and reviewed through the Annual Work Plan process.

Water Access for Canoeing, Kayaking and Fishing

Opportunities for water access are somewhat limited on Chesapeake Forest. However, some of the tracts along Nanticoke River offer possible access/take out points as part of an “interpretive” water trail being developed. The Department will continue to evaluate the feasibility of access on the Marshyhope Complex and the King’s Misfortune tract. As part of an interpretive water trail, these locations could be used to highlight forestry’s connection to the Chesapeake Bay. In addition, in Dorchester County the Lewis Tract offers access opportunities to the Fishing Bay water trail, and the newly acquired Blackwater Tract offers a water access point along the Little Black Water River. Proposals on these water access opportunities will be developed and reviewed during the Annual Work Plan process.

9.3 Education and Public Outreach

The Department's goal for Chesapeake Forest is that it will be viewed as a national model of sustainable forest management, and that the Department will increase 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 Chesapeake 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.

9.4 Chesapeake Forest Website

The website (http://www.dnr.state.md.us/forests/chesapeakeforestlands.asp) has been and will continue to be an invaluable mechanism for communicating with the public. It has been used to share information regarding the planning process and the opening of tracts to the public. However, its future value is dependent on the Department's ability to continually update the information.

9.5 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 forest demonstration trail on the Tommy Tyler Complex. The Department is currently updating the 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, the State Forest and ark Service and Vision Forestry.

9.6 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 should continue to sponsor cooperative research projects as part of the implementation of the Monitoring Plan (see 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)

9.7 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

Chesapeake Forest interdisciplinary team and once reviewed and approved will be implemented as part of the AWP. 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 (LAC) procedures and protocols will be used to monitor these public use activities (see Monitoring Plan – Chapter 10).

CHAPTER 10

Chesapeake Forest Monitoring Plan

10.1 Introduction

The primary goal of the Chesapeake Forest Project is to demonstrate that public forests can be sustained on an economic and environmental basis. Sustainability 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 success of Chesapeake Forest Lands (CFL), and, at a minimum, must meet 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 limits to the involvement of current staff in the project. This critical component of the Chesapeake Forest Project will not be successful unless support continues to be adequate, whether financed by CF income or other sources.

10.2 Monitoring Plan

The monitoring plan supports the needs of Chesapeake Forest Lands 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. 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 Appendix C & D.

Data obtained from the monitoring has been used to update the Chesapeake Forest Geographic Information System, and spatially integrated with the base ownership layer. Data collected in Tier I inventory included GPS coordinates, which are kept for references to the 210 permanent plots. 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, Resource Planning, Monitoring and Non-Tidal Assessment, and contacts for the Technology Toolbox and Property View. New data are added to the GIS system through the data manager assigned for the respective layers.

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

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 physiographic and hydro-geomorphic 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 Appendix C & D). The first round of data collection was conducted in 2004, including:

1) Forest over-story 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, including bird, reptile, and amphibian species, diversity, relation to 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, macro-invertebrate 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 assured representation of sensitive resource areas like forest interior habitat, 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 Chesapeake 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://www.dnr.state.md.us/forests/chesapeakeforests/, including the sustainable 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.

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 18). 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 CFL ownership, and will correspond partially to stream order; streams originating entirely in CFL are likely to be smaller (first, second, or third order), while streams passing through or bordering CFL are likely to be larger (third order or higher). Terrestrial strata focus on major stand types and areas with rare species, 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 Chesapeake Forest GIS system, managed out of the Chesapeake Forest Office.

Table 18: Strata Identified for Long-term Monitoring in the Chesapeake Forest

Stream and Water Quality Sampling		**Terrestrial Vegetation and Species Sampling**	
Geomorphic Region	***Stream Location***	***Forest Composition***	***Sensitive Resources***
Surficial Confined	Originates in Chesapeake Forest	Pine	Forest Interior Dwelling Species (FIDS) Core
Fine-grained Lowland	Passes through CF	Upland Hardwood	Delmarva Fox Squirrel (Core and Future Core)
Well-drained Upland	Borders CF	Bottomland Hardwood	Ecologically Significant Areas
Poorly Drained Upland		Mixed Pine-Hardwood	Riparian/Wetland Areas
Poorly Drained Lowland			

Terrestrial Vegetation and Species Sampling

For terrestrial samples, approximately 1000 12-acre plots were defined using a randomly placed GIS Hexmapper grid that covers the entire Chesapeake Forest area with equal-area plots. A total of 210 plots were randomly sampled from the 1000 potential plots, using the center point of the 12-acre hex to locate sample plots unless it did not lie within the CF boundary. To gather detailed data on bird and amphibian abundance and habitat features, a subset of 82 plots from sensitive resource plots were selected for additional data collection using multiple visits from spring to late summer to adequately sample seasonally available populations. 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.

Vegetation structure and composition were quantified using methods similar to those of the Continuous Forest Inventory, based on USDA Forest Service inventory sampling and analysis methods. 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 were collected. Data analysis was contracted with USDA Forest Service Forest Inventory and Analysis section and used techniques consistent with the Maryland forest inventory. Data summaries for forest overstory include tree volume, basal area, density, and growth rates. Calculations for wildlife information include the Shannon-Weiner diversity index, relative frequency, and relative abundance. Analysis of Variance is used to determine contribution of stand types and age classes to observed population characteristics. Vegetation information from the detailed wildlife habitat subset of plots was analyzed using detrended correspondence analysis techniques to identify six community types.

Living organisms were monitored with emphasis on sensitive species, including forest interior dwelling and other birds, reptiles, and amphibians. Standard methods included constrained time searches, pitfall traps, and call counts, tailored to the species' habits.

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 CFL 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. Baseline water quality was sampled in 2002, emphasizing areas in forest interior-dwelling bird habitat.

Water quality monitoring used procedures outlined in Boward and Friedman (2000). 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 macro-invertebrates 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 Macro invertebrate Index of Biotic Integrity, Habitat score, and percent of suitable habitat.

In 2002, 82 stream segments were randomly selected for sampling. Many segments were dry, given the extremely low rainfall and groundwater levels during most of 2002, and a few other segments had no reasonable access, leaving 33 sample able sites for grab samples. Some sites had no measurable flow, so were not evaluated for macro invertebrates. Almost all sites meet the hypothesis that water quality measures do not exceed desirable standards (Table 19), and the sampling helps identify areas and characteristics of sites most appropriate for improvement of water quality or habitat.

Table 19: Synoptic Water Quality sampling on Chesapeake Forest Lands, Spring 2002

Measure	*Range*	*Average*	*Comment*
PO4, mg P/L	0.001 to 0.160		
NO_3, mg N/L	0.01 to 12.00		Only 1 site over 10 mg/L standard
Temperature (^{o}C)	3.75 to 14.48		
pH	5.20 to 8.21		Acceptable range (not sure of source of high pH)
Conductivity	0.046 to 0.259		
Dissolved Oxygen (mg/L)	4.63 to 12.10		All within acceptable limits
Discharge (L/s)	0.000 to 110.646		0 discharge indicates stagnant water
Habitat Score	60 to 129		140-112 Excellent, 105-77 Good 70-42 Fair, <35 Poor
Habitat %	43 to 95		>80% Excellent, >55% Good, >30% Fair, <25% Poor
Index of Biotic Integrity	1.86 to 3.86		Highest rating is only fair.

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

Objectives

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

1) Occurrence and management needs for rare, threatened, or endangered species,
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.

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 macro invertebrate 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;
- Other indicator species.

Trail impacts 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 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.

Invasive Species

Information on general occurrence of invasive plants is captured in the Tier I inventory, and will be updated on the same cycle as that inventory. The baseline inventory found common invasive species on Chesapeake Forest on a third of the plots in wetlands, stream buffers, and Endangered Species Areas. The most ubiquitous invasive was Japanese honeysuckle (*Lonicera japonica*). Other common invasives were Japanese stiltgrass (*Microstegium vimineum*), phragmites (Phragmites australis), mile-a-minute (*Polygonum perfoliatum*), and multiflora rose (*Rosa multiflora*). 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. 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 reinfestation 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.

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

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 Chesapeake Forest Project over the long term. Tier III monitoring is needed to document compliance with SFI Objectives 1, 2, 3, 4, & 6 and FSC Principles 5, 6, 7, 8, 9, & 10 (App. C & D).

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. Harvest Site Review checklists include, Haul Roads\skid trails & landings, Merchandizing & Selection, Streamside Management Zones (SMZ) & Stream Crossings, Safety BMP's 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 are for commercial first and second thinning. However, final harvests of young stands are anticipated in order to regulate an unbalanced forest condition based on age class distribution. Silvicultural prescriptions may be modified based on the following:

- Presence of rare species, including Delmarva Fox Squirrel Areas 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).

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.

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 Heritage staff specialists evaluate selected sites with high potential for rare species for presence and abundance of target species following burn treatment.

Herbicide Application

The use of herbicides is being minimized on CF lands, 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 Chesapeake

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 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.

Spray trials were carried out to determine the lowest herbicide rate to control most gum and maple while avoiding eradication of oak species. Vision Forestry (*the first land management contractor on CFL)* set up a spray trial on the E. Mace Tract to compare effectiveness of 4 rates of Arsenal (7, 8, 10, and 12 oz/ac.) and a control non-spray area. Baseline data and treatment results will be evaluated after 2 growing seasons. Data collection focuses on vegetation: grasses, mature trees, saplings, seedlings, and shrub/herb layers. Good control of maple and sweetgum were achieved at all levels, although follow-up data to determine effects of sprouting in later years is continuing. Based on the results of the trial, the standard rate of application of Arsenal following thinning has been reduced to 8 oz/acre.

The trials are designed to test whether there is change in proportion of hardwood to pine before and after the herbicide spray for each of the different rates. Measures to be tested include:

- Proportion of hardwood to pine,
- Percent oak and poplar, and
- Percent maple/sweetgum.

Measured items include trees, saplings, and seedlings, with composite stems/acre being calculated as the sum, at each level of spray in comparison to the control area. Diameter and volume growth of pines under the different spray levels is also of interest.

The E. Mace Smith trial area results should be applicable to both thinning operations and regeneration harvests. Vision Forestry set up a trial on the Haislip Butler tract, stands 1 and 2 (1982 and 1991 plantations respectively), using a lower concentration of herbicide (8 oz./acre Arsenal), with no spray on windrows where hardwood concentrations are highest. This trial will be used to monitor development of oak, maple, and gum in the loblolly plantations and the ability of this type of prescription to develop a mixed pine-hardwood stand. Lower rates of herbicide were used in a trial on the Smullen tract because even the 7 oz. rate used earlier achieved more mortality of hardwoods than expected. However, the installed trials on the Smullen tract later suffered a wildfire that destroyed plot center markers and the ability to distinguish effects of different levels of herbicides.

Water quality was sampled for residual herbicides on October 5 and 15, 2003 from an October 3rd spray of Arsenal (active ingredient imazapyr) on the Smullen tract. Sampling was done at four locations in a waterway on the interior of the spray tract with a 150-foot buffer, spray rate of 5 oz/acre. No imazapyr was detected at the time of spraying or two weeks later, using a detection limit of 1 part per billion. The currently used procedures and spray buffers were successful in avoiding transport to water bodies, even one in the interior of the tract being sprayed.

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 through the use of the Harvest Site Review form.

Intermediate Operations

Commercial and pre-commercial thinning is planned for the Chesapeake Forest. The same procedures as outlined for harvesting are followed, regarding site review, modification of operation for rare or sensitive species, and BMP compliance.

Future research related to thinning operations will be planned to investigate effect on regeneration amount, species, and distribution. Data to be collected in sample plots include initial and residual basal area of over-story trees and number and species of woody seedlings. Heavier thins are expected to result in greater amounts of regeneration, especially for light-demanding species such as pine or oak. Hypothesis to test include:

H_0: There is no change in density of seedlings following thinning to varying basal areas.
H_A: There is a change in density of seedlings following thinning to varying basal areas.

10.7 Special Area Projects for Water Quality

Some additional projects are being undertaken for water quality and wildlife objectives. Watershed improvement projects are chosen in locations where slowing water could improve nutrient and sediment levels in water leaving Chesapeake Lands. 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.

Several watershed restorations projects have taken place on the Chesapeake Forest. The primary DNR staff contacts are within the Watershed Restoration Division. *See Appendix M for a current status on Watershed Improvement Projects.*

Habitat Improvement Projects are chosen in areas with great potential to support rare species types. MD DNR Heritage Program 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, and restoring hydrology where past drainage has reduced extent of wetland habitat. Presence and extent of rare species will be recorded before and after projects.

10.8 Special Area Projects for Wildlife & Heritage

Chesapeake Forest lands are being surveyed annually for bird presence. Bird counts are added to other regional data and summarized in the Breeding Bird Atlas. A detailed study of bird use, including forest interior dwelling species, was completed previously by principal investigators at Frostburg University, and found extensive use even in some pine-dominated regions. Follow-up study of this result is anticipated in partnership with Frostburg or another university.

10.9 Public Use and Recreational Activity

Hunting is permitted on Chesapeake Forest lands, including public hunting and fee hunt clubs. For lands open to public hunting, monitoring consists of periodic roadside vehicle counts during hunting season. Club hunting is monitored using a database which tracks revenue, number of hunters per club per tract, maintenance the club has provided and an annual harvest report. The annual harvest report includes estimates for harvest by species: white-tailed deer, sika deer, turkey, dove, quail, squirrel and rabbit. Waterfowl hunting currently is not included in the hunt club agreements, although the reporting form makes provision for it.

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 & Heritage Division.

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 Chesapeake 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). Chesapeake Forest cooperated in an effort to collect white-footed mice and blacklegged ticks as part of a Lyme disease study by Johns Hopkins Bloomberg School of Public Health during 2003.

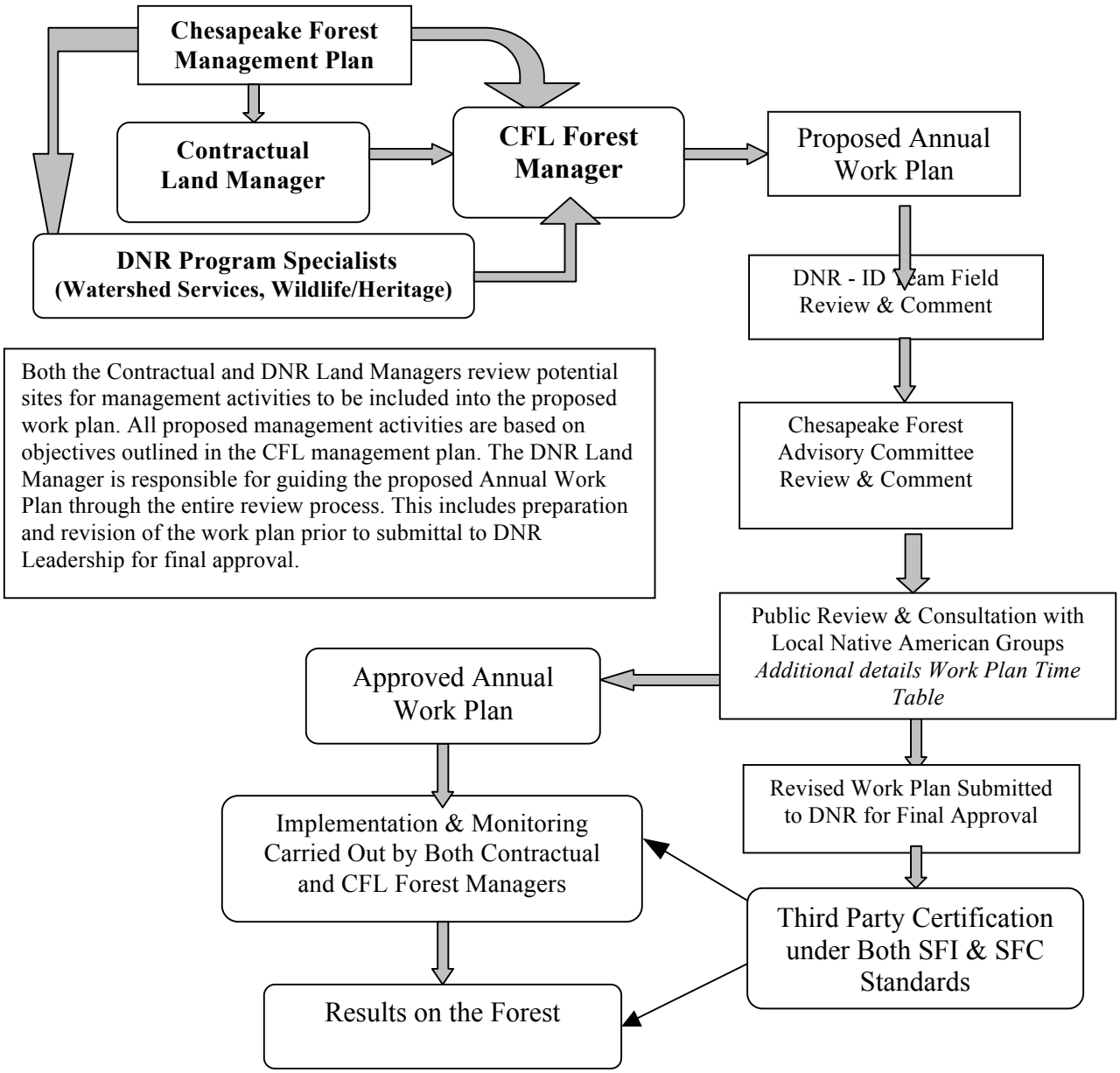
CHAPTER 11

The Annual Work Plan

11.1 Annual Work Plan

The Annual Work Plan (AWP) will be the controlling document to assure that the Land Managers (both Contractual and DNR) effectively carry 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 MD DNR Land Manager is responsible for preparation of the Annual Work Plan. Figure 17 depicts the process used in the development of the Annual Work Plan.

