National Park Service
U.S. Department of the Interior

DRAFT Forest Management Plan and Environmental Assessment

for

Marsh-Billings-Rockefeller National Historical Park

National Park Service
U.S. Department of the Interior

Dedication

This plan is dedicated to Laurance Spelman Rockefeller and his long stewardship of this forest.

> The true importance of Marsh, Billings, and those who follow in their footsteps goes beyond simple stewardship. Their work transcends maintenance. It involves new thought and new action to enhance and enrich...the past. ...We cannot rest on the achievements of the past. Rather, each generation must not only be stewards, but activists, innovators and enrichers.
>
> Laurance Spelman Rockefeller (1910 -2004)

Marsh-Billings-Rockefeller National Historical Park
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DRAFT
FOREST MANAGEMENT PLAN AND ENVIRONMENTAL ASSESSMENT

National Park Service

U.S. Department of the Interior

Marsh-Billings-Rockefeller National Historical Park

Woodstock, Vermont

Prepared by:

Marsh-Billings-Rockefeller National Historical Park
NPS Conservation Study Institute
NPS Olmsted Center for Landscape Preservation
Philip B. Huffman, Planning Consultant
Redstart Forestry, Inc.

November 1, 2005

Share Your Thoughts With Us

This Draft Forest Management Plan and Environmental Assessment (EA) for Marsh-Billings-Rockefeller National Historical Park's Mount Tom Forest will help guide today's stewardship of the forest and lay important foundations for determining the composition and character of the forest we want to see 100 to 200 years into the future. This draft presents four management alternatives, including a preferred alternative,and assesses the potential effects of each alternative on natural and cultural resources, visitor experience, and the surrounding community.

I would like thank all those who have participated in the development of this draft—particularly the members of the planning team—for their thoroughness, professionalism and hard work, and their deep commitment to future of this very special place.

The draft Plan will be available for public review for 30 days. We would be pleased to receive any comments you may have and will carefully review them as a final plan is prepared. To share your comments, or request additional information, please contact:

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Woodstock, Vermont 05091
Christina_Marts@nps.gov

We look forward to hearing from you.

Rolf Diamant
Superintendent

Please note: It is our practice to make comments, including names and home addresses of respondents, available for public review. Individual respondents may request that we withhold their home address from the record. There also may be circumstances in which we would withhold a respondent's identity from the record. If you wish us to withhold your name and/or address, please state this prominently at the beginning of your comment. We will make all submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, available for public inspection in their entirety.

Cover photograph: View of sugar maples at the Summer Pasture. (MABI 2003)

Acknowledgments

We are grateful to many organizations and individuals for their contributions to the preparation of this document, including The Woodstock Foundation, Inc., Vermont Agency of Natural Resources, Vermont Institute of Natural Science, USDA Forest Service State and Private Forestry, Vermont State Historic Preservation Office, University of Vermont, NPS Northeast Temperate Inventory and Monitoring Program, Woodstock Conservation Commission, Town of Woodstock, Pennsylvania State University, The Conservation Fund, NPS Rivers and Trails Technical Assistance Program, NPS Northeast Region Exotic Plant Management program, and local teachers.

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Executive Summary

The Mount Tom Forest is a key component of the cultural landscape of the 555-acre Marsh-Billings-Rockefeller National Historical Park and plays an important role in the Park's interpretation and demonstration of stewardship.[1] The Forest Management Plan provides a strategy for managing the Mount Tom Forest that will:

- Perpetuate the tradition of sustainable forest management on the property
- Incorporate a long-term perspective on the changing composition and character of the Forest
- Value the Forest as both a natural and cultural resource
- Emphasize the relationship of the Park's forest management to broader community well-being and sustainability
- Strengthen civic engagement and stewardship

The plan will be guided by seven specific management goals related to:

- historic character
- ecological health
- sustainable management practices
- education and interpretation
- visitor use and recreation
- watershed and community connections
- adaptive management

SUMMARY OF ALTERNATIVES

The following management scenarios were created to explore and assess different opportunities for addressing these goals:

Alternative A, Continue Current Management: This is the "no action" alternative required by the National Environmental Policy Act (NEPA) and does not include a long-term strategy for management. The approach would continue the forest management practices that have been implemented since the National Historical Park opened to the public in 1998, which emphasize responding to immediate, short-term needs such as preservation maintenance, interpretation programs, visitor safety, and continuing with projects having a short-term emphasis (i.e., hazardous tree removal, mowing of vistas and fields, and cleanup of storm-damaged trees). Under this alternative, in 100 to 200 years historical features—such as the plantations and old "legacy trees"—would eventually disappear due to gradual decline and decay or potential catastrophic loss. Areas currently in plantations would regenerate to mixed hardwood forest, and resemble other unmanaged, second-growth forests in Vermont.

Alternative B, Adopt a "Replacement In-Kind" Approach to Historic Preservation: This management strategy would focus on preserving the most exact representation of plantations, hardwood and mixed forest stands, open fields, and legacy trees as they existed in 1997, the end of the property's period of historical significance. As existing plantations decline and no longer represent single-species, even-aged plantings, these areas would be cleared of all trees and replanted with the same species and in the same planting pattern. In order to reestablish and retain plantations, competing regeneration of native plants would be suppressed by using herbicides or mechanical removal. Under this alternative, in 100 to 200 years as visitors travel the carriage roads and trails they would experience single-species plantations at various stages of even-aged growth that reflect the history of forest management from 1874 to 1997, but will not see demonstrations of best current thinking and practices in forest management.

Alternative C, Continue the Tradition of Applying the Best Current Thinking and Practice in Forest Management: This management approach favors the continuation of the long tradition of applying and demonstrating progressive sustainable forestry on the property. The strategy would allow the landscape character to continually evolve to reflect the forest management practices of each new era, and would not take steps to perpetuate individual landscape features that illustrate the history of forest management on the property. As plantation trees age and decline, these stands would be slowly transitioned to mixed hardwood and conifer forests of native species that would regenerate naturally on the site. Existing hardwood and mixed forest stands would be managed to promote greater species and structural diversity. Under this alternative, in 100 to 200 years the forested areas of the Park would become more homogenous as plantations and other historic features are lost. As visitors travel the carriage roads and trails, they would see demonstrations of best current thinking and practices in forest management and experience a landscape with more native hardwood and mixed forest stands punctuated by large, remnant plantation and hardwood trees.

Alternative D (NPS Preferred), Recognize and Work with Ecological Change in Preserving the Historic Character of the Forest: This approach would respect the legacy of forest management implemented by Frederick Billings, and continued by his wife and daughters, and Mary and Laurance S. Rockefeller. The strategy would preserve broad landscape patterns and representative features that contribute to the distinctive historic character of the Forest, while working with the forces of ecological change and continuing to apply best current thinking and practices in forest management. In adapting to the changing ecology of the Forest that favors hardwoods over softwoods, some individual features would not exist as they do today—they might be found in new locations, vary in size, or exist in different stages of maturity as the result of forest growth and change. Overall, this alternative reflects the forward thinking stewardship approach of Mary and Laurance S. Rockefeller, and the care they took in preserving the historic forest character and understanding and working with ecological change.

Along the main carriage roads, opportunities would be pursued to retain edges of plantations or seek out new locations where small-scale plantings of new softwoods might be accomplished. Elsewhere in the Forest, the softwood plantations would transition to a mixed-aged forest with greater diversity of native species and structure, dominated in many areas by hardwoods. Where opportunities exist, forest management would be used to promote the regeneration of seedlings from plantation trees as a new generation of replacements. Consequently, while changes would occur on the landscape, in 100 to 200 years visitors traveling the main carriage road corridors would experience the familiar pattern of fields, plantations, hardwood forests and legacy trees that would evoke a strong sense of the property's history and its legacy of stewardship, and see demonstrations of the best current thinking and practices in forest management.

Many management activities would be the same under Alternatives B, C, and D, such as protecting important ecological areas, preserving stone walls and small-scale features, and maintaining recreational opportunities.

SUMMARY OF POTENTIAL EFFECTS

Potential effects of the four alternatives on a variety of resources and management factors are analyzed in this Plan in accordance with the National Environmental Policy Act (NEPA) and Section 106 of the National Historic Preservation Act. Over the long-term, Alternative A would create a greater ecological diversity, but would have major adverse effect on the Forest's historic character. Alternative C would maintain the tradition of using best current thinking and practices in forest management and foster greater ecological diversity, but would result in moderate adverse effects on the historic character of the Forest. The effects of Alternatives A and C on cultural landscape resources would be considered "adverse effect" under Section 106 of the National Historic Preservation Act, and potentially an impairment of Park resources under the NPS Organic Act. Alternative B would preserve the Forest's historic character to the greatest degree, but in doing so would have numerous adverse effects on natural resources, aesthetics, and sustainable operations. Alternative D would provide Alternative D would provide for both the retention of the Forest's historic character and enhancement of the Park's ecological values, educational opportunities, and sustainable operations. Alternatives B and D would have a determination of "no adverse effect" under Section 106, and would not impair any Park resources.

Alternative D is the National Park Service's preferred alternative because it most directly addresses current ecological conditions and forest change while maintaining historic landscape characteristics and patterns. Alternative D also is the environmentally preferred alternative under the criteria established in NEPA.

The Forest Management Plan and Environmental Assessment meets the requirements of National Park Service planning policies, the National Environmental Policy Act, and the National Historic Preservation Act. It reflects the thoughts and contributions of many individuals and organizations who participated in a variety of public programs and discussions over the last two years.

Reader's Guide: What You Will Find in This Plan

Part 1: Introduction
This chapter explains the history and purpose of the Marsh-Billings-Rockefeller National Historical Park, the significance of the Mount Tom Forest, the need for a Forest Management Plan, and the approach used in developing the Plan.

Part 2: Context for Mangement
Part 2 explores how both the natural and cultural histories of the Mount Tom Forest have influenced the landscape, and discusses the challenges and opportunities that these forces pose to the future management of the Forest.

Part 3: The Future of the Mount Tom Forest
This chapter provides a long-term vision for the Mount Tom Forest and specific management goals, and describes four management alternatives for reaching these goals.

Part 4: Description of the Mount Tom Forest
Part 4 describes the existing cultural and natural resources and current management activities associated with the Mount Tom Forest.