Figure 17: Annual Work Plan 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 Chesapeake Forest Lands. 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 Land Managers 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. If each individual project required separate agency review and approval, the chances of the procedural calendar and the work calendar coming into conflict escalate. If this occurred, the likely casualty would be the timely completion of fieldwork that could adversely affect the goals of the Chesapeake Forest Plan.

Figure 17 shows how achieving desirable on-the-ground results, which are the key outcomes of this plan, 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 Chesapeake 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/time lines:

1. The Contractual and DNR Land Managers begin fieldwork to review sites to be included in the next annual work plan from November through February.
2. The DNR Land Manager drafts a proposed work plan and sends it for ID Team review by March 31.
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 CFL Forest Manager by August 31.

4. The DNR Land Manager presents the proposed work plan to the Chesapeake Forest Citizens Advisory Committee for comment and review and then holds a meeting for Public Review and Comment, process to be completed by November 12th.
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 December 1st.
7. The DNR obtains final official approval of the Annual Work Plan, as revised, by February 1st.
8. The Land Managers begin implementing the approved Work Plan July 1.
9. 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 will include:

- Identification of proposed silvicultural activity for the year, including stands to be thinned or harvested, fertilized, 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 insure 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 Chesapeake Forest Lands. It is the Department's intent that all revenues generated from the Chesapeake Forest Lands will be used to pay for the management and operation of the Forest. 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.

12.2 Objective

One of the eight original management objectives of the Chesapeake Forest states: - *"Maintain an economically self-sufficient forest that pays for the cost of management, operation, restoration and public use of these lands, plus makes a positive economic contribution to the natural resource future of the Eastern Shore. This will be accomplished through the sale of products and the sharing of revenues with the affected counties under Maryland law."*

The following information is a breakdown on Revenues and Operational expenses associated with Chesapeake Forest. Yearly changes in the timber markets and weather conditions can severely affect revenues. Also gradual changes in the acreage under hunt club lease agreements to more public hunting areas will reduce 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.

12.3 CHESAPEAKE FOREST REVENUE SOURCES:

Revenues that are generated from the Chesapeake Forest are deposited into the Department's Forest Reserve Fund. In order to cover expenses out of this Fund, a Chesapeake 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.

Hunt Club Lease Revenue

This is revenue generated from annual fees charged to Hunt Clubs for lease agreements. Fees are based on a per acre rate for exclusive hunting rights on specific forest tracts during the legal hunting seasons. This revenue source should remain constant with the current commitment to maintain 50% of the Forest in Public Hunting and 50% in leased hunting.

12.4 OPERATIONAL COST

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

Staffing Cost:

This cost is associated with Departmental contractual staffing and land management fees associated with private contractual management. A private contractual management team will implement timber sales and some forest management activities as prescribed in the annual work plan for the Chesapeake Forest. State Personnel are 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 and leased hunting programs and implementing all restoration projects.

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, forest fertilization, 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.

Forest Certification, Inventory & Monitoring Program Cost

This 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 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 Chesapeake Forest under both the Sustainable Forest Initiative (SFI) and the Forest Stewardship Council (SFC). 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.

County Payments

These are revenue payments to local county governments which will vary every year. Payments are made on an annual basis to each county government based on 15% of the revenue generated from the Chesapeake Forest in that county, except for Worcester County were the payment is based on 25% of the revenue generated. The higher payment to Worcester County resulted when the Department of Natural Resources acquired more than 20% of the county land base. The majority of the county payments come out of revenue generated from timber sales. These payments are used to help the counties offset the loss in property tax revenues which are not paid on state owned lands.

Fixed Costs

This expense includes all Public Drainage Association (PDA) tax assessments. This tax is paid only on the portions of the forest that fall within Public Drainage Associations. The annual tax is used to maintain drainage ditches within the boundaries of each association.

12.5 Other Revenue/Funding Sources

Annual Amounts vary

Other budgetary funding that is utilized on an annual basis in the management of Chesapeake 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 four fulltime state personnel working on the Chesapeake Forest, a forest manager, field forester and two forest technicians. 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.

12.6 Summary

This is the general breakdown on Revenues and Operational Cost associated with the Chesapeake Forest. As described, these amounts 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

Chesapeake Forest Project - Planning Organization

Listed below are the names of Steering Committee and Planning Team members who from the year 1999 through 2000, were responsible for the development of The Conservation Fund's original sustainable forestry plan for the portion of the property that was gifted to the State of Maryland in December of 2000.

Steering Committee

Objective: *The Steering Committee served as the decision making body for the planning process, they met with the Planning Team on a monthly basis to provide guidance and interim decisions. The members of the Steering Committee were:*
David Sutherland, Senior Vice President, The Conservation Fund, Arlington, VA, Chair
Mike Nelson, Assistant Secretary, Maryland Department of Natural Resources, Annapolis, MD
Don Baugh, Vice President, The Chesapeake Bay Foundation, Annapolis, MD
Larry Walton, Forester, Smurfit-Stone Forest Products Co., Pocomoke City, MD

Planning Team

Objective: *The Planning Team assembled data, illustrated options and decision choices, responded to Steering Committee decisions and Scientific Review Team comments, and prepared a Sustainable Forest Management Plan for the TCF-Mellon portion of the Chesapeake Forest, suitable as the basis for a conveyance of those lands to the State of Maryland, The plan established standards, methods and timetables that will meet, at minimum, the goals of the TCF-Mellon commitment, the Maryland DNR legal framework, and the Sustainable Forest Initiative Standard.*

Neil Sampson, Planning Coordinator; President, The Sampson Group, Inc., Alexandria, VA
Overall coordination; liaison with Steering Committee; communication with MD DNR and other sources of technical input; development of plan documents.

Dan Botkin, President, Center for the Study of the Environment, Santa Barbara, CA.
Identifies and clarifies ecological issues and data gaps to assure scientific integrity in documents.

Lester DeCoster, President, The DeCoster Group, Inc., Reston, VA. Issue identification and communications issues; regional economic data gathering and analysis; public presentation materials and visuals.

Matt Kamp, Forester, The Sampson Group, Inc., Alexandria, VA. Provides GIS and data management support for the Planning Team.

Steve Prisley, Associate Professor, Virginia Tech Dept. of Forestry, Blacksburg, VA.
Selects, adapts, and operates forest planning models and data, develops option scenarios, provides silvicultural expertise.

James Remuzzi, Forester, The Sampson Group, Inc., Alexandria, VA. Provides document preparation and review support for the Planning Team.

Evan Smith, Forester, The Conservation Fund, Arlington, VA. Coordinates field forestry operations with Smurfit-Stone foresters; provides forest management expertise; identifies local issues and experts.

Bill Street, Watershed Restoration Leader, Chesapeake Bay Foundation, Annapolis, MD. Prepares plan sections on water quality and watershed issues, identifies water quality enhancement opportunities in coordination with Maryland DNR scientists.

Scot Williamson, Field Representative, Wildlife Management Institute
Prepares habitat, endangered species, and other wildlife issues in plan in close coordination with Maryland DNR and USF&WS scientists.

Scientific Review Team

Objective: *The Scientific Review Team provided peer review of the planning process, the data and models utilized, and the resulting plan documents. The Team consisted of:*

Dr. Norman Christensen, Dean, Nicholas School of the Environment, Duke University
Dr. Don Boesch, President, University of Maryland Center for Environmental Science
Dr. John Gordon, Pinchot Professor of Forestry, Yale University
Carlton Owen, Wildlife Program Coordinator, International Paper Corporation

Maryland Department of Natural Resources

The Planning Team received continuous assistance from the personnel at Maryland DNR, and owed a great deal to their support and skill. Although a complete listing is impossible, the following deserve special recognition:

Jim Mallow, State Forester and Director, MD Forest Service
Gene Piotrowski, Director, Resource Planning
Mike Slattery, Director, Wildlife and Heritage Division
John Wilson, Chief, Eastern Region, Resource Planning
Kip Powers, Regional Forester, Eastern Region, MD Forest Service
Pete Jayne, Regional Manager, Eastern Region, Wildlife & Heritage Division
Glenn Therres, Chief, Biodiversity Program
Lynn Davidson, Natural Heritage Information Manager

Appendix B

Chesapeake Forest Lands - 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:

WILDLIFE PROFESSIONAL:
A person associated with a private or public Wildlife group/organization.

RECREATIONAL PROFESSIONAL:
A person directly connected with local tourism.

ECONOMIC INTEREST:
A person employed by or owner of a local forest product industry.

FORESTRY PROFESSIONAL:
A licensed professional Forester associated with a private business interest.

HUNTER:
A local hunter that would be a good representative of hunting interest

RECREATIONAL USER:
Rep from a local recreational business

ECOLOGIST:
A degreed Ecologist from a private firm or a local university

TIMBER INTEREST:
A forest products operator

CONSERVATION INTEREST:
A representative from a conservation organization

STUDENT REPRESENTATIVE:
A student with natural resource interest from a local college/university

FISHERMAN:
A local waterman

INDIGENOUS PEOPLES:
A representative from one of the local indigenous tribes

Appendix C

FSC Principles & Criteria for Forest Stewardship

FSC-STD-01-001 (version 4-0) EN
Approved 1993
Amended 1996, 1999, 2002

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[3]
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: Plantations
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.

For additional information go to the Forest Stewardship Council homepage at:
http://www.fsc.org/en/

Appendix D

SUSTAINABLE FORESTRY INITIATIVE® (SFI)

2010-2014 STANDARD

Note: This following information is an excerpt from Section 2 of the 2010-2014 SFI Standards. For additional details go to http://www.sfiprogram.org/sustainable_forestry_initiative_standard.php

SFI Program Participants believe forest landowners have an important stewardship responsibility and a commitment to society, and they recognize the importance of maintaining viable commercial, family forest, and *conservation* forest land bases. They support *sustainable forestry* practices on forestland they manage, and promote it on other lands. They support efforts to protect private property rights, and to help all private landowners manage their forestland sustainably. In keeping with this responsibility, *SFI Program Participants* shall have a written *policy* (or *policies*) to implement and achieve the following *principles:*

1. *Sustainable Forestry*
To practice *sustainable forestry* to meet the needs of the present without compromising 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 ecosystem services such as the *conservation* of soil, air and water quality, carbon, *biological diversity, wildlife* and *aquatic habitats,* recreation, and aesthetics.

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

3. *Protection* of Water Resources
To protect water bodies and *riparian* zones, and to conform with *best management practices* to protect water quality.

4. *Protection* of *Biological Diversity*
To manage forests in ways that protect and promote *biological diversity,* including animal and plant species, *wildlife habitats,* and ecological or natural community types.

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 forests and lands of special significance (ecologically, geologically or *culturally important*) in a manner that *protects* their integrity and takes into account their unique qualities.

7. Responsible *Fiber Sourcing* Practices in North America
To use and promote among other forest landowners *sustainable forestry* practices that are both scientifically credible and economically, environmentally and socially responsible.

8. Avoidance of *Controversial Sources* including *Illegal Logging* in Offshore *Fiber Sourcing*
To avoid wood fiber from illegally logged forests when procuring fiber outside of North America, and to avoid *sourcing fiber from countries without effective social laws.*

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

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

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

12. Public Involvement
To broaden the practice of *sustainable forestry* on *public lands* through community involvement.

13. Transparency
To broaden the understanding of forest certification to the *SFI 2010-2014 Standard* by documenting certification audits and making the findings publicly available.

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

OBJECTIVES FOR SUSTAINABLE FORESTRY

SUMMARY

Some *Program Participants* own forest land, others own forest land and manufacturing facilities, and others own manufacturing facilities only. As such:

• *SFI Standard* land management *objectives* 1-7 provide measures for evaluating *Program Participants*' conformance- with the *SFI 2010-2014 Standard* on forest lands they own or control through *long-term* leases. Through these *objectives,* addressed in forest management plans, *Program Participants* are implementing *sustainable forestry principles* by employing an array of economically, environmentally and socially sound practices in the *conservation* of forests — including appropriate *protection,* growth, harvest and use of those forests — using the *best scientific information available.*

• *SFI Standard fiber sourcing objective*s 8-10 provide - measures for evaluating *Program Participants*' conformance with the *SFI 2010-2014 Standard* through their *fiber sourcing programs* within the United States and Canada.

• *SFI Standard fiber sourcing objectives* 11-13 provide measures for evaluating *Program Participants'* conformance with the *SFI 2010-2014 Standard* through their *fiber sourcing programs* outside the United States and Canada.

• *SFI Standard* land management and *fiber sourcing objectives* 14-20 provide measures for evaluating all *Program Participants'* conformance with the *SFI 2010-2014 Standard* for research, training, legal compliance, public and landowner involvement, management review, and continual improvement.

A summary of *SFI 2010-2014 Standard objectives* follows:

Objective 1. Forest Management Planning
To broaden the implementation of *sustainable forestry* by ensuring *long-term* forest *productivity* and yield based on the use of the *best scientific information* available.

Objective 2. Forest *Productivity*
To ensure *long-term* forest *productivity*, carbon storage and *conservation* of forest resources through prompt *reforestation* soil *conservation, afforestation* and other measures.

Objective 3. *Protection* and Maintenance of Water Resources
To protect water quality in streams, lakes and other water bodies.

Objective 4. *Conservation* of *Biological Diversity* including *Forests with Exceptional Conservation Value*

To manage the quality and distribution of *wildlife habitats* and contribute to the *conservation* of *biological diversity* by developing and implementing *stand*-and *landscape*-level measures that promote *habitat* diversity and the *conservation* of forest plants and animals, including *aquatic species.*

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 ecologically, geologically, or *culturally important* in a manner that takes into account their unique qualities.

Objective 7. Efficient Use of Forest Resources
To promote the efficient use of forest resources.

Objective 8. Landowner Outreach
To broaden the practice of *sustainable forestry* by forest landowners through *fiber sourcing programs.*

Objective 9. Use of *Qualified Resource* and *Qualified Logging Professionals*
To broaden the practice of *sustainable forestry* by encouraging forest landowners to utilize the services of forest management and harvesting professionals.

Objective 10. Adherence to Best Management Practices
To broaden the practice of *sustainable forestry* through the use of *best management practices* to protect water quality.

Objective 11. Promote *Conservation* of *Biological Diversity, Biodiversity Hotspots* and *High-Biodiversity Wilderness Areas*
To broaden the practice of *sustainable forestry* by conserving *biological diversity*, *biodiversity hotspots* and *high-biodiversity wilderness areas.*

Objective 12. Avoidance of *Controversial Sources* including *Illegal Logging*

To broaden the practice of *sustainable forestry* by avoidance of *illegal logging.*

Objective 13. Avoidance of *Controversial Sources* including *Fiber Sourced from Areas without Effective Social Laws*

To broaden the practice of *sustainable forestry* by avoiding *controversial sources.*

Objective 14. Legal and Regulatory Compliance
Compliance with applicable federal, provincial, state and local laws and regulations.

Objective 15. *Forestry* Research, Science, and Technology
To support *forestry* research, science, and technology, upon which sustainable forest management decisions are based.

Objective 16. Training and Education
To improve the implementation of *sustainable forestry* practices through appropriate training and education *programs.*

Objective 17. Community Involvement in the Practice of *Sustainable Forestry*
To broaden the practice of *sustainable forestry* by encouraging the public and *forestry* community to participate in the commitment to *sustainable forestry*, and publicly report progress.

Objective 18: *Public Land* Management Responsibilities
To support and implement sustainable forest management on *public lands.*

Objective 19. Communications and Public Reporting
To broaden the practice of *sustainable forestry* by documenting progress and opportunities for improvement.

Objective 20. Management Review and Continual Improvement
To promote continual improvement in the practice of *sustainable forestry*, and to monitor, measure, and report performance in achieving the commitment to *sustainable forestry*.

For additional information on the Sustainable Forestry Initiative go to the homepage at:
http://www.sfiprogram.org/index.cfm

Appendix E

Chesapeake Forests Project: Soil Management Groups

This is a forest management grouping designed specifically for the Chesapeake Forest plan, based on the soil series descriptions contained in the six county surveys.

Management Group 1 – Poorly and very poorly drained medium textured soils with heavy subsoils.

Soils:
- Annemessex-Manokin complex
- Askecksy loamy sand
- Corsica mucky loam
- Crosiadore silt loam
- Elkton loam
- Elkton mucky silt loam
- Elkton sandy loam
- Elkton silt loam
- Fluvaquents
- Othello and Kentuck soils
- Othello silt loam
- Quindocqua silt loam

Description: These are poor and very poorly drained, medium textured soils that have a fine-textured 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. Fluvaquents are labeled in the Dorchester County survey, and may become part of a named soil series as newer soil surveys are published. 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
- Corsica and Fallsington soils
- Fallsington loam and sandy loam
- Fallsington-Glassboro complex
- Glassboro loam
- Hurlock loamy sand and sandy loam
- Klej loamy sand
- Klej-Galloway complex
- Klej-Hammonton complex
- Lenni loam and sandy loam
- Mullica-Berryland complex
- Othello-Fallsington complex
- Pocomoke loam
- Pone mucky loam and mucky sandy loam

Description: Medium and sandy-textured, poorly and very poorly drained soils on upland flats. Small areas in depressions will pond 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 loamy sand and sandy loam
- Fort Mott loamy sand
- Hambrook loam and sandy loam
- Hambrook-Sassafras complex
- Hammonton loamy sand and sandy loam
- Hammonton-Glassboro complex
- Ingleside loamy sand and sandy loam
- Ingleside-Runclint complex
- Keyport fine sandy loam and silt loam
- Manokin silt loam
- Matapeake fine sandy loam and silt loam
- Mattapex fine sandy loam and silt loam
- Nassawango fine sandy loam and silt loam
- Pepperbox-Rockawalkin complex
- Queponco loam and silt loam
- Rockawalkin loamy sand
- Sassafras sandy loam
- Woodstown sandy loam
- Woodstown-Glassboro complex

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 and sand
- Evesboro-Galestown complex
- Galestown loamy sand
- Galestown and Rosedale soils
- Rosedale loamy sand
- Runclint loamy sand and sand
- Runclint-Cedartown complex
- Runclint-Evesboro complex
- 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
- Honga peat
- Indiantown silt loam
- Johnston loam
- Kentuck mucky silt loam
- Longmarsh and Indiantown soils
- Manahawkin muck
- Nanticoke and Mannington soils
- Nanticoke silt loam
- Puckum mucky peat
- Sunken mucky silt loam
- Tangier mucky peat
- Transquaking and Mispillion soils
- Zekiah sandy loam and 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:	Beaches	Urban Land
	Miscellaneous water	Water
	Mixed Alluvial land	

Table 20: Map symbols used in county soil survey reports, by soil series & phase. Highlighted soil series indicate presence on CFL.

Soil Series	MG	Caroline	Dorchester	Talbot	Wicomico	Worcester	Somerset
Acquango sand	4					AcB, AcC	
Annemessex-Manokin complex	1						AoA, AoB
Askecksy loamy sand	1	AsA			AsA	As	
Beaches	-		1		Be	Be	Be
Berryland mucky loamy sand	2				BhA	Bh	
Bestpitch and Transquaking	5		2				
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, CdB			CdA	CeA, CeB	
Chicone mucky silt loam	5		3			Ch	
Corsica and Fallsington soils	2						CRA
Corsica mucky loam	1	CoA, CrA			CoA		
Crosiadore silt loam	1			CsA, CsB			
Downer loamy sand	3		4C				
Downer sandy loam	3		5A, 5B				DoA, DoB
Elkton loam	1		6				
Elkton mucky silt loam	1		8				
Elkton sandy loam	1					Ek	
Elkton silt loam	1	EmA	7	EmA		Em	EmA
Endoaquepts and Sulfaquepts	5				EQB		EQB
Evesboro loamy sand	4				EwA, EwB, EwC	EvA, EvB, EvC	
Evesboro sand	4	EwA, EwB	9C, 9E				
Evesboro-Galestown complex	4						EzB
Fallsington loam	2	FgA			FgA		FgA
Fallsington sandy loam	2	FaA	10		FaA	Fa	FaA
Fallsinston-Glassboro complex	2						FhA
Fluvaquents	1		11				
Fort Mott loamy sand	3		12A ,12B		FmA, FmB	FmA, FmB	
Fort Mott, Evesboro, and Downer soils	3		13E				
Galestown loamy sand	4	GaA, GaB	14A, 14B		GaA, GaB	GaA, GaB, GaC	GaB
Galestown and Rosedale soils	4	GAE					
Glassboro loam	2						GlA
Hambrook loam	3	HcA	15A, 15B				HcA
Hambrook sandy loam	3	HbA, HbB, HbC			HbA, HbB	HbA, HbB	HbB
Hambrook-Sassafras complex	3			HfB, HfC			
Hammonton loamy sand	3					HmA, HmB	HmA
Hammonton sandy loam	3	HnA	16		HnA		HnA

Soil Series	MG	Caroline	Dorchester	Talbot	Wicomico	Worcester	Somerset
Hammonton-Fallsington-Corsica complex	2	HoB					
Hammonton-Glassboro complex	3						HgB
Honga peat	5		17		Ho		Ho
Hurlock loamy sand	2					Hu	HuA
Hurlock sandy loam	2	HvA	18		HvA		HvA
Indiantown silt loam	5					In	
Ingleside loamy sand	3	IeA, IeB, IeC			IeA, IeB		
Ingleside sandy loam	3	IgA, IgB, IgC	19A, 19B				IgA, IgB
Ingleside-Runclint complex	3						IkC
Johnston loam	5						
Kentuck mucky silt loam	5			KnA		Ke	
Keyport fine sandy loam	3				KfA, KfB		
Keyport silt loam	3		20				KpA
Klej loamy sand	2					KsA, KsB	
Klej-Galloway complex	2	KgB			KgB		KgB
Klej-Hammonton complex	2		21				
Lenni loam	2	LgA			LgA		
Lenni sandy loam	2	LhA			LfA		
Longmarsh and Indiantown soils	5	LO			LO		LO
Manahawkin muck	5	Ma			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		22A, 22B	MtA, MtB		MkA, MkB	
Mattapex fine sandy loam	3		23		MpA	MpA, MpB	
Mattapex silt loam	3	MtA, MtB	24A, 24B		MtA, MtB	MqA, MqB	
Miscellaneous water	-	M-W			M-W		M-W
Mixed Alluvial land	-						
Mullica-Berryland complex	2				MuA	Mu	MuA
Nanticoke and Mannigton soils	5	NM			NM		NM
Nanticoke silt loam	5		25				
Nassawango fine sandy loam	3				NnA, NnB	NnA, NnB	
Nassawango silt loam	3	NsA, NsB		NsA, NsB	NsA, NsB	NsA, NsB	
Othello and Kentuck soils	1		27		OKA		OKA
Othello silt loam	1		26	OtA	OtA	Ot	OoA, OtA
Othello-Fallsington complex	2						OvA
Pepperbox-Rockawalkin complex	3				PrA, PrB		
Pocomoke loam	2						
Pone mucky loam	2		29				
Pone mucky sandy loam	2		28				
Puckum mucky peat	5	Pk	30		Pk	Pk	Pk

Soil Series	MG	Caroline	Dorchester	Talbot	Wicomico	Worcester	Somerset
Purnell peat	5					Pu	
Queponco loam	3						QbB
Queponco silt loam	3						QeA, QeB
Quindocqua silt loam	1						QuA
Rockawalkin loamy sand	3	RkA			RkA, RkB		
Rosedale loamy sand	4	RoA, RoB			RoA	RoA, RoB	
Runclint loamy sand	4				RuA, RuB	RuA, RuB	
Runclint sand	4		31A, 31B		RsA, RsB		RsB
Runclint-Cedartown complex	4				RwA, RwB		RwB, RwC
Runclint-Evesboro complex	4						RxB
Sassafras loam	3		32				
Sassafras sandy loam	3	SaA, SaB				SaA, SaB, SaC	
Sunken mucky silt loam	5		33		SuA	Su	SuA
Tangier mucky peat	5						Ta
Transquaking and Mispillion soils	5	TP			TP	TP	TP
Transquaking mucky peat	5					Tk	
Udorthents	4	UbB, UfF, UoB	34		UbB, UfB, UoB	Uz	UbB, UfB, UfF, UgB, UoB, UwB
Urban Land	-	Up					
Water	-	W	W		W	W	W
Woodstown loam	3	WoA, WoB	35				WoA
Woodstown sandy loam	3	WdA, WdB	36A, 36B		WdA	WdA, WdB	WdA, WdB
Woodstown-Glassboro complex	3						WpA
Zekiah sandy loam	5	Za					
Zekiah silt loam	5			Zk	Zk	Zk	

Appendix F
FIDS/FORESTRY TASK FORCE

Chesapeake Bay Critical Area - Timber Harvest Plan Guidelines

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.

HOW TO USE THE 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 on pages 137-138 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 on page 129, 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 on page 137-138, 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 others which 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 on page 147.

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.

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 disjunct if separated by at least 30 feet of nonforested 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 Natural Heritage Program on a case by case basis.

5. **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 on page 147.

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:

- focus traditional wildlife management practices, such as wildlife food plots, near existing forest edges
- minimize the number, length and width of forest roads
- 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 ≥ 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 stand 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 21 on pages 143-144 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 page 147.

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 Division 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:
      (1) 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).
      (2) 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.
      (3) Adjacent to existing loblolly pine stands.
      (4) 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 21 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 ≥ 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 forest types on pages 143-144, 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 21 on pages 143-144 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 on page 147.

1. *Use Table 21 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 Division 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:
   (1) 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).
   (2) 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.
   (3) Adjacent to existing loblolly pine stands.
   (4) 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.

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 ≥ 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 21: Silvicultural methods that are allowable in upland hardwood forests.

% 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

Table 21: Continued

> 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 22 below on pages 146 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 on page 147.

1. *Use Table 22 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 22. Silvicultural methods allowable in riparian forests.

Table 22: Silvicultural methods allowable in riparian forests

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/COVE 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 147. *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 Division 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 Natural Heritage Program. These measures could include no harvesting.

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 nonforested 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 G

THE HISTORICAL AND ECOLOGICAL ROLE OF FIRE IN THE FORESTS OF MARYLAND'S EASTERN SHORE

Allen R. Carter

FIRE HISTORY

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.

Use of Fire by Native Americans

Frost (1988), in his Presettlement 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.

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.

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 1800's and early 1900's, 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.

THE ECOLOGICAL ROLE OF FIRE

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 presettlement 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".

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 resprout 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 advance 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 midstory and understory trees would provide adequate light for the oak advance 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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Appendix H

Criteria for Assessing Suitability of Tracts for Public Use

Each Chesapeake Forest tract was evaluated based on the criteria listed below a tract had to meet at least two of the listed criteria in order to be considered for Public Hunting. **Access** into the tract was one of the major factors for consideration.

Criteria

A **Proximity** to other DNR lands-
Lands adjacent or very close to existing DNR lands;
Land managers have staffing in close proximity to manage and monitor these tracts effectively.

B **Size of Complex:** Meets minimum total acreage (250 acres) of all contiguous tracts. Larger sized tracts or complex improves ability to manage area effectively for public use.

C **Access** into complex is directly off of a public road without having to use a right-of-way that crosses private land. This will allow for establishment of main access points and public parking areas.

D **Water Access:** These tracts or complexes have access points on water that could be used by kayakers and canoe paddlers.

E **Readiness** for Public Use: There is an existing network of suitable roads, parking areas and or trails that can be utilized with minimal improvement work.

F **Opportunities** for Public Use: These tracts or complexes hold opportunities for recreation and education activities, based on factors such as diversity of habitats, species, forest age classes and the presence of special features.

G **Location:** under this criteria are tracts/complexes that based on their location in the county provide new opportunities for Public Use that may be lacking in that area.

A few years ago a review was completed of the Chesapeake Forest to determine the best areas to open to public hunting, keeping in mind that the Forest Service was tasked to open at least 50% of the Forest for that purpose by the 2005/2006 hunting season. This review identified over 28,000 acres that met the review criteria listed above for Public Hunting, which included several miles of shoreline that will be available for waterfowl hunting. The task of opening up this land was completed over a two year period with 14,500 acres opened for public hunting in the 2004/2005 hunting season and the remaining opened prior to the 2005/2006 hunting season.

Appendix I

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 J

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 23). 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 23: 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 24: 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	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	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	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	Wildlife Management Area	18 (7.1)
	Lower Dan's	Wildlife Management Area	25 (10.2)
	Upper Mill Run	Wildlife Management Area	129 (52.2)
State Park Lands			
Rocky Gap State			
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	42 (17.0)
Wye Island NRMA			
Queen Anne's County	Schoolhouse Woods	Natural Resources Management Area	14 (5.8)
Monocacy			
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

Scientific Name	Common Name	Typical Life Span	Maximum **Life Span**	**Half of Maximum Attainable Age***	**40% Maximum Attainable Age****
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
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	East Cotonwood	60	100-200	75	60

Scientific Name	Common Name	Typical Life Span	Maximum **Life Span**	**Half of Maximum Attainable Age***	**40% Maximum Attainable Age****
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
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

Scientific Name	Common Name	Typical Life Span	Maximum **Life Span**	**Half of Maximum Attainable Age***	**40% Maximum Attainable Age****
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 K

CFL – Modeling Long-term Sustainability

The model reflected in this appendix was created in April 2007 and details a 50 year projection on the effects of various forest management activities identified in this plan. In order to run the model on Chesapeake Forest the first step was to identify each stand (or polygon in the GIS system) with four attributes (called *themes* in the Spatial Woodstock lexicon) that describe its current situation. The following lists indicate the themes chosen to represent forest stands in the Chesapeake Forest model.

THEME 1 – Primary Forest Type

AWC Atlantic White Cedar – A special type planted for restoration. May be associated with baldcypress in some stands.
HP Hardwood Pine – A mixed pine-hardwood forest containing over 50% hardwood
LP Loblolly Pine – A pine forest or plantation containing over 75% loblolly pine
MH Mixed Hardwood – A hardwood stand with over 75% hardwoods (oak, maple, gum, poplar, etc.)
NO Non Operative – Non-forest land such as transmission lines, railroads and roads, plus areas that are too wet (open marsh, wetland pool) or isolated and inaccessible for mechanical operations.
NP Native pines (pond, pitch, shortleaf) – Not common currently, but some special sites are slated to be converted to these species upon removal of the existing forest cover.
PH Pine Hardwood – A mixed pine-hardwood forest containing 50-75% loblolly pine.