Part 5: Potential Effects of the Alternatives
This chapter examines the potential effects of the four management alternatives on the resources and management activities associated with the Mount Tom Forest, and discusses why Alternative D is both the National Park Service's preferred alternative and the "environmentally preferred alternative."

Part 6: Preparers, Public Involvement, and Agency Consultation
Part 6 identifies the planning team, project advisors, and recipients of this document, and outlines the steps the planning team undertook to involve the public and federal, state, and local governmental agencies in the Plan's development.

Part 7: References
Part 7 provides a list of works cited, guiding laws and policies, and a glossary of terms used in this Plan.

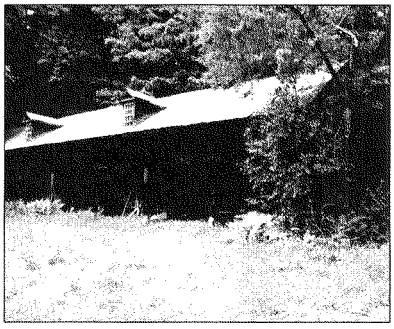
Appendices
Appendices A, B, C, and D provide supporting reference materials associated with this Plan.

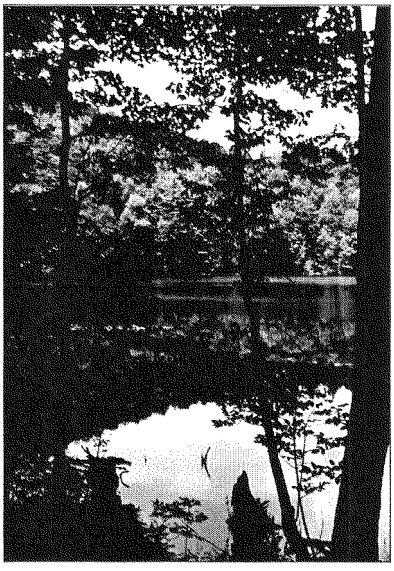
Endnote

[1] "Park" is used in this document to refer to both the physical place and to the administrative unit of the NPS that manages it.

(OCLP 2004)

PART 1: INTRODUCTION





Part 1: Introduction

This chapter outlines the purpose of the Marsh-Billings-Rockefeller National Historical Park (Park), the significance of the Mount Tom Forest (Forest), and the need for a Forest Management Plan (Plan). It details the process the Park used to develop the Plan, including creating an interdisciplinary planning approach and offering meaningful public discussions about the future of the Forest. It then presents related plans and planning processes the dovetail with the proposed actions of this Plan. The chapter ends with a discussion about how the Park intends to keep the Plan relevant and responsive to change and continue the public dialogue about the stewardship of the Mount Tom Forest. A fold out map of the park entitled "Base Map" is provided at the end of this chapter.

From top: Stone boundary marker along main carriage road (Marsh-Billings-Rockefeller NHP, hereafter MABI, 2003); winter view of a white pine (Laura A. Cohen 2004); view of Woodshed (Olmsted Center for Landscape Preservation, hereafter OCLP, 2003); the Pogue (Tom Lautzenheiser 2002).

1.1 THE PARK'S MISSION AND SIGNIFICANCE OF THE MOUNT TOM FOREST

Marsh-Billings-Rockefeller National Historical Park encompasses the historic Marsh-Billings-Rockefeller Mansion, the surrounding grounds, and the Mount Tom Forest in Woodstock, Vermont. It was a gift to the people of the United States from Mary French and Laurance S. Rockefeller. Mary Rockefeller's grandfather, Frederick Billings, developed the property into a model farm and forest in the late 1800s. Billings' stewardship efforts were influenced by George Perkins Marsh. A conservationist and author of the 1864 landmark book Man and Nature, Marsh spent his childhood years on the property.

The Park was created by an Act of Congress in 1992 with five key purposes:

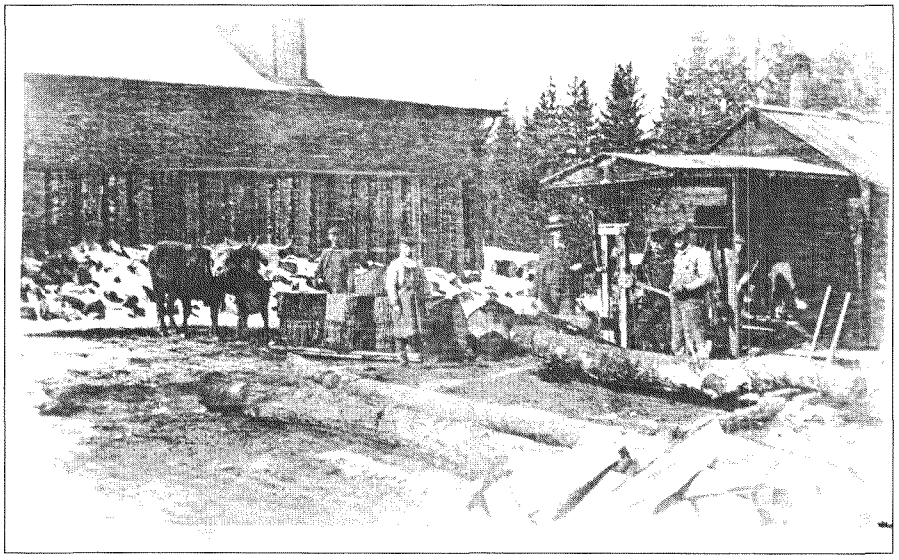
- To interpret the history and evolution of conservation stewardship in America
- To recognize and interpret the birthplace and contributions of George Perkins Marsh, pioneering environmentalist, author of Man and Nature, statesman, lawyer, and linguist
- To recognize and interpret the contributions of Frederick Billings, pioneer in reforestation and scientific farm management, lawyer, philanthropist, and railroad builder, who extended the principles of land management introduced by Marsh
- To recognize the significant contributions of Julia Billings, Mary Billings French, Mary French Rockefeller, and Laurance Spelman Rockefeller in perpetuating the Marsh-Billings heritage
- To preserve the Marsh-Billings Mansion, which is a National Historic Landmark, and its surrounding lands

When the property was designated as a National Historical Park in 1992, it was administratively listed on the National Register of Historic Places. The Mount Tom Forest is significant as the earliest surviving example of planned and managed reforestation in the country and is a key component of the Park's cultural landscape. It is a living exhibit that illustrates the evolution of forest stewardship in America, from the earliest scientific silvicultural practices borrowed from nineteenth-century Europe to contemporary practices of sustainable forest management. Nine of the plantations set out by Frederick Billings in the late 1800s still stand. Older trees such as open-grown sugar maples that date to the Marsh period and hemlocks over 400 years old can still be found throughout the property.[1] The network of carriage roads designed and built by Billings continues to provide public access to the Park and adjoining public lands, showcase the evolution of forestry on the property, and reveal breathtaking scenery.

Cultural Landscapes are geographic areas (including both cultural and natural resources and the wildlife therein) associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values (NPS 1996).

1.2 Laying the Foundation for Forest Planning and Management

The Park's enabling legislation and 1999 General Management Plan/ Environmental Impact Statement (GMP) provide clear direction to the National Park Service to actively manage the Mount Tom Forest as a cultural landscape. In a letter cited in and appended to the Senate Committee on Natural Resources Report on the Marsh-Billings National Historical Park Establishment Act 102-290, then NPS Director James Ridenour underscored the importance of ongoing management of the Forest:



Sawing firewood at the Woodshed, possibly c.1895-1900, before the Woodshed was extended by adding one bay. From a black & white penny postcard in the archives of the Woodstock Historical Society, not dated. (Woodstock Historical Society)

> Important historical and cultural aspects of the Marsh/Billings National Historical Park are the forest management practices instituted by Frederick Billings. Many of the trees on the property were planted under the direction of Billings and represented a major advance in reforestation practices at that time. You (Laurance Rockefeller) have continued the progressive forest management practices of Billings over the years and the condition of the lands reflect that care...active forest management is an important part of not only preserving the resource but of interpreting the cultural importance of the landscape. We will continue the program substantially as you have in the past....[2]

In keeping with that direction, the GMP calls for the Park to manage the property to illustrate its evolution through the occupancy of the Marsh, Billings, and Rockefeller families. The GMP also recommends continuing the tradition of professional forest management as an educational demonstration of conservation stewardship and sustainable forest management:

> Park managers will continue to actively manage the forest as part of the Park's cultural landscape. The Marsh-Billings National Historical Park [forest management plan]...will deal significantly with the Mount Tom forest, prescribing appropriate forest management strategies. The forest treatment section will establish objectives for forest stands involving thinning, harvesting of firewood and sawlogs, replanting, and other appropriate silvicultural practices to achieve the established objectives. Baseline monitoring programs will be developed. Forest areas of historical and ecological significance will be identified.

Stewardship: The Forest Management Plan upholds the definition of stewardship that formed the core philosophical ideal for managing the Park reflected in the General Management Plan. The word stewardship, derived from the old Norse word sti-vardr, meaning "keeper of the house," is used in the GMP and in this plan in two co-existing contexts: (1) as an expression of a deeply held personal belief associated with a commitment to future generations; and (2) as an approach to conservation practice that values both nature and culture, including the imprint of people on the land.

This management approach necessarily includes active management, including appropriate harvesting, to preserve the character-defining features of the forest while perpetuating its historic use as a model forest.

Public participation throughout the process will ensure that the public understands the practices of good forest stewardship.[3]....A variety of educational programs will be developed that demonstrate the basic principles of forestry. Programming will stress the importance of balance in forest management respecting historic character, natural values, aesthetics, and recreational use.[4]

"We must conceive of stewardship not simply as one individual's practice, but rather as the mutual and intimate relationship, extending across the generations, between a human community and its place on earth."