THEME 2 – Management Area Designations

C Delmarva fox squirrel core area
E1 Ecologically Significant Area Zone 1
E2 Ecologically Significant Area Zone 2
E3p pulp ESA Zone 3 (pulpwood management)
E3s saw ESA Zone 3 (sawtimber management)
F Delmarva fox squirrel future core area
FID Forest Interior Dwelling Bird Habitat
GEN General Forest Management Area
SB Stream Bottomland

THEME 3 – Thinning Status

PCT pre-commercially thinned
T1 thinned once
T2 thinned twice
UT not thinned

THEME 4 – Regeneration Status

N Natural Regeneration
P Planted
X Non forest or unknown

The model is then programmed to carry out the primary forest management activities (Section 5.4). In terms of timber production and maintenance, those are thinning and regeneration harvests, primarily involving the loblolly pine. To do this, the model must be able to identify which stands are eligible (correct age, cover vegetation, and management area) to be thinned or harvested, then which (if any) of the theme attributes need to be changed to reflect the post-activity condition. A sample of that programming would be:

ACTION aThin1 N 1st thinning *(The action is labeled **aThin1,** the **N** means that this activity does not re-set the age of the stand to 0)*

*OPERABLE athin1 *(The following represent the areas eligible for first thinning)*

Pine mgt ok2t1 _AGE 15 _AGE 22 _LOCK 6 *(This code instructs the model to thin pine stands (LP, HP, PH) in the Management zone (GEN, C, F, and E3s) that are either unthinned or pre-commercially thinned between the ages of 15 and 22, then lock it up from any further thinning or harvest for 6 years)*

pine FID ok2t1 _AGE 20 _AGE 30 _LOCK 7 *(In pine stands in core FID habitat, thinning is held off to an older age to minimize disturbance and the lock is extended one year).*

ACTION aCC Y *(this action is to clearcut and regenerate a new stand. The Y means that after this action, the age of this stand is re-set to 0 in the model.)*

*OPERABLE aCC

? E3p ? _AGE >= 25 & _AGE <= 30 *(This means that, in the E3p zone, where the plan calls for short-rotation pine pulpwood management, all forest types, in all thinning categories, will be clearcut and regenerated between 25 and 30 years of age.)*

pine c ? _AGE >= 60 & _AGE <= 80

pine gen t2 _AGE >= 35 & _AGE <= 40

(These two code lines say that pine forests in the core fox squirrel area, in all thinning categories, will be harvested after age 60 and before age 80, while those in the general category that have been thinned twice will be harvested at age 35-40.)

There are many other action codes so that all possibilities are defined and the model is able to move through the yearly steps and select stands for treatment that meet the eligibility requirements. As each activity is carried out, the model contains *yield tables* that tell how much, and what kind, of timber product will be produced. The tables in the Chesapeake Forest model have been developed from the actual measurements of thinning and harvest operations during the 2000-2006 operating years, so provide a well-documented set of yield estimations.

From these yields come dollar estimates of the return to the forest. These, too, are the average net stumpage prices received from actual sales in 2000-2006. These prices have been used (without inflation) for the 50-year model. As can be seen from the graphics that follow, pine pulpwood returns very low net proceeds, and virtually all of the timber income on the Chesapeake Forest is generated by the sale of pine sawtimber. Hardwood sawtimber is of very limited quantity and low quality on these lands, and there have been no hardwood timber sales in 2000-2005. Hardwood pulpwood is removed as needed for stand improvement, but seldom attracts a price that will pay for the logging and hauling costs, thus resulting in a net zero or financial loss. Those conditions may change in the future, but for the purpose of this modeling exercise, they were assumed to continue.

Optimizing and Constraining the Model

Spatial Woodstock links to a linear program solver to derive a "best fit" solution for the desired objectives. In these runs, the model uses LPABO, a freely available LP solver that appears to be adequate for this size model. The model is optimized to seek the maximum timber return to the landowner, thus the focus on building and maintaining pine sawtimber harvests as the primary financial driver in the forest. In looking at financial returns, it is important to remember that they are not inflated into the future, so changes represent the quantity of material sold, not the prices foreseen.

To achieve reasonably smooth results in the face of the uneven age distribution facing forest management in the early years, it was necessary to constrain the model. Testing many options resulted in selecting the following constraints for the runs illustrated below:

- Total thinned and harvested area is held to less than 3,500 acres per year.
- First thinning area is held to less than 1,000 acres per year for years 1 to 10.
- Clearcut area is held to less than 900 acres per year for years 1 to 10
- Total pine harvest volume is forced into even-flow constraints allowing only 30% difference (up or down) between adjacent years.
- Thinning (both first and second) and clearcut acres are all forced into even-flow constraints allowing only a 35% difference between adjacent years.
- Available pine inventory can only vary 20% year-to-year.

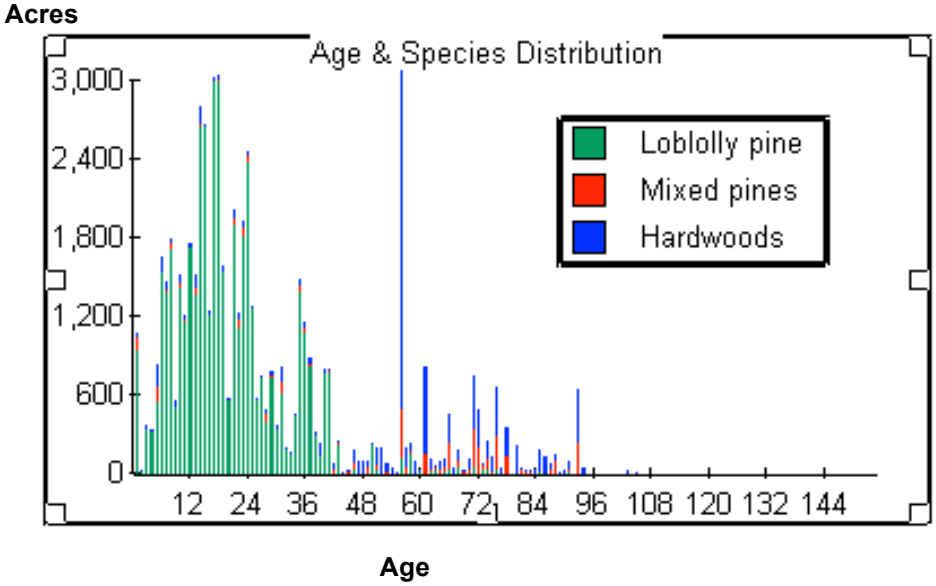
Other constraints could be tested and imposed, but these seemed to produce the best results in testing thus far.

The Results

The following figures illustrate some of the results of the Chesapeake Forest model as it is currently constructed. Remember that year 0 in the model is now 2007, and the forest ages have been updated to current conditions. Work to make corrections to the GIS database continues, so the actual values in the model runs may well change as the data are improved, but these illustrations can be used to indicate general trends in future conditions under the planned management system. It is anticipated that, as staff gets more expert in model formulation, or, as conditions change, the model will be updated and expanded to illustrate additional trends. That is made reasonably easy through the integration of the model data in the GIS system, since each update of the GIS will then be reflected in new model runs.

Figures 18 and 19, on the next page, illustrate the impact of the forest management system on the age and species distribution within the Chesapeake Forest. In 2007, the majority of the land (the y axis is acres) was in pine and the age was heavily skewed toward the 18-25 year ages. (In 1999, when the Chesapeake Forest Project was launched, the land was dominated by 12-18 year old pines. The current situation illustrates 7 years of aging plus management actions to achieve a more normal age distribution.)

Figure 18: Age and species distribution at the start of the model runs (2006)



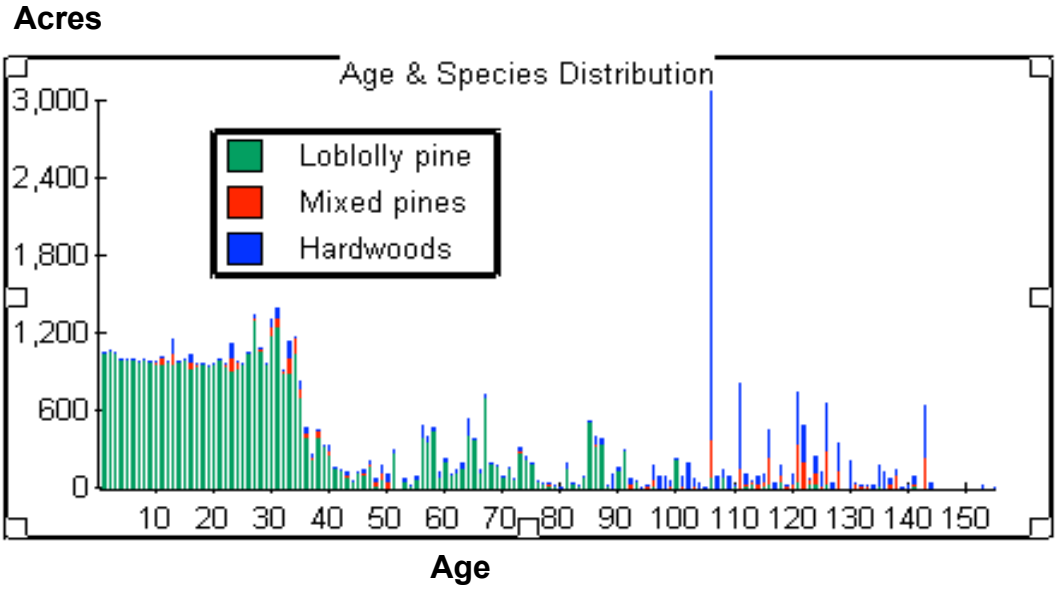


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Figure 19: Age and species distribution after 50 years.

Figure 19 above illustrates the impact of the 50-year management plan. The hardwoods have largely aged 50 years, since few if any have been harvested. The age distribution on the pine forests is much more "normal," with approximately the same amount of each age class. There will be a significant increase in mixed pine-hardwood forests, due to actions designed to enlarge stream buffers and convert critical habitat areas to a more mixed forest condition

Figure 20: Acres of first and second thinnings, harvests, & total area treated.

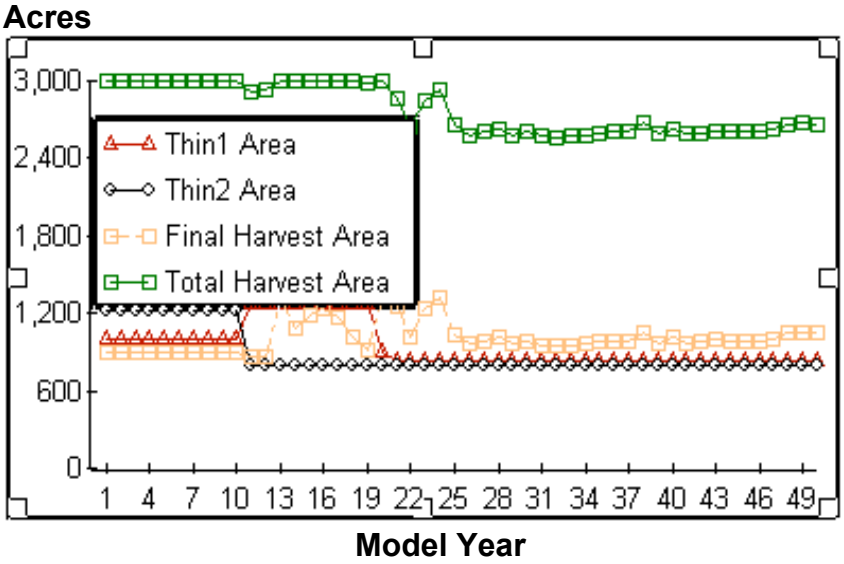

Figure 20 illustrates the model's estimate of the amount of land to be thinned and clearcut over the 50-year time frame. One goal was to keep that activity level reasonably stable, as a means of assuring that contractors could find predictable work, mills could rely on reasonably predictable wood supplies, and other community impacts would be fairly stable. This, of course, cannot predict the vagaries of weather or markets that can dramatically alter the amount of work able to be done in any given year. What the model indicates, however, is that the planned management system can produce a reasonably stable economic impact if these other factors do not alter conditions too seriously.

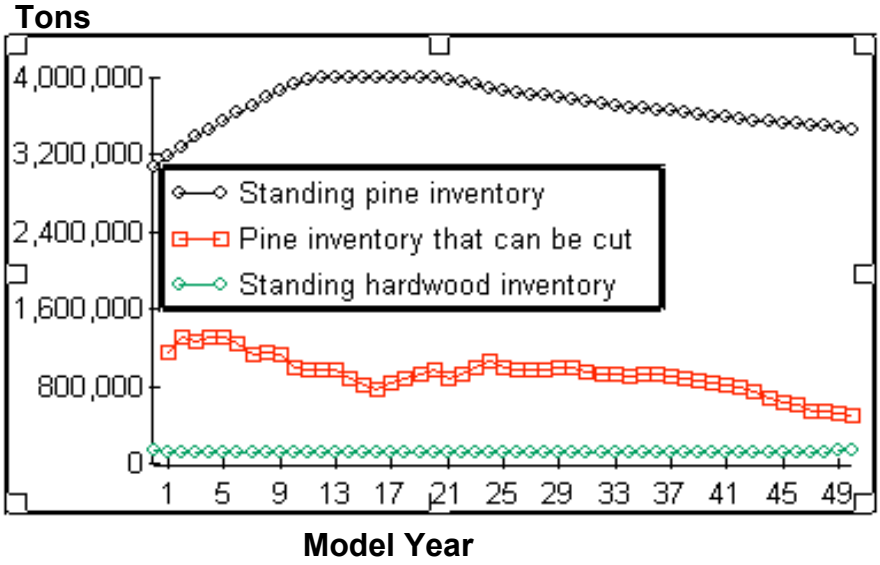

Figure 21: Amount of standing pine inventory & inventory available for harvest.

Figure 21 illustrates the growth in standing pine inventory as the current stands grow older and larger, then a gradual decline as more hardwoods are included in the stands. The available pine inventory, however, stays stable throughout the 50-year projection at somewhere around 1 million tons per year.

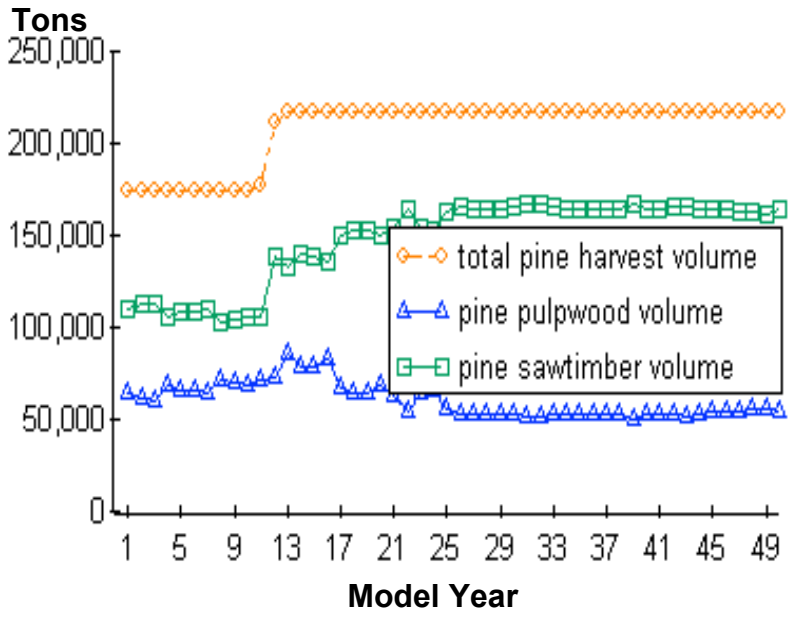

Figure 22: Est. harvest volumes of pine sawtimber & pulpwood over 50 years.

Figure 22 estimates the pine harvest volumes over the 50-year model. The volume of pulpwood remains fairly stable, since the current stands are undergoing thinning that produces mainly pulpwood, and the current thinning levels are about what can be anticipated to continue. The sawtimber volume increases fairly significantly as the young stands mature and the harvest cycle begins in full after about 20 more years. This moves the annual sawtimber harvest into the 170,000 ton range – about 25 to 30 million board feet of timber a year.

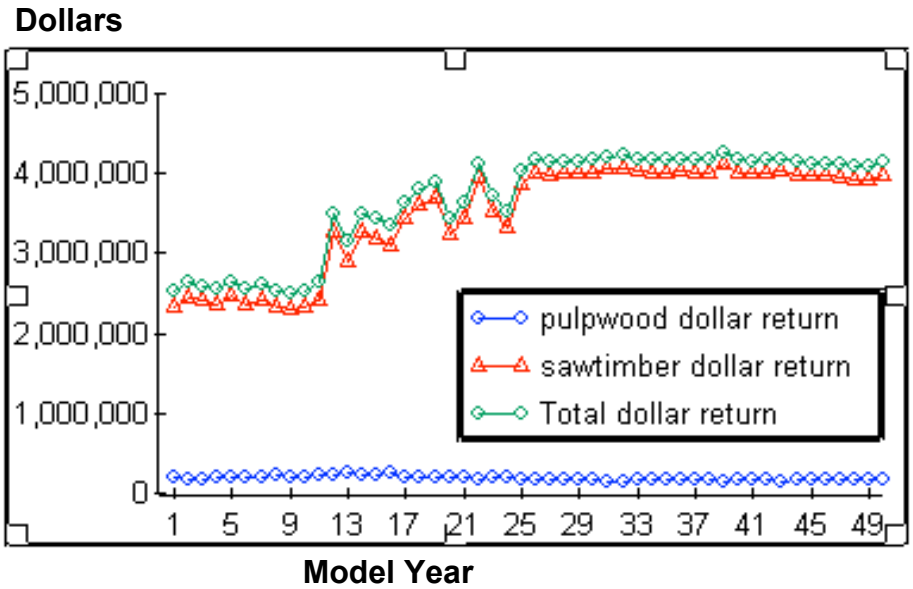

Figure 23: Model estimates of dollar return from timber sales over 50 years.

Figure 23 illustrates the potential financial returns to the Chesapeake Forest from the planned timber harvesting program. Note that while these are net stumpage estimates, they are gross income into the Chesapeake Forest, and must pay for all forest investments (planting, prescribed fire, pre-commercial thinning, fertilizing, etc.) as well as land management costs. What the model shows, however, is that the current management plan should result in relatively steady financial results for the next 10-15 years, followed by an increasing trend as more sawtimber enters into the market mix. That should stabilize at a level almost double what is realized today, and stay reasonably stable thereafter.

Since the Spatial Woodstock program is capable of assigning activities to the various polygons on which they occur, the next modeling step is to create 5-year activity maps that can be reviewed in the field to develop short-term strategic plans. Here, field foresters look at the model proposals and test them for validity on the ground. The basic question is: how do managers plan to best achieve the projected results?

The model has been programmed to avoid activity on tiny, scattered patches because they are either inefficient or inaccessible, and to limit clearcut harvests to 40 acres or less to meet FSC certification requirements. Clearcuts are also not allowed adjacent to other clearcuts until the new stands are 4 years old, to meet the adjacency requirements of the SFI Standard.

In spite of those programmed limits, the model sometimes suggests activities where they are not efficient or suitable, so each proposal must be field checked before it is included in an Annual Work Plan. If the field checking discovers that a stand has been misclassified in the GIS system and the model, those classifications are corrected.

At the end of each quarter, the GIS data base is updated to reflect all activity during the quarter. In this way, new model runs can be created at any time in the future to maintain a watch over the

continued impacts on long-term sustainability as well as develop new 5-year activity schedules for continuous update and improvement of the management system.

Habitat values are somewhat more elusive, in that habitat quality is often affected as much by the size, location, and connections of stands as by the age and condition. We have identified some aspects that can be identified from the available age and stand size parameters, but the modeling effort continues to search for good habitat indicators that can be added to the model.
Figure 21 illustrates the changing range of tree size in the pine forests. Here, the existence of pole-sized pines (10" dbh and up) has been identified as one indicator that stands were beginning to reach the size that Delmarva fox squirrels utilize, and the existence and maintenance of larger (16"+ dbh) pines means even higher quality habitat. Using cruise data, a yield table was built to reflect the proportion of stands that met these size thresholds. Thus, a 100-acre stand that had 50% pole-sized pines would be shown as 50 acres of pole size.

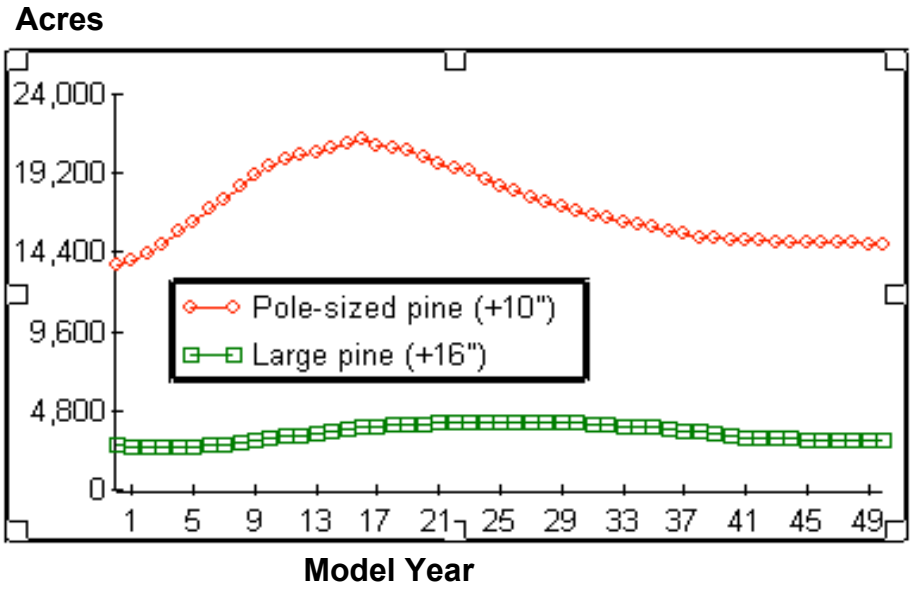

Figure 24: Area of pole-sized (+10" dbh) and large (+16" dbh) pine over time.

Other important habitat types are open or early-successional types that support a variety of species, and the critical water and water-related features on the landscape. As Figure 24 illustrates, open and early successional habitat types tend to be fairly dynamic during the early years while the age lumps are being worked out of the forest. Once the age distribution begins to even out, the average amount of open and early successional habitats becomes more stable, at somewhere around 9% of the total area.

Water and associated buffer areas are critical to many species, but the model does not change those, as Figure 25 illustrates. Those areas will be altered somewhat during field operations as buffers are established or expanded to meet water quality and habitat goals. Those alterations will be entered into the GIS system as they occur, and thus future model runs will show somewhat different (and probably larger) water and buffer areas based on new GIS mapping.

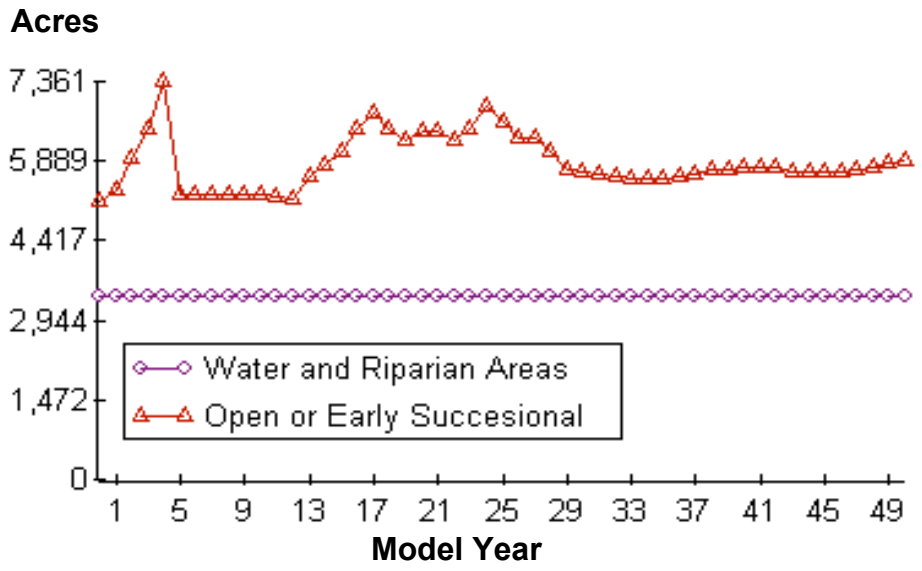

Figure 25: Areas of open or early successional habitat, water & associated buffer areas.

Another indicator of habitat quality identified to date involves the size of the timber in what have been grouped as "habitat" timber types. These include ESA zones 1 and 2, stream and marsh buffers, habitat retention areas, FID core areas and inaccessible forests that are retained as habitat areas. Figure 23 indicates the area of 10" trees (of all species) likely to occur in those areas and suggests a steady growth of older, larger forests in the lands managed largely for habitat values.

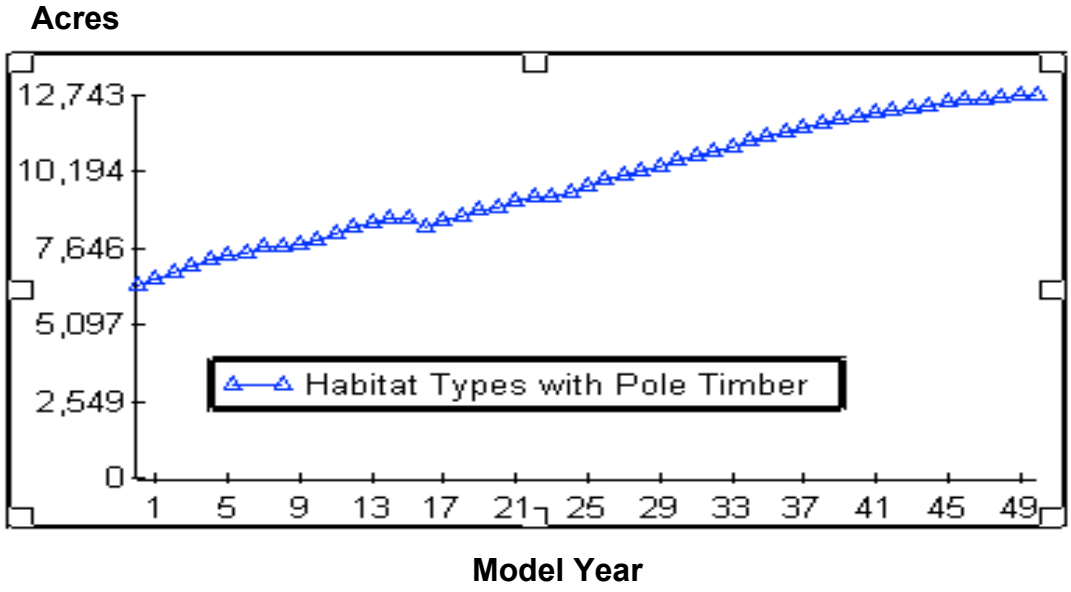

Figure 26: Area of land managed primarily for wildlife habitat, trees 10" & larger.

Appendix L

Land Additions and Acquisitions to Chesapeake Forest

Wicomico Demonstration Forest:

This property consisting of 1,264 acres and located in eastern Wicomico County was originally established in 1936 as a U.S. Forest Service Research Station. The majority of the property which was abandoned farmland and woodlots was purchased by the U.S. government between 1936 and 1941. The existing offices and shop buildings on the property were built in 1937. Then in 1942 the research forest along with the buildings were leased to the State of Maryland, this arrangement continued until 1955 when title of the property was deeded over to the State. The deed which has a reversionary clause calls for the State to continue to manage the forest for the purpose of demonstrating forestry practices. The federal government still holds mineral rights to the property.

For the past 65 years the Maryland Forest Service has carried through on implementing and demonstrating forestry management practices. This long standing use of the Wicomico Forest mirrors many of the principles of Sustainable Forestry that were established for the Chesapeake Forest Lands, also when the Chesapeake Forest was acquired a number of large Chesapeake Forest tracts adjoined the boundaries of Wicomico Forest. So in July of 2006 the decision was made to move the Wicomico Demonstration Forest under the same management oversight as for Chesapeake Forest Lands.

Seth Demonstration Forest:

This property consisting of 122 acres is located in central Talbot County just east of the town of Easton. This small forested tract was gifted to the State of Maryland by Mary W. Seth in 1928 that according to the deed "shall be under management of the State Department of Forestry and used to demonstrate proper forestry practices." The deed for this property has a reversionary clause that it must be used for the purpose identified in the deed. This property has been managed over the past 80 years by the Forest Service for the purpose as noted above in addition this tract also contains an Ecologically Significant Area (ESA). The Seth Demonstration Forest does not adjoin any Chesapeake Forest parcels, however due to the existing management of this Forest being in line with the same goals as Chesapeake Forest, and to simplify the day to day management of this area the decision was made in July of 2006 to add this area under the CFL Sustainable Forest Management Plan.

Blackwater Resort Acquisition:

In June of 2007, the Maryland Department of Natural Resources acquired approximately 728 acres of property which was formerly part of the Blackwater Resort development in Cambridge, Dorchester County. The primary objective for this purchase is to provide additional water quality and wildlife habitat benefits for this property which lies in the headwaters of the Little Blackwater River. The importance of this acquisition to Chesapeake Forest Lands in addition to the habitat and water quality benefits is that it borders the eastside of the CFL Dail Tract and connects out to Egypt Road which will provide additional access into the property. The Blackwater acquisition will potentially provide future benefits in that it is an important link that will eventually connect with other acquisitions which in turn will connect other CFL properties.

Of the 728 acres, approximately 588 acres are currently in agricultural production. The remaining

acreage is currently in forest buffers along adjacent streams. The enhancement plan for this property incorporates a number of different activities and interest. The primary objective of the plan is to improve the quality of the waters entering Maple Dam Branch and the Little Blackwater River. The secondary objective is to enhance habitat for aquatic fish species and upland wildlife species. The enhancement plan provides for these improvements through the protection and enhancement of existing forest and stream buffers, and by the incorporation of wetlands and stream enhancements, reforestation and agriculture. This parcel will also provide a significant addition to a CORE Fox Squirrel area that encompasses several CFL tracts in this area and will be beneficial in the management and protection of this federally endangered species.

Foster Estate Property:

The Foster tract was the largest private contiguous land holding left on the Eastern Shore totaling 4,768 acres. The tract is located in Worcester County west of Nassawango Creek and between Millville Creek to the north and Furnace Creek to the south. The property is bordered by Pocomoke State Forest to the southwest and the northeast. About 80% of the tract lies within the Nassawango Creek watershed. The Nature Conservancy negotiated the deal — the organization's largest-ever transaction in Maryland — they worked with state and federal partners to help secure $14.4 million for the acquisition. The Conservancy has been working with partners to connect a corridor of conservation lands along Nassawango Creek, which feeds into the Pocomoke River and ultimately the Chesapeake Bay.

At least five state-rare plant species inhabit the property, including the white-fringed orchid, which is threatened primarily by the loss of its natural bog habitat. Similarly, many deep-forest-dwelling birds that are losing habitat elsewhere will benefit from the Foster acquisition.

Lindner property

The former Lindner property totaling 322 acres is surrounded on 3 sides by Chesapeake Forest lands. It is located in the Little Blackwater Watershed in Dorchester County. The property consists of 218 acres of forests, 108 acres of forested wetland and approximately 103 acres of fields. The property is also in the Nature Conservancy's Blackwater matrix forest block near the Blackwater Unit of the Chesapeake Marshlands National Wildlife Refuge Complex.

Sustainable Conservation Properties,

Seven parcels located in four counties totaling 1,073 acres was originally part of the Glatfelter Pulpwood industrial forest land properties. Sustainable Conservation Inc, a branch of The Conservation Fund purchased the properties in 2004 as part of a major timberland transaction where all the timberlands in Maryland owned by Glatfelter Pulpwood were sold. Most of the Glatfelter timberland was sold to The Forestland Group, but a few select tracts with unique environmental characteristics were purchase by Sustainable Conservation, Inc.

These parcels are located in various counties throughout the Eastern Shore and are situated adjacent to Chesapeake Forest and other State owned and protected lands. Once this parcel is acquired, it will become part of Chesapeake Forest Lands and will be managed under the Sustainable Forest Management Plan for the forest. This will insure that forest products from this tract will continue to be available to local forest industries. Also the land will be available for the general public and will provide a multitude of recreational activities. The Lankford Tract adjoins Deal Island WMA and is in

very close proximity to several Chesapeake Forest parcels, the Evans tract borders Monie Creek directly across from Deal Island WMA and is in close proximity to several Chesapeake Forest parcels. By acquiring these tracts it will enhance our ability to effectively manage our Chesapeake Forest properties.

Besley Rodgers Inc.