John Elder, *Inheriting Mount Tom*

In accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties, the GMP established a "rehabilitation" strategy for the Park's cultural landscape that allows for repairs, alterations, and additions on the property while preserving those portions or features that convey historical and cultural values. The GMP further guides the Park to identify and retain features and characteristics that contribute to the Forest's historical or ecological significance, and to apply contemporary best forest management practices to achieve management objectives.[5]

Portable sawmill in the Upper Meadow. (OCLP 2003)

1.3 NEED FOR THE FOREST MANAGEMENT PLAN

The GMP established the overall management philosophy to guide decision-making for the Mount Tom Forest. Within that general framework, a forest management plan is needed to provide a more specific vision for long-term management of the Forest and to identify management activities that will ensure the following:

- the patterns, characteristics, and underlying management ethic most critical to the historical integrity of the Forest remain evident and interpretable to the public hundreds of years from now

- significant ecological features and processes that have influenced the evolution and diversity of the Forest remain intact and are allowed to evolve over time

- best current thinking and practices in forest management are used to guide forestry activities and perpetuate the historic role of Mount Tom as a model forest

Since the development of the GMP, the Park has conducted only limited forest management activities that responded to immediate needs such as preservation maintenance and visitor safety (i.e., hazardous tree removal, mowing of vistas and fields, and cleanup of storm-damaged trees). More extensive, longer-term forest management activities have been deferred to allow time for completion of key natural and cultural resource studies and this Plan.

Best current thinking and practices in forest management is used in this Plan to describe the ethic of management that has informed forestry work on Mount Tom since Frederick Billings' time. Over the ensuing 135 years, each of the property's stewards drew upon current research and the expertise of forestry professionals to guide their management activities. This progressive approach to forestry ensured that the Forest was managed with the highest degree of care, and continued to serve as a relevant and inspirational demonstration of forest stewardship.

However, the profession and science of forest management in the U.S. has evolved over the past century, and what was historically considered "best thinking and practices" may not be viewed as sound forestry today.

For example, during Billings' time, reforestation using single-species plantations of non-native conifers was considered to be the state-of-the-art in forest management. The approach was effective in addressing pressing concerns of the day in Vermont—namely, the need to rapidly reforest barren agricultural lands in order to retain soils, stabilize water flows, and provide a sustainable source of wood products and income to the state's depressed rural economy.

With the evolution of the science and practice of forestry and the reforestation of much of Vermont since Billings' time, monoculture plantations of non-native species no longer constitute best current thinking and practice for much of the Northeast. Today, forest management practices are driven by a greater understanding of the forest as a complex ecosystem. For forests like Mount Tom, this includes an emphasis on managing for a diverse mix of native species using techniques that mimic natural disturbance regimes.

The practice of forestry constantly adjusts to changes in scientific knowledge, environmental conditions, resource economics, and social values. As such, what constitutes best current thinking and practices in forest management will continue to evolve.

1.4 Planning Approach

1.4.1 INITIAL STEPS: DEVELOPING AN INTERDISCIPLINARY PERSPECTIVE

To develop a management plan for the Mount Tom Forest that respects the legacy of diverse human and ecological influences on the landscape, the Park formed an interdisciplinary team of NPS staff and consultants. The team included professionals in cultural landscape preservation, forestry, ecology, wildlife biology, planning, and geographic information systems (GIS). A full list of team members can be found in Section 6.1.

The team initiated the planning process by synthesizing information from an array of natural and cultural resources studies that the Park initiated for the

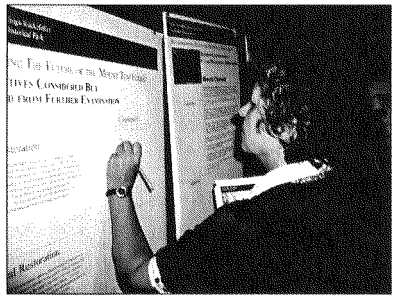
CULTURAL RESOURCE STUDIES
Archeological Overview and Assessment (Draft), 2005
Cultural Landscape Inventory (Draft), 2005
Cultural Landscape Report for the Forest: Site History, 2000
Cultural Landscape Report for the Forest: Existing Conditions and Analysis (Draft), 2005
Cultural Landscape Report for the Mansion Grounds: Site History, Existing Conditions and Analysis, and Treatment Recommendations (Draft), 2005
Frederick Billings: The Intellectual and Practical Influences on Forest Planning (Draft), 2003
Historic American Engineering Record: Carriage Roads, 2004
Historic American Landscapes Survey, 2002
Land Use History, 1994

NATURAL RESOURCE STUDIES
Amphibians and Reptiles Inventory, 2001
Bat Biodiversity Survey, 2001
Breeding Birds Inventory, 2003
Emigration and Habitat Use by Jefferson and Spotted Salamanders, 2001
Forest Dynamic Monitoring: Three-Year Baseline, 2004
Forest Insect and Disease Survey, 2004
Freshwater Fish Inventory, 2005
Invasive Plant Inventory, 2004
Legacy Tree Inventory, 2004
Mammal Survey, in preparation
Natural Community Assessment, 2002
Silvicultural Inventory, 2004
Vascular Plant Inventory, 1997
Vernal Pool Inventory, 2000
Water Quality Data Analysis, 1997
Water Quality Inventory, 2000

property. These studies are listed in the box above and are summarized in Part 4: Description of the Mount Tom Forest.

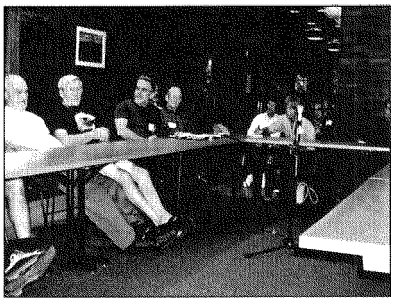
1.4.2 PLANNING IN PARTNERSHIP: ENGAGING THE PUBLIC IN ENVISIONING THE FUTURE OF THE FOREST

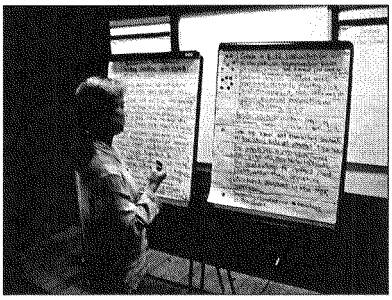
The planning team solicited suggestions and concerns from the public during a scoping process that included a series of special hikes, visitor center displays, workshops, meetings, and mailings to over 800 individuals and organizations. Through these events and mailings, the team reached out to adjacent landowners and other local residents, academics and professionals from a range of relevant disciplines, local, state, and federal officials, and a wide array of nonprofit organizations. (See Section 6.2 for further information on public engagement activities conducted during the development of this Plan.)



Open house for Forest Management Plan. (MABI 2004)

The broad planning issues, management direction, and alternatives articulated in this Plan reflect the public input the planning team received from these outreach efforts. In addition, participants in the planning process raised a variety of specific questions and suggestions regarding the treatment of, and potential impacts to,





Top, participants at a memory workshop (MABI 2004); bottom, brainstorming at a teachers' workshop (MABI 2003).

"You set out a tree knowing you'll never see it mature. A Tree Farm is like a tree garden...but it takes 100 to 150 years to grow a tree...Billings Farm showed what can be done, and what many people can do, if each generation practices stewardship."

Irwin Fullerton, resident and Tree Farmer, South Woodstock
From Stories from the Woods, 2004

Civic Engagement in Planning: Dialogues of Discovery

In addition to more traditional outreach efforts, such as mailings, meetings, and visitor center displays, the following events were held for the Forest Management Plan:

Stories from the Woods: As part of the Park's Forest Festival weekend, several local foresters and conservationists participated in a memory workshop facilitated by the Vermont Folklife Center. They shared their personal histories of living and working in the woods of Mount Tom and surrounding forestlands and discussed how those experiences inspired and informed their land ethic and their vision of forest stewardship. The public was invited to join the session and share their stories of discovery and perspectives on the future of forest stewardship.

Mount Tom as a Learning Laboratory: The Park met with a dozen local teachers to discuss how the Forest could be used as an outdoor learning laboratory for students to explore issues in environmental history and forest sustainability through hands-on learning experiences. The suggestions included involving students as citizen scientists; creating K–12 educational experiences that will allow students to study the forest growth and change as they progress through their school years; and involving students in hands-on management activities such as restoring historic trails, clearing over-grown apple orchards, planting new trees—so that they can contribute to the stewardship of the Park meaningfully and recognize that they can make a difference in the betterment of their parks and communities.

Future of the Forest Hikes: As part of the Park's regularly scheduled special tours, resource management staff teamed up with Park interpreters to lead special hikes to explore and discuss the history and future management of the Mount Tom Forest. The hikes focused on some of the most challenging management areas (such as plantations, legacy trees, unique natural communities) to allow participants the opportunity to experience these places first-hand and share their impressions and ideas with Park staff.

"Contested Landscapes: Humans and Nature in National Parks" Seminar: This seminar and associated "town hall" public forum in part focused on the Park's Forest Management Plan. The forum discussed related case studies from Point Reyes National Seashore, Cuyahoga National Park, and Marsh-Billings-Rockefeller National Historical Park. The discussion centered around the difficult challenge of recognizing and developing management approaches for places that are neither cultural nor natural but have attributes of both.

cultural and natural resources, visitor experiences, educational opportunities, and connections to the larger community. The full list of those detailed management considerations is provided in Appendix A.

1.4.3 ENSURING CONSISTENCY WITH GUIDING LAWS, POLICIES, AND REGULATIONS

In addition to the input provided by the public and interdisciplinary specialists described above and listed in Section 6.2, the development of this Plan has been guided by a variety of legal requirements that apply to the NPS and the Park. Foremost, all activities at the Park are governed by the 1916 legislation (the "Organic Act") that created the National Park Service and established its mission:

> To conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

The Park's mission and management direction are further articulated by its enabling legislation and General Management Plan, as discussed in Section 1.2

above. As a federal property, Park management and this Plan also are guided by federal laws and NPS policies and regulations, including:

- National Historic Preservation Act
- National Environmental Policy Act
- Endangered Species Act
- Clean Water Act
- Clean Air Act
- Archeological Resources Protection Act
- NPS Management Policies
- Director's Order 28, Cultural Resource Management
- NPS Natural Resource Management Manual #77
- Executive Order #13112 regarding invasive species
- Executive Order #12898 on environmental justice
- Executive Order #11990 regarding protection of wetlands
- Executive Order #11988 on floodplain management

In addition, as further described in this Plan, the Park is a nationally significant historical landscape and the Forest contributes to the historic significance of the property. Therefore, in accordance with Sections 106 and 110 of the National Historic Preservation Act, as part of this planning process cultural resources within the Forest were identified and evaluated for their contribution to the significance and integrity of the property relative to criteria established for the National Register of Historic Places. (A summary of these findings is presented in Section 4.1). Furthermore, this Plan articulates how treatment of the Forest will be carried out in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties and analyzes the potential effects of proposed actions on historic resources. The Park has consulted with the Vermont State Historic Preservation Office (SHPO) in the development of this Plan. Once the Plan is finalized and a management alternative is selected, the Park will work with the SHPO to prepare a programmatic agreement on management activities related to the preservation of historic and archeological resources associated with the Forest

The applicable laws, policies, and regulations that have guided the development of this Plan are further described in Section 7.2.

1.4.4 RELATIONSHIP TO OTHER PLANS AND PLANNING PROCESSES

In addition to the GMP and the guiding laws, policies, and regulations outlined above, several existing plans have informed the development of the management actions proposed in this Plan. Additionally, several compliance and implementation documents are being developed with this Plan to detail how specific management actions will be implemented. These documents will be completed after a management alternative is adopted and the Plan is finalized.

1.4.4.1 Related Plans

- *Hazardous Tree Management Plan (NPS 2005, Draft).* The Hazardous Tree Management Plan defines the goals for managing hazardous trees in the Park. This Plan is an operational document describing actions to be taken by National Park Service staff to implement the Park's hazardous tree program in accordance with NPS policies and goals.

- *Wildland Fire Management Plan (NPS 2005).* The Wildland Fire Management Plan is an operational document describing the actions National Park Service staff will undertake to minimize the risk of wildland fires and provide for firefighter and public safety, and protection of Park natural and cultural resources.

- *Cultural Landscape Report for the Mansion Grounds Marsh-Billings-Rockefeller National Historical Park, Volume 3: Treatment Plan (Auwaerter and Curry 2005, Draft).* The document recommends treatments for the historic grounds adjacent to the Mansion. Treatment recommendations developed in the document draw upon the research and analysis presented in Volume 1: Site History and Volume 2: Existing Conditions and Analysis of the Cultural Landscape Report for the Mansion Grounds. This research, findings, and recommended treatments will be shared with the Vermont State Historic Preservation Office as part of the development of a programmatic agreement.

- *Long-Range Interpretive Plan (NPS 2003).* The Long-Range Interpretive Plan defines Park interpretation and education goals, and outlines a program to promote educational opportunities and visitor experiences related to these goals.

1.4.4.2 Concurrent Planning Processes

- *Programmatic Agreement with the Vermont State Historic Preservation Office.* Upon selection of a management alternative, the Park will pursue a programmatic agreement with the Vermont State Historic Preservation Office. This agreement will detail a Section 106 review process for ongoing forest management activities to ensure that these activities do not adversely affect historic characteristics and archeological resources within the Forest.

- *Stand Descriptions and Treatment Recommendations (NPS, in preparation).* This document outlines cultural and natural resource data relevant to individual forest stands, hayfields, and pastures. Upon selection of a management alternative, stand-level goals, short-term and long-term management activities, and priorities for the treatment of each stand will be developed.

- *Integrated Pest Management Plan (International Pest Management Institute, in preparation).* This document will identify pests and pest management issues related to the Park's forest, grounds, buildings, and curatorial collections. The plan will provide information on pest biology and conditions conducive to their survivability, suggest monitoring strategies, set thresholds for treatments, and outline physical/mechanical, cultural, and chemical treatment options.

- *Non-native Invasive Plants Inventory and Treatment Plan (NPS, in preparation).* This document will present an inventory of known non-native invasive plants, including their distribution and abundance as assessed by the NPS Northeast Temperate Inventory and Monitoring Network (NETN). Management priorities will be developed using a ranking system developed by NETN. Physical/ mechanical, cultural, and chemical treatment options will be presented.

- *Historic Carriage Roads and Trails Assessment and Maintenance Plan (Paul Daniel Marriott and Associates, in preparation).* This document will provide condition assessments and maintenance recommendations for the Park's historic carriage roads and trails. The plan will include an inventory of historic features and characteristics, analysis of preservation issues and considerations, and detailed maintenance recommendations. The plan will be shared with the Vermont SHPO and proposed management actions will be incorporated into the programmatic agreement.

- *Phase III of the Northeast Temperate Network Inventory and Monitoring Program (NETN, in preparation).* The NPS Northeast Temperate Network Inventory and Monitoring Program (NETN) was created to design and implement ecological monitoring programs in eleven parks throughout the Northeast. The NETN has selected ecological vital signs for long-term monitoring and is currently developing monitoring protocols for each vital sign (see Appendix B).

1.4.5 ONGOING DIALOGUE, REFINEMENT, AND ADAPTIVE MANAGEMENT

The management of the Forest will evolve beyond the life of this plan as new information and perspectives about the Forest's historical and ecological significance become available and best current thinking and practices in forest management change. The Park is committed to:

"Parks are places to stimulate an understanding of history in its larger context, not just as human experience, but as the sum of interconnection of all living things and forces that shape the earth..."

Rethinking the National Parks for the 21st Century, the National Park System Advisory Board

- encouraging an ongoing public dialogue about management of the Forest

"Civic engagement is an enactment of our community values about what we think [national parks] ought to be. It has to be Americans, all of us, ...coming into places that they care about, sharing their different stories of those places, and by so doing, enacting, reproducing and resurrecting what it means to practice democracy, what it means to care for ecosystems, what it means to sustain community."

Bill Cronon, Contested Landscapes workshop, September 2004

- adjusting management approaches and actions as necessary in light of new information and understanding (i.e. adaptive management)
- revisiting the Plan periodically to ensure that it continues to reflect current knowledge, and best thinking and best management practices over time

The Park will conduct a more formal public involvement process to revise/rewrite the Plan when major changes in direction are contemplated or deemed necessary. It is anticipated that this may occur approximately every twenty years.

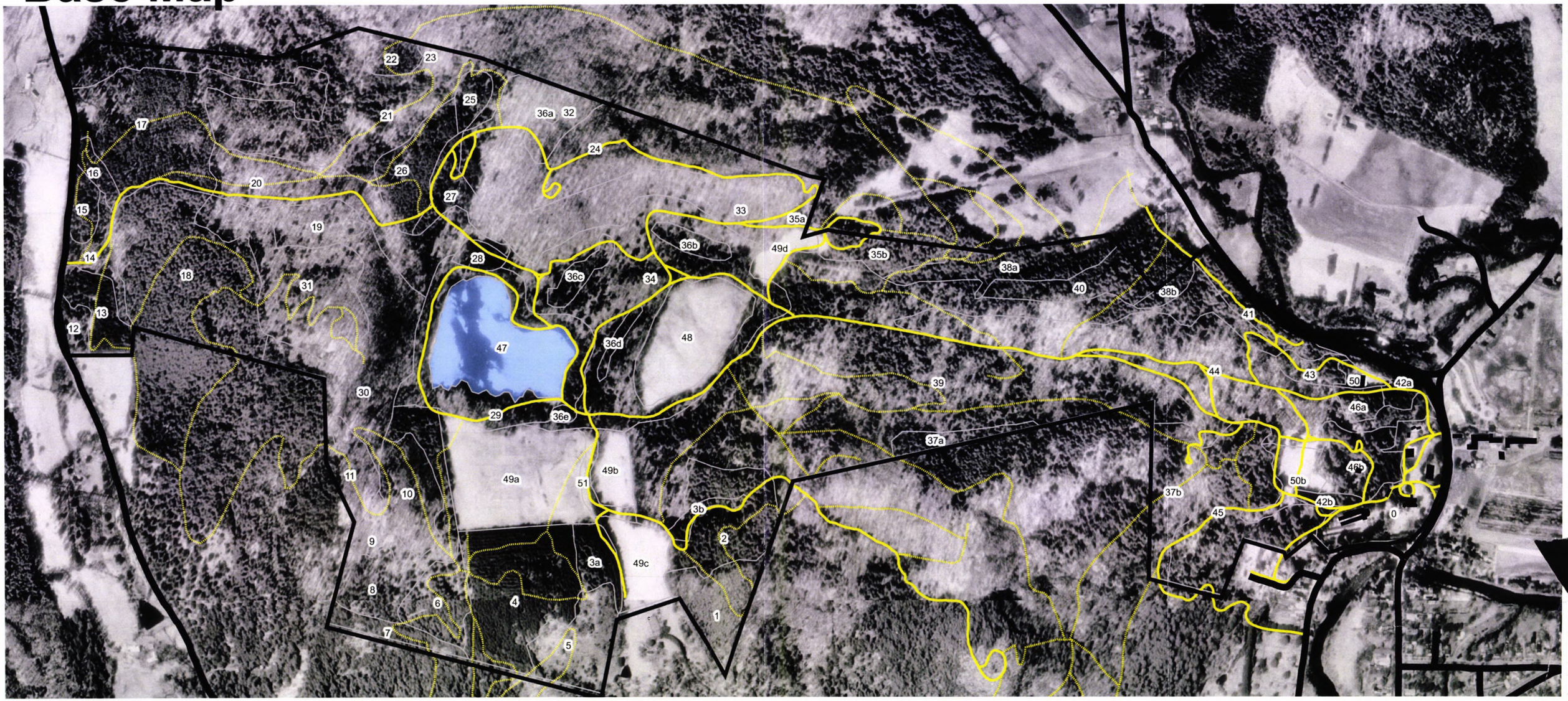
Endnotes to Part 1

[1] These trees are referred to as "legacy trees" throughout the Plan.
[2] Public Law 102-350. August 26, 1992, 102nd Congress, S. 2079.
[3] NPS 1999, 27.
[4] NPS 1999, 27.
[5] NPS 1999, 27.