This acquisition totals approximately 1,036 acres of land broken down into five separate tracts which are part of the forestland properties belonging to Besley and Rodgers, Inc. This company was started 1942 by the first State Forester of Maryland (Fred Besley) and his son, was one of the largest private non-industrial forest landowners in Maryland. The properties are located west of Fishing Bay WMA and to the south of the Blackwater National Wildlife Refuge with one tract located on Taylors Island surrounded by Nature Conservancy property. These tracts are intensively managed forestlands that serve as critical habitat for ducks, American bald eagle, peregrine falcons, and Delmarva Fox Squirrels.

The tracts also contain a significant amount of non-tidal wetlands, marshlands and habitat for sensitive species and they border several important creeks such as Slaughter Creek, Farm Creek and Coles Creek. With the total ownership exceeding 1,000 acres this acquisition represents a significant step towards protecting the water quality of the Chesapeake Bay. As outlined in the “Protecting the Forests of the Chesapeake Bay Watershed” Response to Directive 06-1, Maryland agreed to, by 2020, to “permanently protect an additional 695,000 acres of forests”. Protection of the Beasley and Rodgers, Inc. tracts is significant step in reaching this goal.

APPENDIX M

Framework for Identifying Water Quality Improvements

The approach taken for water quality and hydrologic objectives is based on the consideration of the geomorphic setting, meaning that the location of water quality improvement projects to manage for desired hydrologic and/or water quality conditions are based on the landscape conditions (see Table 25). The desired hydrologic conditions have been identified as those that mimic, to the extent possible, the natural hydrologic conditions characteristics of the specified geomorphic setting, landscape feature, and/or drainage network location. The desired water quality conditions target the removal of 90% of the input concentrations of total suspended sediment, total nitrogen, and total phosphorous (100 * output-input / input). The buffer widths specified in the Sustainable Plan have been based on groundwater removal rates of nitrate nitrogen and surface removal rates of sediment, nitrogen, and phosphorous documented in Maryland's Coastal Plain, and designed to meet or exceed target removal rates.

Two scales are considered in the physically based buffer planning approach, including the *hydro-geomorphic regions* (Figure 27) on the Lower Delmarva Peninsula and *drainage network locations*. These scales were used to differentiate generalized flow paths (surficial or subsurface) and dominant pollutant pathways. Special geomorphic features within the lower Delmarva Peninsula were also considered, including Carolina (Delmarva) Bays, relic dune formations, and well-drained land areas within poorly drained settings. Drainage network locations were differentiated based on stream order.

Two primary assumptions are associated with this approach: 1) there is a consistency in the physical environment characterizing each hydro-geomorphic region, with the exception of the special features that have been identified; 2) there are different geomorphic processes occurring within the drainage network, including the convergence of localized groundwater and surface water flows in headwater areas, sediment production in headwater non-tidal channels, and sediment storage in higher order non-tidal channels. Based on these assumptions, it is concluded that opportunities are greatest for watershed scale pollutant removal in headwater areas and geomorphic floodplain environments associated with higher order stream channels. It is also concluded that the existing artificial drainage ditches are currently the most efficient pollutant pathways in the poorly drained areas, thereby providing a focus for the reduction in pollutant export efficiency. The recommended buffer widths therefore reflect consideration of the hydrologic signature of the landscape setting, which is assumed to promote possible secondary benefits related to the conservation of natural hydrologic conditions in aquatic habitat areas.

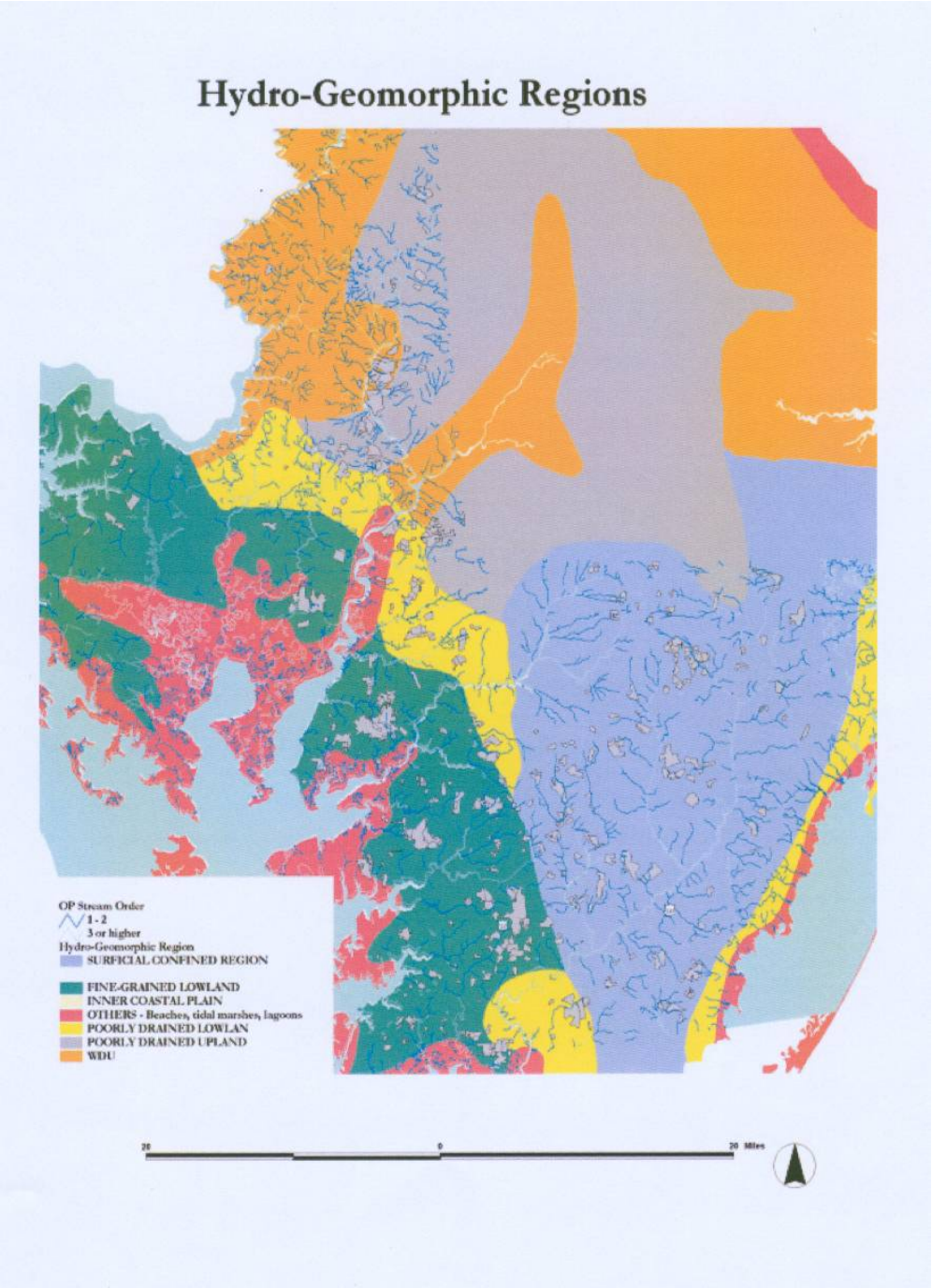

Figure 27: Hydro-geomorphic regions on the lower Delmarva Peninsula

Table 25: Hydro-geomorphic Content for Water Quality Improvement

Geomorphic Feature	Geomorphic Region	Soil Type	Hydrology / Dominant Pollutant Path	Rationale / Strategies
1,2 order stream (Case 1)	Well Drained Upland Surficial Confined ridges, dunes* Poorly Drained Upland (PDU) hilly topo	Non-hydric Soils adjacent to riparian area, including: ▪ Well Drained outside of riparian areas ▪ Well drained sandy loam in Surficial Confined ridges/dunes ▪ Well drained sandy loam in Poorly Drained Upland hilly areas	Water table > 2' outside of riverine areas Subsurface	*Rationale:* ▪ Well-drained soils are commonly associated with relatively rapid groundwater movement and faster. surface flows, which reduces runoff pollutant removal efficiency. ▪ Well-drained soils are commonly associated with higher topographic relief and greater sensitivity to erosion. *Strategies:* ▪ Extend residence time for surface and subsurface flows ▪ Optimize opportunity for buffer/groundwater interaction in low topographic areas near initiation of subsurface flow paths. ▪ Increase surface flow path distance and resistance in erodible, steeply sloped soils. ▪ Minimize opportunities for in-channel sediment production from high rates of runoff.
3rd order or greater streams	Well Drained Upland, Poorly Drained Upland, Surficial Confined	▪ Hydric ▪ Well drained on side slopes	Water table < 2 Combined	*Rationale:* ▪ Floodplain areas are commonly incised into the landscape, thereby interacting with deeper groundwater movement ▪ Floodplain areas are commonly characterized by wetland conditions. ▪ Floodplain areas associated with higher order channels are commonly sediment deposition areas *Strategies* ▪ Optimize potential for buffer / groundwater interaction in areas with low topographic position in the landscape. ▪ Provide opportunity for surface interception of

Geomorphic Feature	Geomorphic Region	Soil Type	Hydrology / Dominant Pollutant Path	Rationale / Strategies
				pollutants. ▪ Optimize opportunity for fluvial sediment trapping.
Tidal waterways	Coastal Lowlands	* Hydric	Tidal Water table< 2'	**Rationale:** ▪ Pollutants moving through the terrestrial borders often move directly into the tidal areas. ▪ Tidal areas are often bordered by a tidal marsh system. ▪ Poorly drained soils can be associated with high water table or soils of low permeability, which are conducive to wetland conditions and low rates of runoff infiltration. ▪ Poorly drained soils are found in relatively flat areas with slow moving subsurface and surface flows, which increase the runoff pollutant removal efficiency through uptake and denitrification. *Strategies:* ▪ Provide opportunity for surface interception of pollutants. ▪ Optimize effectiveness of tidal marsh system, where present.
Unplugged ditch system	All hydro-geomorphic regions	Hydric	Water table < 2' Surface	*Rationale*: ▪ Artificial ditches are the most efficient pollutant pathways in poorly drained areas. ▪ Artificial ditches modify natural hydrologic conditions by drained the adjacent land areas and increasing base flows to receiving natural waterways. ▪ Poorly drained soils can be associated with high water table or soils of low permeability, which are conducive to wetland conditions and low rates of runoff infiltration. ▪ Poorly drained soils are found in relatively flat areas with slow moving subsurface and surface flows, which increase the runoff pollutant removal efficiency through uptake and denitrification.

Geomorphic Feature	Geomorphic Region	Soil Type	Hydrology / Dominant Pollutant Path	Rationale / Strategies
				Strategies: ▪ Provide opportunity for surface interception of pollutants. ▪ Optimize potential for denitrification in shallow organic surface layers.
Plugged ditch system+	All hydro-geomorphic regions	Hydric	Water table < 2' Surface	*Rationale*: ▪ Artificial ditches are the most efficient pollutant pathways in poorly drained areas. ▪ Artificial ditches modify natural hydrologic conditions by drained the adjacent land areas and increasing base flows to receiving natural waterways. *Strategies:* ▪ Reduce efficiency of downstream pollutant export. ▪ Provide enhanced opportunity for denitrification. ▪ Restore hydrologic condition natural occurring with the geomorphic setting. ▪ Restore natural base flow conditions in downstream natural channels.

+ More detailed criteria can be developed for specific soil types (Ex. 1: Evesboro sandy loam correlate well with Surficial Confined ridges/dunes; Ex. 2: Galestown sandy loam correlate with Poorly drained upland hilly areas)

++ Provides opportunity for forest harvesting operations in extensive areas upstream of ditch plugs due to elimination of ditch channel buffers

Specific Project Descriptions

Horsebridge Creek - Watershed Improvement Project (*proposed for fy15)*

Horsebridge Creek, located in Wicomico County was first channelized in the late 1950's to aid with farming (draining the fields) in the area, then abandoned for a period of time until when in the early 1980's it was re-ditched and is now a "tax ditch" with the Horsebridge Creek PDA Assoc. assuming control of maintenance etc. The Nature Conservancy has been working in the Nassawango Creek watershed since 1978 to protect and preserve the rare and unique habitats found there and presently owns 10,000 acres spanning Worcester and Wicomico Counties. Horsebridge Creek is the only tax ditch which flows directly into Nassawango Creek and as such is the greatest direct contributor of nutrient and sediment loads to the Nassawango, these creeks meet immediately upstream of Twilley Bridge in Wicomico County.

The goal of this project is to allow for the seasonal flooding regimen to occur behind the large earthen berm (the now cut-off floodplain) presently in place and consisting of the dredge spoils from the creek/ditch. We hope that by installing large (3 foot) dia. culvert pipes strategically along and through the berm we will achieve not only the restoration of some flow but also the settling out of some nutrients and sediments that now flow unabated into the Nassawango, we also expect this diversion of floodwater will slow the flow of storm water entering the Nassawango as well.

While the immediate project of installing culverts will be a first step, eventually it's hoped that a total restoration of the creek to a more natural state can be achieved all the while maintaining the benefit to the farming community upstream.

Since the berm was established there has been no seasonal natural flooding of the floodplain to the south of Horsebridge Creek, this area is dominated by a mix of cypress, black and tupelo gum and red maple and is dependent on the cyclical flooding of the bottomland hardwood forest there. To recap, the primary reason in pursuing this restoration project is to restore flow but equally as important, to remove some of the nutrient and sediment loads before they reach the main stem of the Nassawango Creek.

Funding

Funding for implementation of the watershed improvement projects will come in part from the operational budget (See Chapter 11) for the Chesapeake Forest Project, but other sources of funding will also be pursued, including government cost share programs and grants. In implementing and funding the watershed improvement projects, the Land Manager will coordinate with other appropriate DNR divisions, government agencies, and organizations involved in wetland and riparian restoration.

Completed Projects:

Puckum Branch Stream Enhancements - Puckum Branch is a 4-mile long stream, which runs in a westerly direction from its headwaters near Finchville, Maryland to the Marshy Hope Creek. Much of the stream has been ditched and/or channelized, particularly in the headwater areas. The watershed (approximately 1,250 acres) consists of an almost even mix of forest and agricultural fields. The project area is located just west of where the stream intersects with Puckum Road. The channelized stream runs through a forested floodplain. The channelization widened and deepened the stream which resulted in less frequent flooding of the adjacent floodplain Work for this project was located along 2,000 feet of this portion of Puckum Branch. The proposed work consisted of installing biologs and other natural materials (i.e. woody debris such as tree trunks and logs) in the

stream to reduce the capacity and encourage more frequent contact with the adjacent floodplain. In order to gather woody materials for this project, young loblolly pines were cut and approximately 10' – 12' of the trucks were banded together and placed in the stream for provide for microtopographic changes. In addition, biologs were placed in across the stream to act as weirs to elevate upstream water levels and create scour areas downstream of the placed biologs. This project enhanced approximately 20 acres of floodplain wetland area and 3,200 linear feet of stream which will result in improved habitat and enhanced water quality.

Puckum Branch Dam and Berm Removal Project - The goal of this project is to remove a dam/berm on Puckum Branch that is located approximately 3000 feet upstream the confluence with Marshy Hope Creek. The dam was constructed across the stream valley in the mid 1900's and consists of an earthen berm that is approximately 250 feet long, 30 feet wide at the base, and 5 feet high. The water control structure for the dam is a failing 30 inch culvert that is currently preventing fish passage upstream of the dam. The dam/berm was removed and the stream channel in the vicinity of the dam was returned to a stable, self-maintaining state. Puckum Branch is tidally influenced up to the dam that results in a low energy stream system which will enhance the success of the dam removal and stream restoration. This project restored approximately 6 acres of wetlands and opened up approximately 4.6 miles of stream habitat for anadromus, catadromous and resident fish species.

Morris Millwork - The site (approximately 20 acres) is bisected by a man-made ditch, which runs in a westerly direction and eventually flows into Leonard's Mill Pond and then to the Wicomico River. The area where the work is scheduled to take place is currently planted in loblolly pine (about 7 - 8 years old). Soils at the site consist primarily of Portsmouth Sandy Loam. The Portsmouth soil series is very poorly drained loamy sands. Work at the site consisted of a series of ditch plugs which will impede the flow of water through the existing ditch. In addition, a low level berm was constructed at the western edge of the project site to further increase the hydro period at the site.