Marsh-Billings-Rockefeller National Historical Park
Vermont

National Park Service
U.S. Department of the Interior

Base Map



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0 250 500 1,000 1,500 2,000 Feet

Produced by
Marsh-Billings-Rockefeller National Historical Park

Ottauquechee River
Pogue
Pogue Stream
Park Boundary
Forest Stands
Carriage Roads
Ski & hiking trails

Base Map

Data Sources:
Carriage Roads & Forest Stands: USFS 2003,
Hiking & Ski Trails: UVM CLR
Streams, Surface waters: TRORC 1:5000 orthophotography
Roads: TRORC 1:5000 orthophotography

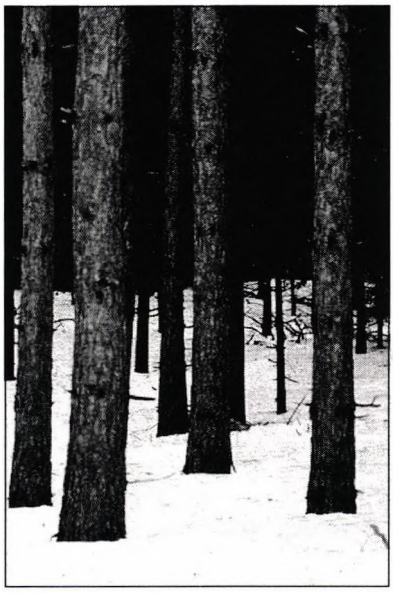
All digital data layers are represented in Nad 83, UTM Zone 18N

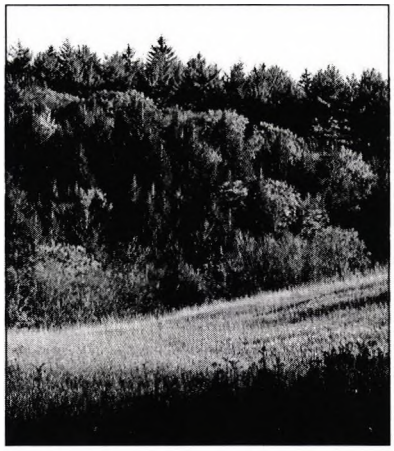
This map should be used for planning purposes only
and is not intended to be interpreted as an engineered plan.
Data layers may change due to updates and edits.

November 2005

(MABI 2003)

PART 2: CONTEXT FOR MANAGEMENT





Part 2: Context for Management

The Mount Tom Forest is a nationally significant cultural landscape. It is a living record of the beginnings of scientific forestry in the United States and the progression of forest management techniques over the past 135 years. The Forest is also a landscape that has been influenced by and continues to evolve as a complex ecological system, propelled by the dynamic processes of natural succession.

This chapter explores how Mount Tom's cultural and natural histories have co-evolved and mutually influenced the composition and character of the landscape that can be experienced today.

The complex interactions of these cultural and natural forces pose unique opportunities and challenges in developing a forest management plan for Mount Tom. These challenges are discussed at the end of this chapter.

From top: Red pines in Stand #4 (MABI 1998); sugar maple bordering the Elm Lot (OCLP 2003); view east from the Summer Pasture (MABI 2000); portable mill in Upper Meadow (MABI 2003).

2.1 OVERVIEW OF THE MOUNT TOM FOREST

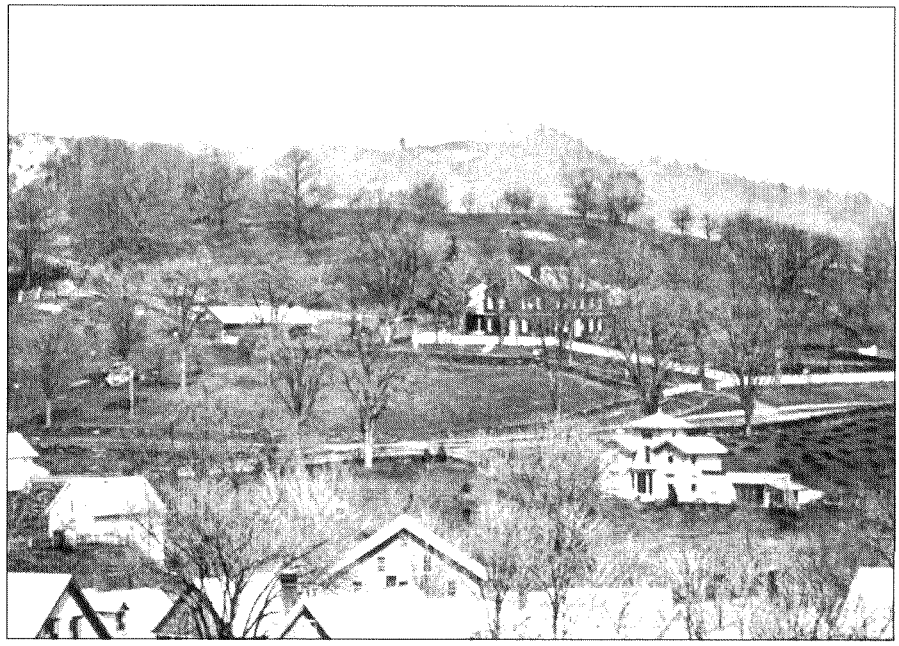
This section provides a brief overview of the cultural and ecological history that has shaped the Mount Tom Forest. More in-depth descriptions about the Forest's historical significance, cultural features, and ecological conditions can be found in Part 4: Description of the Mount Tom Forest.

The Forest contributes to the historical significance of the property, most notably:

- For it's association with American conservationists George Perkins Marsh, Frederick Billings, and Laurance Rockefeller for the period of 1801 to 1997
- As an example of pioneering nineteenth-century forestry from 1873 to 1910 and an example of continuous private forest management up through 1997
- As an example of landscape design during the Country Place Era from 1870 to 1930, and as part of a late-nineteenth-century model farm.

2.1.1 CULTURAL HISTORY

George Perkins Marsh grew up on the property that is now the Park during a time of enormous social and environmental upheaval. By the mid-nineteenth century, Mount Tom, like thousands of other once-forested landscapes in New England, had been cleared for farms, potash, and firewood. In the 1830s the opening of commercial wool markets ignited the merino sheep farming boom and precipitated one of Vermont's earliest environmental catastrophes. Woodlands were cleared to meet the increasing demand for sheep pasture and fences—almost 8,000 wooden rails were needed to enclose a 40-acre pasture. In a historical blink of an eye, places like Woodstock's Mount Tom were stripped of most of their vegetation, then were quickly eroded and left deeply gullied and infertile. Upland topsoils were washed into streams and rivers, threatening drinking water and creating massive fish kills. Meanwhile, struggling lowland villages were afflicted by frequent mudslides and flooding. Both George Perkins Marsh and Frederick Billings witnessed this rapid degradation of the Vermont landscape. Years later, while serving as U.S. Ambassador to Italy, Marsh wrote passionately about the consequences of deforestation and argued for a new ethic of stewardship in his 1864 landmark book, *Man and Nature*.



View of the Marsh Place looking north over Woodstock village in 1869. (Woodstock Historical Society)

Frederick Billings, a Vermont native, lawyer, railroad executive and pioneer conservationist, purchased the Marsh property, including much of Mount Tom, in 1869. Billings was a believer in material progress and sustainable use, an outlook characteristic of American conservation up through the middle of the twentieth century. In the West, he had directed efforts to encourage settlement and commerce along the route of the Northern Pacific Railroad by planting trees,

"I spent my early life almost literally in the woods; a large portion of the territory of Vermont was, within my recollection, covered with the natural forest; and having been personally engaged to a considerable extent in clearing lands, and manufacturing, and dealing in lumber, I have had occasion both to observe and to feel the effects resulting from an injudicious system of managing woodlands and the products of the forest."

George Perkins Marsh in a letter to botanist Asa Gray, 1849

Billings Estate spruce plantation featured in the periodical *American Forests* (February 1910). Pictured is George Aitken (1852-1910), Manager of the Billings Farm. (MABI)

building windbreaks, and establishing various initiatives to stimulate rural development. In Woodstock, Billings set about creating a farm and forest on the former Marsh property that would serve as a model of land stewardship and sustainability for the depressed agricultural economy of his home state. He harbored a vision of social improvement and rural recovery based in part on reforestation, agricultural improvement, and conservation. As Billings was planting trees by the thousands, he simultaneously developed 12 miles of carriage roads to showcase his pioneer forestry work and provide picturesque drives for the public to enjoy. His approach to the estate's development exemplified nineteenth-century landscape design sensibilities, which strove to create landscapes that were as useful as they were beautiful and inspiring.

"[Frederick] would plant trees in the Spring of the year, determining to cover the hills with forest. He was quite fond of going around and working with his men. He was led to consider forestry by reading the writings of Geo. P. Marsh regarding climate changes induced by devastation of the forests...His example has caused many farmers here to plant trees on the barren hillsides and has therefore proved vary valuable."

Julia Parmly Billings

When Billings started this bold experiment, forestry was not yet an established profession in America. He and his professional farm manager, George Aitken, used scientific practices borrowed from nineteenth-century European forestry, drawing heavily on Billings' personal library of German and French forestry texts. The earliest plantations established by Billings on Mount Tom were Norway spruce and European larch—fast-growing European species thought to be best suited for the New England climate. The use of these species is one demonstration of the dominant influence of European scientific forestry on the nascent profession in America. In other places on the property Billings experimented with plantations of native trees (such as white pine), or simply cultivated trees that were naturally regenerating and occasionally planting desirable native hardwood species in regenerating areas.

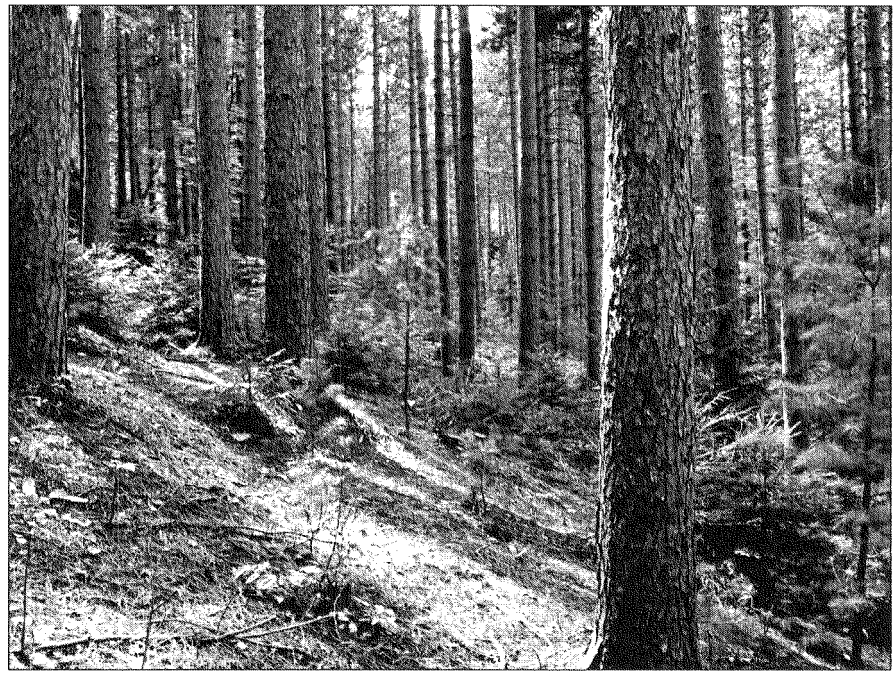
Sustainable Forest Management: Billings' approach to forest management drew upon the best current thinking and practices of his time to heal the landscape, cultivate a productive forest, and provide economic stability to local communities. His approach constituted what would now be considered "sustainable forest management," although this phrase would not be coined until later in the twentieth-century.

In a contemporary context, the understanding of sustainable forest management has deepened to include a greater emphasis on protecting and enhancing environmental values while allowing for continual production of quality wood. (See Lansky 2003 and McEvoy 2004 for examples.)

As is true for the term "best current thinking and practices of forest management" described in section 1.3, our understanding of what constitutes sustainable forest management and the means by which we practice it will continue to evolve as the science of forestry advances.

Billings' scientific forestry program on worn-out agricultural lands influenced other efforts of forestry conservation throughout Vermont and the New England region. Billings promoted the first state commission to study forestry in Vermont, and was a principal author of its final report that emphasized the role of forestry in the revitalization of rural Vermont. In the context of American conservation history, his forestry work was farsighted and pioneering for its time.

After Frederick Billings' death in 1890, his wife and daughters continued to develop his forestry program on Mount Tom. Their work coincided with the rapid growth of the forestry profession in America and rise of forest conservation in the public sector, particularly with the establishment of municipal, state and national reforestation programs. The Billings women applied reforestation and forest management techniques that drew upon the best science and management practices of their time, practices that were being developed and disseminated through Vermont state forestry programs and tree nurseries. The plantations established during this time included both native white pines and red pines that would dominate the twentieth-century reforestation techniques in the northeastern U.S.

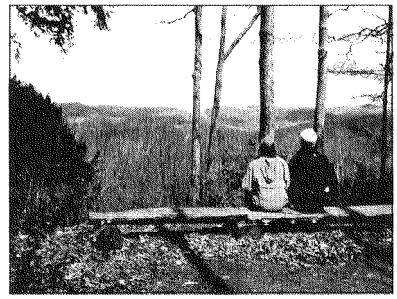


Red Pine plantation (Stand #26) planted in 1917 along the North Ridge. (OCLP 2003)

Reforestation on Mount Tom continued up through the mid-twentieth century, with the last plantation in the Park established in 1952. In the 1970s, Mary and Laurance S. Rockefeller assumed full management of the Forest. Embracing the philosophy of "Conservation for People," the Rockefellers managed Mount Tom with an emphasis on natural resource protection, historic preservation, aesthetics, and tourism in addition to continuing the practice of sustainable forest management. By the 1970s, most of the open land had been planted or naturally regenerated, and forestry work under the Rockefellers shifted to promoting the growth and development of existing plantations and hardwood stands, and enhancing the aesthetic and recreational opportunities of the estate. The Rockefellers added miles of new trails for cross-country skiing, and encouraged the public to continue to explore and enjoy Mount Tom.

"Perception of beauty, and action to preserve and create it, are a fundamental test of a great society..."

Laurence Rockefeller, from *Catalyst of Conservation* by Robin Winks, p.195



View north from the North Ridge Road. (OCLP 2004)

2.1.2 ECOLOGICAL HISTORY

While the cultural dimension of forestry practiced by Billings and his heirs is critical to understanding the evolution of the Mount Tom Forest, this story is incomplete without also considering the ecological history of the site that developed over the same time.

In ecological terms, the Mount Tom Forest is a hardwood site. While part of Mount Tom was being deliberately reforested with thousands of planted seedlings, abandoned fields elsewhere on the property slowly began the transition through natural succession to a forest dominated by a mix of native species. As this process unfolded, early "pioneer" tree species such as white pine, white and gray birch, and aspen were the first to colonize the unmanaged, open fields. These trees could sprout and grow in the thick pasture grasses, tolerate nutrient poor soils, and thrive in the dry, sunny open land. As these pioneers became established, they influenced the site by adding organic material to the soil, and forming dense canopies that shaded the grasses and herbaceous plants. Under these conditions, the shade-tolerant tree species such as sugar maple, American beech, and eastern hemlock became established and to this day dominate the composition of the Forest. However, from Billings' time forward, the pace and character of forest succession was also influenced by management in many parts of the Forest. As pioneer species matured, they were harvested or thinned to favor the more shade-tolerant, longer-lived hardwood species. Poor-quality and diseased trees were also removed. The resulting managed hardwood forest has readable signs that tell this story, including the high quality of remaining trees and roads used for skidding wood from the Forest.

Pasture lands on the West Ridge were abandoned in the 1940s and began to transition to a native hardwood forest. (OCLP 2003)

The softwood plantations were successfully established primarily due to extensive forest clearing and lack of hardwood competition. Many of the conifer species used in the reforestation efforts, such as white pine, Norway spruce, and red pine, were selected because they grew fast, tolerated nutrient-poor soils, and competed with the grasses of the agricultural fields. These species quickly established a continuous cover that inhibited the growth of native seedlings, thus giving these planted conifers a

temporary competitive advantage over other plants that might have naturally colonized the site. However, in order to maintain the health of plantation trees, periodic thinning was required to avoid overcrowding, to prevent stagnation, and ultimately avoid loss of the plantation. The thinnings increased the amount of sunlight reaching the forest floor and resulted in a burst of regeneration from native seedlings. These partial shaded conditions, similar to those created by naturally regenerated pioneer species, supported the establishment and growth of shade-tolerant native seedlings such as sugar maple, beech, and hemlock. After thinning, plantation trees quickly responded with a growth spurt that once again closed the canopy and suppressed the growth of the native hardwood seedlings. As the plantations aged and the openings created through thinning became larger, native hardwoods eventually became a significant component of the plantation composition.

The overstory of Stand #1 is still dominated by the European larch planted in 1887, but the young trees in the understory (regeneration) are native hardwoods. (OCLP 2004)

Today, much of the Forest favors the regeneration and development of hardwoods and hemlock rather than planted conifers and early-successional species. As has been the case for hundreds of years, the forces of natural succession continue to combine with past and present management in shaping the composition and character of the Forest.

2.2 MAN AND NATURE ON MOUNT TOM

The interplay between human intention and natural processes has ultimately shaped the character of the Mount Tom Forest. Key landscape characteristics that reflect both natural and cultural processes illustrate some of the most important aspects of the Forest's historical significance. These characteristics include the landscape's patchwork of fields, hardwoods, and plantations; the diversity in forest architecture of plantations and hardwood and mixed forests; and remnant legacy trees. These integrated defining landscape characteristics, and their cultural and ecological associations, are briefly described below. More in-depth descriptions about the Forest's historical significance, cultural features, and ecological conditions can be found in Part 4: Description of the Mount Tom Forest.

Historic Character is the sum of all visual aspects, features, materials, and spaces associated with a cultural landscape's history (NPS 1996).

2.2.1 LANDSCAPE PATCHWORK

Any hiker or skier who visits Mount Tom leaves with a very basic impression: this is a diverse landscape. The character of the Forest is largely defined by a mosaic of spaces formed by the interrelationship of hills and valleys, naturally regenerated and planted forest stands, agricultural fields, and The Pogue (a 14-acre pond in the center of the Park).

This patch-like character reflects over 135 years of continuous forest management and the agricultural origin of the landscape. As visitors hike along the carriage roads and trails, they can explore the history of reforestation on Mount Tom as expressed in a diverse system of plantations of white pine, Norway spruce, red pine, European larch, and Scots pine plantations that were planted from late nineteenth century to as recently as 1952. They can also experience over sixteen different natural communities that include early-successional big-toothed aspen stands, red maple–black ash swamps, and rich northern hardwood forests of maturing American beech, sugar maple, and white ash.

The diverse qualities of the Forest are further highlighted in the way nineteenth-century landscape design was applied to create a sequence of different vistas and visual qualities that are experienced from the network of carriage roads and trails. The carriage roads track deep into dark hemlock ravines created by the Pogue Stream, and then climb to The Pogue and surrounding ridgetops to offer sweeping views out of the Park and into the surrounding Vermont countryside. The overall experience is one of contrast—natural and designed areas, open and enclosed spaces, and intimate and expansive views.

In addition to its historical value, the patchwork character of the landscape is also an important part of the Park's ecology. The diversity of the forest types and interspersed openings over a relatively small area provides valuable habitat for many wildlife species. For example, species like fishers and wood thrushes move

Views of the Elm Lot from the red pine plantation in Stand #4 and the Maple Lot from Stand #51. (OCLP 2003)

about the various forest stands; bobolinks nest in the hayfields; and the wetlands provide critical habitat to Jefferson salamanders.

For a map showing landscape patchwork characteristics, see the fold out "Landscape Patchwork" at the end of this chapter.