Dunn Swamp – This site is located along Hillman Road approximately 2 miles southwest of Pocomoke City. The site is actually a portion (20 acres) of a larger agricultural field (88 acres). The site is bisected by a drainage ditch, which will be plugged as a part of the project. Soils at the site consist primarily of Fallsington soils with some Woodstown soils on the fringe of the project area. Work done at the site included the plugging of the existing ditch, the installation of a low level berm and some minor excavation. This site was reforested with native Atlantic white cedar and associated vegetative allies.

Pepperfield – This is a forested 100-acre site that has been hydrologically altered by the installation of a ditch. This ditch system commonly known as Rayfield Ditch drains approximately 585 acres of forest and farmland. Soils in the affected area consist primarily of Fallsington and Pocomoke soils. The project involved the installation of native structural components (i.e.; logs, etc.) to retard the conveyance of water off-site and increase retention in the adjacent forested floodplain area.

Little Blackwater Restoration Project - The Enhancement Plan for the Blackwater land acquisition incorporates a number of different activities and interest. The primary objective of the plan is to improve the quality of the waters entering Maple Dam Branch and the Little Blackwater River. The secondary objective is to enhance habitat for upland and aquatic fish and wildlife species. This plan provides for these improvements through the protection and enhancement of

existing forest and stream buffers, and by the incorporation of wetlands and stream enhancements, reforestation and agriculture. There are a total of ten separate projects covering the 721 acres of this property, specific details are listed in the restoration plan which can be viewed on the Chesapeake Forest website.

Appendix N

Chesapeake Forest ESA Summary

The following ESAs have been delineated and occur, in part or totality, on CF lands (see Table 27 for management category and zonation):

Adkins VI – Horsebridge Creek Bogs *Wicomico County*
This ESA contains populations of 27 rare, threatened and endangered (RTE) plant species including 12 state-endangered and 10 state-threatened plants. Most of these species are associated with wetlands, including bog, wet meadow and shrub-swamp communities, though a few are associated with xeric sand ridges and pine-oak savannahs. The area within this ESA includes wetlands supporting rare species, adjacent and upstream wetlands that influence hydrology and water quality, and nearby xeric sandy soils that act as recharge areas and habitat for additional rare species. The portion of this ESA within The ESA boundaries also include a Wetland of Special State Concern (WSSC), rare species habitat within a powerline right-of-way (ROW) and a 300-foot upland buffer for FIDS management.

Andrews Branch Swale *Wicomico County*
This ESA harbors populations of 2 state-endangered and 1 state-threatened plant species that are part of a coastal plain bog wetland system along two different tributaries of Nassawango Creek. The ESA boundary includes bogs, other nontidal wetlands (including an old logging roadbed) that provide habitat for rare species, a powerline ROW with rare species habitat, wetlands upstream to protect hydrology and water quality, and forested wetland and stream buffers.

Beech Swamp Sandpits *Worcester County*
This ESA contains a series of shallow water, seasonally flooded sandpits that support an array of freshwater emergent plants. Two RTE wetland species, one of which is state-endangered, are located in these sandpits. This ESA was delineated to include the series of sandpits and associated uplands that support the rare species. A 100-foot upland buffer is included for all wetlands.

Big Millpond Dorchester County
This ESA was delineated to protect 2 state-endangered species. The ESA boundary includes a large pond created by impoundment of the Chicamicomico River which is a designated WSSC, and an additional 300 ft upland buffer to support a FIDS core habitat area and protect hydrology and water quality for rare aquatic species.

Breeding Roadside *Caroline County*
This small ESA was designed to encompass a state-threatened plant species, which is found along the edge of a mowed ditch in hard-packed sands of the Fallsington soil series.

Brookview Ponds *Dorchester County*
This ESA encompasses a series of Delmarva bays, boggy roadside ditches and adjacent sandy upland openings. It is host to 14 RTE plants and 1 RTE animal, including 7 state-endangered and 4 state-threatened plant species, and 1 amphibian species state-listed as In Need of Conservation. The ESA boundary includes all the Delmarva bays in the area plus adjacent upland amphibian life zones and groundwater recharge areas.

Buck Harbor Road Ditch *Worcester County*
This ESA contains a state-threatened plant species that occurs along the upper reaches of the now ditched Pilchard Creek. This ESA boundary contains the habitat supporting the rare species and available habitat in the immediate vicinity.

Campbell Complex *Wicomico County*
This diverse ESA has 13 RTE species including 5 state-endangered and 4 state-threatened plants, and 1 amphibian species state-listed as In Need of Conservation. The ESA boundary encompasses a powerline ROW with both RTE wetland and xeric sand ridge plant species, a number of Delmarva bays supporting RTE plant and animal species, dry xeric ridges supporting a rare tiger beetle species, and areas with rare plants with pine barren affinities. This ESA includes the only Maryland location and 1 of 2 Delmarva Peninsula locations for a rare pine barren plant. The ESA boundary also includes forested wetland buffer.

Centennial Ponds *Dorchester County*
This ESA is a series of Delmarva bays and surrounding upland that includes 4 state-endangered plant species and potential habitat for rare amphibians. The ESA boundary includes the bays and adjacent wetlands that are hydrologically connected, plus a forested upland buffer suitable as amphibian life zones.

Chicone Woods *Dorchester County*
This ESA was designed around a rich woods community and the associated Chicone Creek. This ESA supports 7 RTE species. Three of these species are state-endangered, one of which is also globally rare and state-endangered, and one that is state-threatened. This ESA contains the rare species populations, the habitat supporting these populations and a wetland buffer around Chicone Creek.

Corbin Canyon *Worcester County*
This ESA encompasses Corbin Branch, a tributary of the Pocomoke River, its steep ravine slopes, upland xeric sandy ridges, and forested buffers for the steep slopes to maintain water quality and the hydrology of Corbin Branch. Four state-threatened plants occur in the forested wetland along Corbin Branch, the steep slopes and the xeric sandy ridges of the uplands. The floodplain also has some characteristics of old growth forest and contains large bald cypress.

Delaware Wildlands *Wicomico/Worcester Counties*
This ESA is an exceptionally diverse wetland complex with a state-endangered bird, state-threatened butterfly, state rare reptile and an amphibian that is state-listed as In Need of Conservation. The ESA boundary includes the already protected Delaware Wildlands property, associated forested wetlands and uplands, and amphibian life zones. This is a landscape-level boundary to maintain the upper Pocomoke River ecosystem. FIDS core habitat is also found within this ESA.

Disharoon Road Powerlines *Worcester County*
This ESA contains 9 RTE plant species and 1 rare amphibian, all located along a powerline ROW that bisects this tract or in an adjacent abandoned logging road, both of which have served as refugia for these rare open-canopy species. Some of these are species of non-tidal wetlands while others occur on xeric sand ridges. This list includes 6 state-endangered and 1 state-threatened plant species, and 1 amphibian species state-listed as In Need of Conservation. Management activities

will focus on expanding these ROW populations to adjacent restored wetland and upland habitat. The ESA boundary includes the ROW, adjacent non-tidal emergent and scrub-shrub wetlands and an area of dry Lakeland soils, to provide a complex of wetlands and xeric sand ridge habitats. The boundary also includes buffering for amphibian life zones.

Dividing Creek Headwaters *Worcester County*
This ESA was designed around four RTE plant species two of which are state-endangered. Three of these species are located in a large clear-cut while the other is located in open canopied pockets found infrequently at the site. The boundary includes that habitat supporting the four RTE species, a Bald Eagle nest and available habitat for the rare species in the immediate vicinity.

East Marumsco Marsh *Worcester County*
This small ESA is an ecologically diverse brackish marsh supporting a population of a state-threatened plant species and its immediate habitat.

Eden Swamp and Powerline *Somerset County*
This ESA encompasses a unique non-tidal swamp forest and a mesic powerline ROW, containing 9 RTE plant species including a state-endangered and globally rare wetland plant and 5 state-threatened plant species. The ESA boundary incorporates the habitat of rare wetland and upland plants and the surrounding designated WSSC, plus additional forested buffer.

Emanuel Cemetery Bay *Somerset County*
Emanuel Cemetery Bay is an ESA containing a series of small open canopied bays that support one state-endangered plant species. The ESA boundary includes the bays and adjacent wetlands that are hydrologically connected, plus a forested upland buffer.

Fishing Bay *Dorchester County*
This large ESA was created to include the Savannah Lake NHA, a large WSSC, DFS and FIDS habitat, many bald eagle nesting sites and supports 4 RTE animal species, other than bald eagles, tracked by DNR. Two of these animals are state-threatened, and two are In Need of Conservation. This ESA contains at least 17 ecological communities in excellent condition. Some of these include salt march cordgrass, salt meadow, saltbush, big cordgrass, black needlerush, narrowleaf cattail, freshwater-mixed, and mud flat. The uplands are a necessary component of these various communities and are thus included in the ESA.

Fleming Mill Complex *Worcester County*
This ESA includes a series of xeric sand ridges and floodplain swamp forest along the eastern side of Dividing Creek that harbor 1 state-threatened and 2 state-rare plant species. The rare plants include xeric sand ridge species, forested swamp species and seepage wetland species (from the base of sand ridges on the swamp side). The ESA boundaries include habitat for all rare species plus adjacent xeric ridges and floodplain swamp.

Franklin Swamp *Worcester County*
The Franklin Swamp ESA includes a large non-tidal swamp forest that supports a state-endangered plant species. Associated with this rare species is an odd assortment of wetland and upland plant species, creating a very ecologically diverse area for this portion of Worcester County. A small portion of CF land in included within this ESA because of similarities in hydrology and soil to the remainder of the ESA.

Greenbrier Swamp Road Flatwoods *Worcester County*
This ESA includes a recently cleared loblolly pine stand that supports 4 rare species, one of which is state-threatened. As well as the current habitat, the ESA also contains areas with similar soil and hydrologic regimes that are necessary for the rare species.

Hound Sandpits *Wicomico County*
This ESA focuses on a series of shallow water, seasonally-flooded sandpits that support an array of freshwater emergent plants and several areas of bog mats dominated by sphagnum moss. Three state-endangered wetland plants occur here including 2 bog species. The ESA boundary includes the sandpits that harbor rare plants and adjacent nontidal wetlands that offer potential habitat for rare plants if open canopy is maintained. A 100-foot upland buffer is included for all wetlands.

Johnson Sand Ridge *Wicomico County*
This ESA encompasses a xeric sand ridge of Evesboro soils and a harbors a population of a state-endangered plant.

LeCompte Bay *Dorchester County*
This ESA contains 7 RTE plant species. Five of these are state-endangered and two are state-threatened. The habitat requirement of these speices includes dry sandy, to seasonally flooded, open canopied wetland habitats. This ESA contains the populations of the rare species, the available habitat in the vicinity and a forested buffer around the wetlands.

Little Mill Run *Worcester County*
This diverse ESA includes 2 state-threatened plants, 1 state threatened animal and a state-rare aquatic plant. The endangered plants are species of mesic-to-hydric woods. This ESA includes a designated WSSC and additional stream buffer/upland habitat along Little Mill Run and tributaries. The ESA boundary also includes some xeric sand ridges adjacent to the floodplain. Much of this area is also high quality FIDS habitat and the buffer was extended 300 ft from the floodplain/upland edge where FIDS habitat is concurrent.

Meadow Bridge Ridges *Worcester County*
This ESA consists of xeric sand ridges, the fresh-tidal forested floodplain of Dividing Creek, a mesic powerline ROW and an abandoned sandpit. Rare species include 2 state-threatened plants (1 of wet woods, one from xeric sand ridges) and 2 state-rare emergent wetland plants. The ESA boundary includes xeric sand ridge habitat and seepage slopes grading to floodplain wetlands. The area also contains high quality FIDS habitat.

Messick Pond *Dorchester County*
The ESA includes a series of small Delmarva bays, connecting riparian corridors, and other forested habitat for rare amphibian life zones. Riparian areas and wetlands were used primarily for the boundary, which also includes upland buffer for a FIDS Core area. The 13 rare species found here are all Delmarva bay species, including 3 globally rare plants. This ESA harbors 7 state-endangered plants, 1 state-threatened plant and 1 amphibian species state-listed as In Need of Conservation.

Moore's Chapel Roadside *Somerset County*

This ESA includes the only Maryland location of a state-endangered plant characteristic of emergent non-tidal wetlands. The ESA boundary includes all emergent and scrub-shrub non-tidal wetlands plus a 100-foot upland buffer. This area may have good wetland rehabilitation potential.

Nassawango Central Macrosite *Wicomico & Worcester Counties*
The following former ESAs were merged into this much larger ESA: Colbourne Ponds, Colbourne Sand Ridge, Forest Lane Roadside, Laws Pond, Lower Sturges Creek Bog, Mt. Olive Church Wetlands, Nassawango-Colbourne Complex, and Twigg Wetland. This ESA includes 1473 acres of CF, connected as part of a landscape-level boundary to maintain the upper Nassawango Creek ecosystem. This area ranks as one of the highest priority areas for the conservation of biological diversity on the Eastern Shore. A total of 20 RTE species occur here including 10 state-endangered plants, 1 state-endangered amphibian, 5 state-threatened plants and 4 state-rare plant species. Unique habitats within this ESA include pine barrens, wet flatwoods, seasonally wet emergent non-tidal wetlands including open-canopy areas dominated by sphagnum moss, xeric sandy ridges, small non-tidal emergent wetlands within interdunal swales, swamp forests, and upland forest buffer.

Payne Ditch Pond *Worcester County*
This ESA harbors a state-endangered plant species found in seasonally wet emergent wetlands. The ESA boundary follows the forest edge to the north and the ESA boundary of Little Mill Run to the south. An upland buffer includes amphibian life zones.

Pikes Creek *Worcester County*
This ESA is a diverse area of xeric sandy ridges, emergent nontidal wetlands, and a floodplain forest supporting 9 RTE species. These include 2 state-endangered emergent wetland plants, 6 state-threatened plants (3 xeric sand ridge species, 3 wetland species) and one state-rare plant. Two of these species are also globally rare. The ESA boundary includes wetlands that support rare plant species and adjacent hydric soils, the headwaters of Pikes Creek, and upland buffer to protect hydrology and water quality of the rare species habitat, plus xeric sand ridges.

Pine Pole Wet Woods *Somerset County*
This ESA contains a state-endangered and a state-threatened plant species, both characteristic of emergent wetlands are on one tract edge and along an old logging road. The ESA boundary includes nontidal wetlands along the woods road that provide habitat for rare plants. Adjacent forested wetlands on Chesapeake Forest property are included for future enhancement opportunities to increase habitat for rare plants that need open canopy. A 100-foot upland buffer is included along wetlands.

Powell Road Wetlands *Wicomico County*
This ESA harbors 2 state-endangered and 4 state-threatened plant species indicative of both non-tidal emergent wetland communities and xeric sand ridge communities. The ESA boundary includes wetland habitat under a powerline ROW that harbors rare plants, adjacent forested wetlands to protect hydrology, water quality and offer potential habitat for rare plants if the canopy were opened. A 100-foot upland buffer that includes xeric sandy soils is included for all nontidal wetlands.

Princess Anne Marshes *Somerset County*
This ESA includes a riparian buffer along the headwaters of the Manokin River and tributaries, upstream of a state- and federally-endangered fresh-tidal wetland plant and 2 other fresh-tidal plant

species (one state-endangered, one state-rare). Management must maintain water quality and quantity. A number of tracts are also in a high-quality FIDS area where riparian buffers are expanded to 300 feet.

Princess Anne Railroad Tracks *Somerset County*
This ESA includes a railroad and powerline ROW that supports small populations of a state-threatened plant species and a state- and globally-rare plant species. The ESA boundary protects rare species habitat within the managed ROW and adjacent wetlands that offer additional habitat for rare species, with appropriate management.

Pusey Branch *Worcester County*
This ESA is designed to protect a Great Blue Heron colony located along Pusey Branch. The swamp forest supporting the colony is inundated year-round from the adjacent Pusey Branch. ESA boundaries include buffer.

Rhodesdale Powerline *Dorchester County*
This ESA contains a state-threatened emergent non-tidal wetland plant species that occurs along a powerline ROW. The ESA boundary includes a 100-foot wetland buffer around a designated WSSC and adjacent wetlands.

Route 313 Powerlines *Wicomico County*
This ESA contains a state-rare non-tidal emergent wetland plant specie whoch occurs along a powerline ROW. The ESA boundary includes wetland habitat along the ROW, associated upstream riparian habitat to protect water quality and hydrology, and expanded buffers to protect a high quality FIDS area.