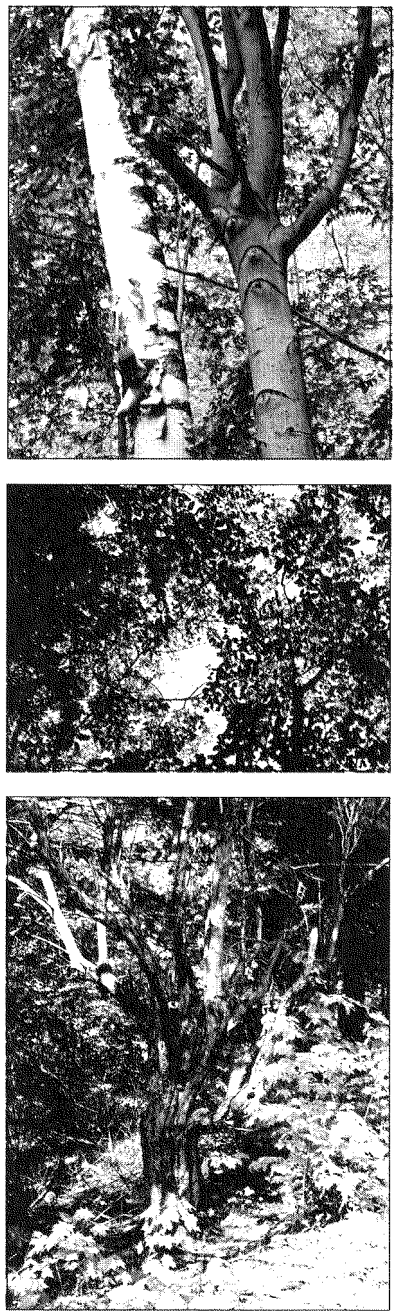
2.2.2 FOREST ARCHITECTURE

For the observant visitor, the diversity of the landscape is readable at even smaller scales. There are over fifty different forest stands on Mount Tom, each with a unique composition, age, and pattern of overstory trees, understory species, and trends in regeneration. The composition and structure of the stands reflect the history of reforestation and forest management activities (e.g., thinning and harvesting) on the property, the influence of aesthetics in forest management, and the response of trees to unique site conditions such as soils, aspect, and the influence of natural succession.

The plantations are diverse in their age, species composition, planting pattern, and degree to which hardwood and conifer regeneration has developed within the stand. The youngest plantations of red pine and Norway spruce can still be found as thick stands of even-aged trees aligned in a grid with their clear trunks stretching up to form a cathedral-like canopy. The understory is bare, suppressed by the dense tree crowns, and allows for sweeping views into the forest. Some of the older plantations are a mix of species, due to intentional plantings or decades of regeneration and competition. These are stands of large trees, whose trunks measure over 30 inches in diameter and heights stretch well above the other trees in the Park. Scattered beneath them are offspring of their own seed and other native hardwoods and softwoods that have regenerated naturally. In these stands, the influence of forest management appears to have mimicked some natural disturbance trends (e.g., wind throws), creating a forest stand with increased structural and species diversity.[1]

The diverse naturally regenerated hardwood and mixed forest stands have their own rich and complex history. Some are remnant hardwood stands that were managed woodlots during the Marsh period, while others regenerated in abandoned agricultural fields and are only fifty years old. Most are even-aged, having grown up when past agricultural fields and pastures were abandoned. However, some are remnants of marginal wetlands and riparian areas that were never cultivated and have scattered large, old trees. In other hardwood stands, remnants of former homestead plantings, such as apple trees, sugar maples, and locusts, can be found scattered amongst early-successional hardwoods.

The decades of forest management have influenced the structure of many plantations and hardwood and mixed forest stands. Some stands have developed greater vertical diversity as intentional forest thinning and natural aging of the



From top: American beech and white birch in Stand #33; hardwoods in Stand #37b; apple tree in Stand #12. (OCLP 2003, 2004)

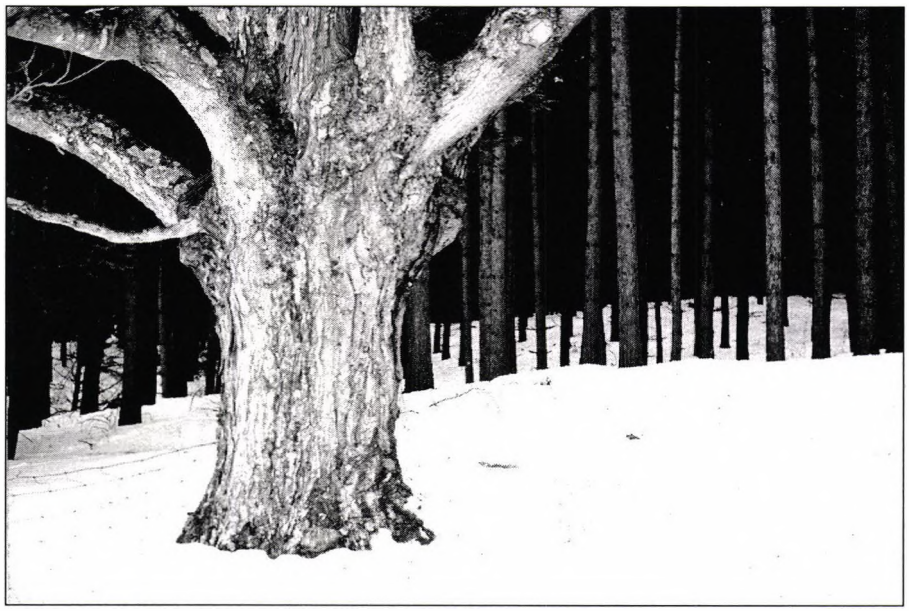
stands opened up the canopy, increasing light for trees in the understory. In other cases, forest management has perpetuated even-aged characteristics or reduced the amount of understory vegetation to provide views into the forest from along the carriage roads.

The complex structure of the Forest is a living record of the interplay of human management and natural forces, which provides a diversity of wildlife habitats and other ecological functions.

For a map showing the types of stands, see the fold out map "Cover Types" at the end of this chapter.

2.2.3 LEGACY TREES

Mount Tom is also a forest of big, old trees that have stood witness to the march of history. As the trees grew through the centuries, their trunks and branches recorded the changes in land use and succession. Those stories are readable to visitors who seek these big trees out and carefully study them. Scattered along the Pogue ravine and around wetlands are sturdy 300–400-year-old hemlocks towering above the canopy, reminders of the pre-settlement forest. Their large lower branches first stretched outward horizontally in response to early forest clearing, and then abruptly turned upward as the surrounding forest began to close in. Elsewhere, in the middle of stands that were once pastures, old sugar maples display a wild, gnarled structure that they developed as they grew uninhibited by the competition of other trees.



Sugar maples such as this tree amongst the red pines in Stand #4 gesture to past agricultural land uses. (MABI 1998)

There are also legacy trees that were intentionally planted as part of the design of the carriage roads and development of the estate. For example, some of the earliest Norway spruce planted by Frederick Billings form stately allées that mark the carriage road gateways around the Mansion Grounds and the old farm roads that once served the Hilltop Farm at the French Lot. In other areas, lines of old sugar maples stretch out along the carriage roads and mark the boundaries of open fields.

In addition to being a testament to changes in land use throughout the Park's history, these big legacy trees also enrich the Park's biological systems. They provide nesting cavities utilized by a host of bird and mammal species including woodpeckers, bats, raccoons, and porcupines, as well as moist cover for amphibians. The decaying trunks house abundant populations of insects, lichens, and fungi that in turn become food for a diversity of animals. Legacy trees also enhance the Forest's structure and provide habitat to species that prefer late-successional forest characteristics for cover and breeding.

For locations of legacy trees, see the fold out map "Legacy Trees" at the end of this chapter.

2.2.4 THE NATURE OF CHANGE ON MOUNT TOM

The forest character we see today is only a snapshot in time; the nature of forest change is constant. The plantations, hardwood stands, and legacy trees are moving along their own unique trajectories influenced by the long history of agricultural and forest management activities, the dynamics of tree growth and aging, competition and disease, and the availability of light, soil, water, and nutrients. For example, the remaining even-aged, single-species plantations, which are the oldest remaining testaments to pioneering reforestation techniques in the United States, will eventually reach their maturity and face strong competition from native hardwood trees. The reestablishment of plantations and suppression of native seedlings is difficult because the landscape of today is quite different from the one Billings and his heirs reforested. Where there were once only sun-scorched hillsides of sparse pasture grasses, there are now thick, mature forests that offer moist, shady growing conditions. Soils that were once worn thin and depleted of nutrients are now enriched from decades of leaf litter decomposing on the forest floor. And, where there were once only scattered remnant native trees dotting the barren hillsides, there are now diverse, dense stands of native trees casting an abundance of seeds that are ready to take advantage of the enriched growing conditions.

2.3 CHALLENGES IN DEVELOPING AND APPLYING AN INTEGRATED MANAGEMENT APPROACH FOR THE MOUNT TOM FOREST

The overarching challenge in planning for the future of the Mount Tom Forest is to manage this nationally significant cultural landscape as a dynamic cultural and natural system that is continually shaped over time by both human and ecological forces. These changes unfold over decades, if not centuries, and require management approaches that envision change beyond typical planning horizons.

"The separation of nature and culture – of people from the environment which surrounds them – which has been a feature of western attitudes and education over the centuries, has blinded us to many of the interactive associations which exist between the world of nature and the world of culture."

Adrian Phillips, IUCN's World Heritage Advisor

Few models exist that attempt to integrate approaches from both natural and cultural resource management to work with the long-term dynamic qualities of landscapes. Management of cultural landscapes such as the Mount Tom Forest requires innovative approaches to preservation that include a greater understanding of natural systems and broader social histories. Cultural landscapes are defined by relationships that humans have developed with a place over time and the material evidence of those relationships. These relationships are characterized by patterns and interactions, rather than solely by physical features. Landscape characteristics encompass ecological and cultural attributes, broad landscape patterns, continuing cultural traditions, and diverse values held by past stewards and current visitors.

Virtually all cultural landscapes evolve from or are dependent on natural resources. In many ways, the dynamic qualities inherent in natural systems are what differentiate cultural landscapes from other cultural resources. Plant and animal communities associated with human settlement and use are considered biotic cultural resources and can reflect social, functional, economic, ornamental, or traditional uses of the land. Within a cultural landscape, biotic cultural resources are recognized either as a system or as individual specimen features that contribute to the landscape's significance. For example, the preservation of a single tree in a historic designed landscape may be critical to the integrity of the overall design.... In contrast, an entire woodland may have significance, so that preserving the ecological processes of the system rather than individual trees or animals becomes paramount (NPS 1998, pp. 103–4).

These landscapes offer unique opportunities for biodiversity conservation and ecosystem management. The pervasiveness of human influences on landscapes, especially in areas with a long cultural history, requires recognition of ecological values that exist in a mosaic of land uses and attention to the role of disturbance—either natural or human-generated—in shaping ecological systems. Examining these relationships can lead to a greater understanding of and appreciation for the role of humans within, rather than apart from, the natural environment.