Saint Lukes Sand Ridge *Worcester County*
This ESA encloses a xeric sand ridge and seasonally wet interdunal swales. Both habitats support RTE species, with a state-endangered plant on the sand ridge and a state-threatened plant in the emergent wetland. The ESA boundary includes xeric sand ridge habitat, associated Lakeland soils, and some nontidal wetlands to the south for maintenance of a xeric/hydric complex. High quality FIDS habitat is also included.

Saint Lukes Wet Woods *Worcester County*
This ESA has 8 RTE plant species, including 1 state-endangered, 4 state-threatened and 3 state-rare species. The rare species occur within a powerline ROW with a seasonally wet emergent non-tidal wetland, a recent clearcut that is also seasonally wet, and sphagnum-dominated open forest trails. The ESA boundary includes occupied and potential rare plant habitat, based on soil type and hydrology, plus adjacent woodlands and buffer.

Sand Road Woods *Worcester County*
This ESA was delineated to protect a state-endangered plant of dry, sandy woods. ESA boundaries include soils with potential habitat and a buffer.

Scarboro Wetlands *Worcester County*

This ESA is a series of abandoned sandpits that contain 3 state-endangered and 1 state-rare plant species. One of the former is the largest Maryland population and 1 of only 3 Maryland populations. The ESA boundary includes a seasonal pond and excavated wetland that harbor rare plants, plus wetlands in the immediate vicinity to maintain hydrology and water quality of rare plant habitat. An upland buffer is included for the seasonal ponds to provide for amphibian life zones.

Shelltown Ponds *Somerset County*
This ESA focuses on protection of 2 fresh tidal marshes and adjacent ponds. The marsh harbors 1 of 3 Maryland populations of a state-endangered marsh grass, and the area around the ponds contains 2 state-rare plants. The ESA boundary includes the marsh, ponds and adjacent buffer, which is the primary function of the Chesapeake Forest tract.

Snethen Church Powerline *Wicomico County*
This ESA contains 2 state-endangered wetland plants, one of which is globally rare, and a state-rare plant of xeric sandy ridges. The ESA boundary includes a complex of wetlands and xeric uplands, plus buffer and amphibian life zones. Pocomoke soils support Delmarva Bay-type communities with rare plants and excellent potential for amphibians. Evesboro-Galestown soils support xeric sandy ridge species.

Southwest Cambridge Wet Woods *Dorchester County*
This ESA supports a population of a state endangered herbaceous plant. The woods are seasonally saturated with large pockets of standing water and a dense shrub layer.

Spearin Road Powerlines *Wicomico & Worcester Counties*
This ESA contains a large powerline ROW with saturated wetland soils and xeric sand ridges with 12 RTE plant species. These include 7 state-endangered, 2 state-threatened and 3 state-rare plants. The ESA boundary includes rare plant populations within the powerline ROW and adjacent xeric sandy soils and
non-tidal wetlands that offer potential habitat for these species if suitably managed.

Steele Neck Road Swamp *Dorchester County*
This ESA is contiguous with LeCompte WMA and supports a large population of DFS as well as a rare reptile. This ESA contains both mixed oak-pine and pine forests that range from freshwater non-tidal to tidal.

Stevens Road Powerline *Worcester County*
This ESA contains a small powerline ROW with two state-endangered plant species, one state-threatened plant species and one state-rare species. These species require a seasonally inundated habitat with sandy soils. The ESA contains the habitat they currently occupy, and additional habitat for these species if suitably managed.

Stump Gut Complex *Wicomico County*
This ESA stands out as one of the premier natural areas on former Chesapeake Forest Products lands. The ESA boundary includes exceptional tidal and nontidal wetland communities bordering the Nanticoke River and associated small tributaries. These wetlands, pristine brackish and freshwater marsh plus floodplain swamp, provide habitat for several rare and uncommon plant species including 1 state-threatened and 2 state-rare plant species. A state-endangered shrub occurs

in the marsh-swamp ecotone, one of only historical 4 Maryland populations. The swamp is a mixture of deciduous trees such as red maple, green ash, pumpkin ash and black gum, with Atlantic White Cedar near the upland edge where freshwater seepages occur. The adjacent sandy uplands contribute groundwater to the nontidal wetlands and have good potential for rehabilitation of the native xeric sand ridge/flatwoods ecosystem that historically dominated this landscape. The large blocks of forest along the Nanticoke River are a FIDS core area.

Taylors Trail Sand Ridges *Wicomico County*

This ESA includes a large xeric sand ridge that parallels the eastern side of the Nanticoke River, the Nanticoke River's high quality tidal marshes, floodplain forest, and sand flats that extend to the east from the xeric sand ridges. Two state-endangered, 2 state-threatened and 1 state-rare plant occur within this ESA, as well as a nesting pair of the state- and federally-threatened Bald Eagle. A number of RTE plants are associated with riparian-xeric interface where freshwater seepage, while others are found exclusively on the xeric sand ridge which has unique "sugar" sands. The ESA boundary includes a large sand ridge and sand flat/wetland complex with tremendous potential for enhancement. There is good potential for additional rare species along the upland-tidal and tidal-nontidal interfaces.

Upper Nanticoke River Macrosite *Caroline & Dorchester Counties*

The following former ESAs were merged into this much larger ESA: Brohorn Creek, Harrison Ferry Wetlands, Hummock Uplands, Marshyhope Creek North, Marshyhope Sand Ridge Complex, Upper Nanticoke River. The largest ESA within the CF project, this ESA includes 3598 acres. This large and diverse ESA is a landscape-level area to maintain the upper Nanticoke River ecosystem, including the Marshyhope Creek ecosystem, and the Upper Nanticoke River NHA. This ESA also includes one of the largest contiguous forested xeric sand ridge habitats along Marshyhope Creek, and riverine swamp forests along Brohorn Creek, Marshyhope Creek, and the upper Nanticoke River. The ESA boundary includes the mainstem of Marshyhope Creek from Federalsburg north, including all tributaries to the headwaters, plus an upland buffer which is expanded to 300-feet through a FIDS core area; tidal and nontidal wetlands along the east side of Marshyhope Creek and tributaries south of Federalsburg, and a mosaic of xeric sand ridges interspersed with sandy flats and wetlands; and along Brohorn Creek the ESA boundary includes wetlands that provide habitat for rare species and an expanded upland buffer (300 feet) where it intersects with high quality FIDS habitat. This ESA has excellent potential for enhancement of natural systems and expansion of existing rare plant and animal communities. The area also features excellent potential for FIDS and DFS management, and includes rich woods areas. This diverse ESA contains >20 RTE plants and animals, including 3 rare fish species, a rare amphibian, a state-threatened and globally rare plant of fresh-tidal mudflats, and a globally rare plant which the Marshyhope floodplain harbors the bulk of the world's population.

Upper Wetipquin Creek *Wicomico County*

This ESA includes the headwaters of Wetipquin Creek and an expanded upland buffer for a high quality FIDS areas. A state-rare tidal freshwater mudflat plant occurs just downstream from the Chesapeake Forest tracts, which act as buffer.

Wango Pines *Wicomico County*

This ESA, which supports 7 RTE species, includes a complex of Delmarva bay-like emergent wetlands interspersed with xeric sand ridges. Rare species include a state-endangered butterfly, 2 state-endangered, 2 state-threatened and 2 state-rare plants. The ESA boundary includes a complex of non-tidal wetlands, surrounding xeric sand ridges, wetland buffer and amphibian life zones.

Wetipquin Pond *Wicomico County*

This ESA includes a Delmarva bay community, surrounding forested wetland and upland buffer. The adjacent property to the Chesapeake Forest tracts contains the only Maryland location for a globally rare and state-endangered wetland shrub. A state-threatened wetland plant also occurs here. There is high potential for rare amphibians in this wetland complex. The ESA boundary surrounds discrete wetlands in the vicinity of the Delmarva Bay, including most of the basin in which the bay occurs. Where the wetland extends thousands of feet west of the bay, the protection boundary was drawn through the narrowest point of the wetland, coinciding with a sand road that bisects the wetland. Impacts of activities that might affect water levels in the bay, such as logging and ditching were considered. On the northeast side, the tributary leading to Peters Creek should be provided an expanded stream buffer of 300 feet as this entire area is a core FIDS area.

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Table 26: Chesapeake Forest ESA Management Zones and Acreages, Version 2

ESA Name	ESA Type	Zone 1 Acres	Zone 2 Acres	Zone 3 Acres	Stream Buffer	ESA V2 Acres
Adkins VI - Horsebridge Creek Bogs:	Emergent Wetland	41.132	0	49.698	5.899	96.729
Andrews Branch Swale	Emergent Wetland	13.482	0	13.44	0	26.922
Beech Swamp Sandpits	Sandpit	13.655	0	19.261	1.897	34.813
Big Millpond	Riverine Swamp Forest	24.879	0	0	0	24.879
Breeding Roadside	Emergent Wetland	1.677	0	3.951	0	5.628
Brookview Ponds	Complex	95.727	239.427	406.899	0	742.053
Buck Harbor Road Ditch	Emergent Wetland	0.638	0	1.9	12.537	15.075
Campbell Complex	Complex	225.451	44.196	101.332	0	370.979
Centennial Ponds	Delmarva Bay	109.861	168.191	123.251	0	401.303
Chicone Woods	Riverine Swamp Forest	2.781	0	0	0	2.781
Corbin Canyon	Riverine Swamp Forest	222.249	0	0	0	222.249
Delaware Wildlands	Riverine Swamp Forest	81.047	0	59.233	8.628	148.908
Disharoon Road Powerlines	Emergent Wetland	44.168	0	74.925	0	119.093
Dividing Creek Headwaters	Emergent Wetland	20.834	0	242.943	53.02	316.797
East Marumsco Marsh	Emergent Wetland	9.29	0	0	0	9.29
Eden Swamp and Powerline	Emergent Wetland	15.913	0	294.489	25.308	335.71
Emanuel Cemetery Bay	Emergent Wetland	21.769	0	5.671	0	27.44
Fishing Bay	Estuarine Forest	1178.734	0	229.832	0	1408.566
Fleming Mill Complex	Emergent Wetland	0.718	0	37.967	0	38.685
Franklin Swamp	Riverine Swamp Forest	24.285	0	0	0	24.285
Greenbriar Swamp Road Flatwoods	Emergent Wetland	19.134	0	28.562	0.159	47.855
Hound Sandpits	Sandpit	2.136	0	14.77	9.414	26.32
Johnson Sand Ridge	Sand Ridge	19.38	0	1.52	0.302	21.202
LeCompte Bay	Complex	14.867	27.26	120.581	7.32	170.028
Little Mill Run	Riverine Swamp Forest	195.64	0	4.619	0	200.259
Meadow Bridge Ridges	Sand Ridge	31.13	0	32.813	2.121	66.064
Messick Pond	Delmarva Bay	2.313	24.856	85.943	40.005	153.117
Moores Chapel Roadside	Emergent Wetland	0.232	0	16.688	0	16.92
Nassawango Central Macrosite	Complex	716.972	0	737.554	18.85	1473.376
Payne Ditch Pond	Emergent Wetland	3.928	0	42.418	0	46.346
Pikes Creek	Complex	169.602	0	78.949	5.137	253.688

ESA Name	ESA Type	Zone 1 Acres	Zone 2 Acres	Zone 3 Acres	Stream Buffer ac	ESA V2 acres
Pine Pole Wet Woods	Emergent Wetland	19.747	0	20.491	0	40.238
Powell Road Wetlands	Emergent Wetland	29.653	0	15.886	7.121	52.66
Princess Anne Marshes	Riverine Swamp Forest	199.652	0	0	0	199.652
Princess Anne Railroad Tracks	Emergent Wetland	12.123	0	40.197	0	52.32
Pusey Branch	Riverine Swamp Forest	4.592	0	0	0	4.592
Rhodesdale Powerline	Emergent Wetland	15.559	0	91.697	11.131	118.387
Route 313 Powerlines	Emergent Wetland	0	0	1.271	6.249	7.52
Saint Lukes Sand Ridge	Sand Ridge	33.43	0	25.565	0	58.995
Saint Lukes Wet Woods	Emergent Wetland	76.434	0	60.617	0	137.051
Sand Road Woods	Sand Ridge	14.808	0	0	0	14.808
Scarboro Wetlands	Emergent Wetland	0	0	16.749	0	16.749
Seth Forest	Delmarva Bay	112.95	9.159	0	0	122.109
Shelltown Ponds	Emergent Wetland	14.803	0	1.039	0.019	15.861
Snethen Church Powerline	Complex	0	5.077	25.478	0	30.555
Southwest Cambridge Wet Woods	Emergent Wetland	24.121	0	0	0	24.121
Spearin Road Powerlines	Emergent Wetland	32.772	0	265.434	0.345	298.551
Steele Neck Road Swamp	Riverine Swamp Forest	0	0	106.648	0	106.648
Stevens Road Powerline	Emergent Wetland	11.637	0	48.282	0	59.919
Stump Gut Complex	Complex	454.474	0	66.511	2.973	523.958
Taylors Trail Sand Ridges	Complex	158.152	0	53.95	0	212.102
Upper Nanticoke River Macrosite	Complex	1580.803	110.186	1719.84	187.362	3598.191
Upper Wetipquin Creek	Riverine Swamp Forest	16.654	0	0	0	16.654
Wango Pines	Complex	199.03	0	94.628	0	293.658
Wetipquin Pond	Delmarva Bay	0	0	92.334	4.442	96.776
	Totals	**6335.018**	**628.352**	**5575.826**	**410.239**	**12949.435**

Table 27: Acreages of Chesapeake Forest Priority Management Areas

Acreages of CFL Priority Management Areas, Version 4 (10/30/13)		
Management Classification	**Acres**	**% of CF**
ESA Total	**13,500.3**	**19.9%**
ESA Zone 1 *(HCVF) (Note: HCVF = High Conservation Value Forest)*	6,945.5	10.2%
ESA Zone 2 *(HCVF)*	659.9	1.0%
ESA Zone 3 - Pulpwood Mgt.	3,277.3	4.8%
ESA Zone 3 - Sawtimber Mgt.	2,617.5	3.9%
ESA Zone 3 Total	5,894.8	8.7%
G3 Community - Soil Types *(HCVF)*	201.7	0.3%
Core FIDS Mgt. Areas Outside of ESA *(HCVF)*	6,320.8	9.3%
Riparian Forest Buffers outside ESA, FIDS & DFS *(HCVF)*	3,561.9	5.3%
DFS *Core* Areas Outside of ESA & Core FIDS *(HCVF)*	14,018.1	20.7%
DFS *Future Translocation* Areas Outside of ESA & Core FIDS	3,628.0	5.4%
DFS *Future Core* Areas Outside of ESA, Core FIDS & DFS Translocation	7,646.9	11.3%
DFS Management Area Total	25,293.0	37.3%
General Mgt. Zone	18,894.3	27.9%
Entire Chesapeake Forest (CF) Project	**67,772.0**	**100.0%**
SUMMARY		
1) Areas Available for Limited Forest Harvest *(HCVF)*:		
ESA Zone 1 (HCVF)	6,945.5	10.2%
ESA Zone 2 (HCVF)	659.9	1.0%
Riparian Forest Buffers outside of ESA	3,561.9	5.3%
Areas Available for Limited Forest Harvest *(HCVF)* TOTAL:	**11,167.3**	**16.5%**
2) Areas Available for Sustainable Forestry:		
ESA Zone 3 - Pulpwood Mgt. (Emergent & Complex ESAs Only)	2,913.4	4.3%
ESA Zone 3 - Sawtimber Mgt.* (*mixed hardwood/pine only)	2,617.5	3.9%
G3 Community - Soil Types *(HCVF)*	201.7	0.3%
Core Fids Mgt. Areas Outside of ESA *(HCVF)*	6,320.8	9.3%
DFS *Core* Areas Outside of ESA *(HCVF)*	14,018.1	20.7%
DFS *Future Translocation* Areas Outside of ESA	3,628.0	5.4%
DFS *Future Core* Areas Outside of ESA	7,646.9	11.3%
General Mgt. Zone	18,894.3	27.9%
Areas Available for Sustainable Forestry TOTAL:	**56,240.8**	**83.0%**
Total Forest Area designated as HCVF	*31,707.89*	*46.8%*