Four key questions continually surfaced in discussions about the complex interrelationships between nature and culture on Mount Tom:

"Cultural landscapes often reflect specific techniques of sustainable land-use,...and a specific spiritual relation to nature. Protection of cultural landscapes can contribute to modern techniques of sustainable land-use and can maintain or enhance natural values in the landscape. The continued existence of traditional forms of land-use supports biological diversity in many regions of the world..."

IUCN World Heritage guidelines, Section 38 (1994)

- How can the "readable" history and essential character of the Forest be retained by working with the dynamics of forest growth and change?
- How can knowledge of natural and cultural systems be integrated to shape an effective, enlightened management strategy for this nationally significant site?
- Can we successfully retain enough of the Forest's historic character while also preserving the integrity of other important aspects of the landscape including its biodiversity, habitat, water quality, and recreational opportunities?
- How can we cultivate a civil dialogue and use this public land to demonstrate a path to sustainability and offer unique educational opportunities about conservation stewardship?

These questions were used to guide the development of the management vision and goals that are discussed in the next chapter. A more detailed list of management considerations identified during the scoping process in provided in Appendix A.

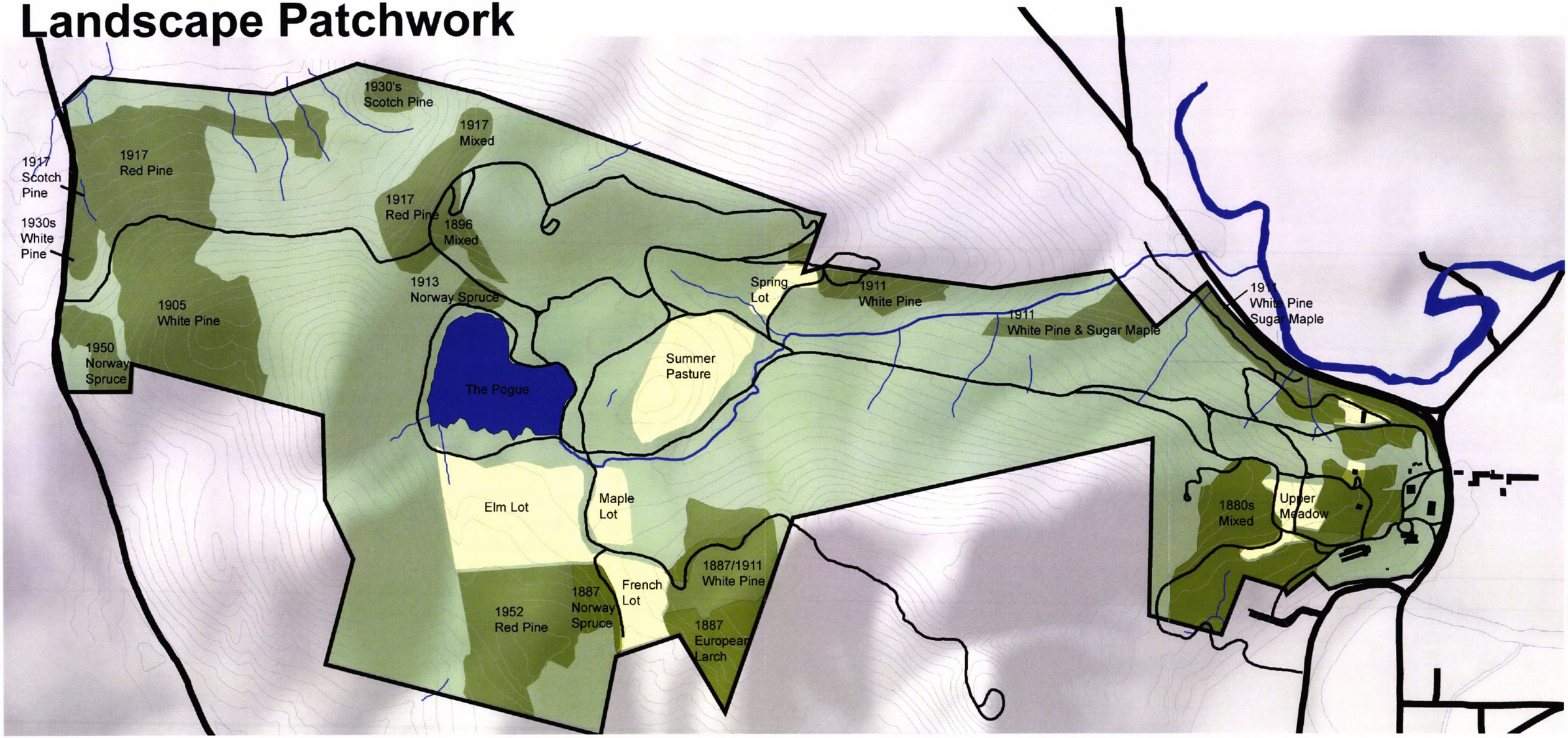
Endnote to Part 2

[1] Keeton 2005.

Marsh-Billings-Rockefeller National Historical Park
Vermont

National Park Service
U.S. Department of the Interior

Landscape Patchwork



N

0 250 500 1,000 1,500 2,000 Feet

Produced by
Marsh-Billings-Rockefeller National Historical Park

- Ottauquechee River
- Pogue
- Pogue Stream and Seeps
- Park Boundary
- Fields and Pastures
- Plantations
- Structures
- Carriage Roads
- Town and State Roads

Landscape Patchwork

Data Sources:
Carriage Roads & Forest Stands: USFS 2003,
Streams, Surface waters: TRORC 1:5000 orthophotography
Roads: TRORC 1:5000 orthophotography

All digital data layers are represented in Nad 83, UTM Zone 18N

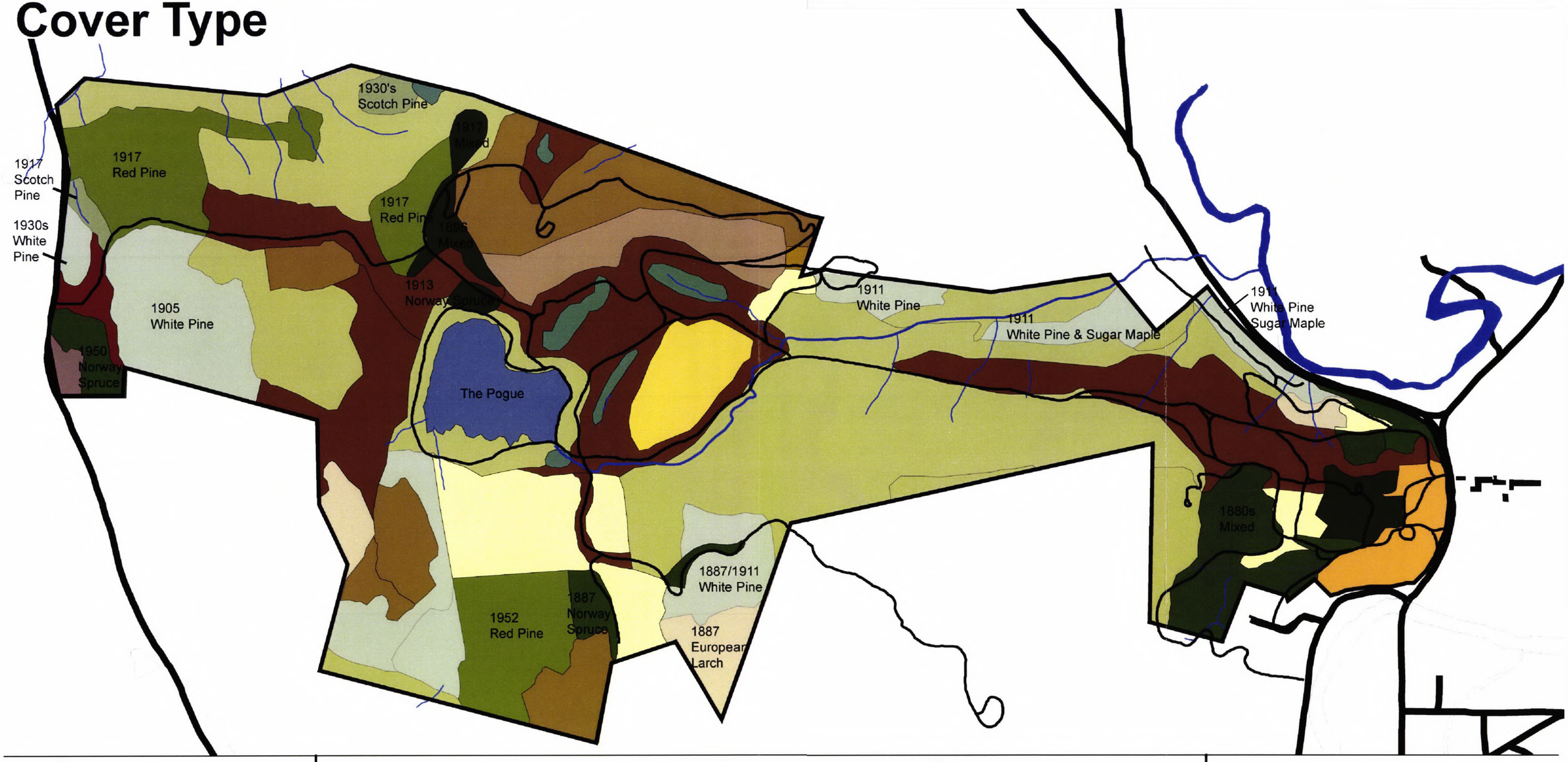
This map should be used for planning purposes only
and is not intended to be interpreted as an engineered plan.
Data layers may change due to updates and edits.

November 2005

Marsh-Billings-Rockefeller National Historical Park
Vermont

National Park Service
U.S. Department of the Interior

Cover Type



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Produced by
Marsh-Billings-Rockefeller National Historical Park

Carriage Roads

Red Maple/Ash	Hemlock	Ironwood	Scotch Pine
Apple	Mixed Hardwood	Black Locust	White Pine
Fields	Sugar Maple	Norway Spruce	European Larch
Pasture	Beech	Red Pine	Mixed Evergreen

Cover Type

Data Source: Forest Stands. Carriage Roads. USFS 2003
Streams, Park Boundary: Natural Communities data set 2002
Surface waters. TRORC 1 5000 orthophotography
Roads: TRORC 1:5000 orthophotography
Pogue. UVM- CLR

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Marsh-Billings-Rockefeller National Historical Park
Vermont

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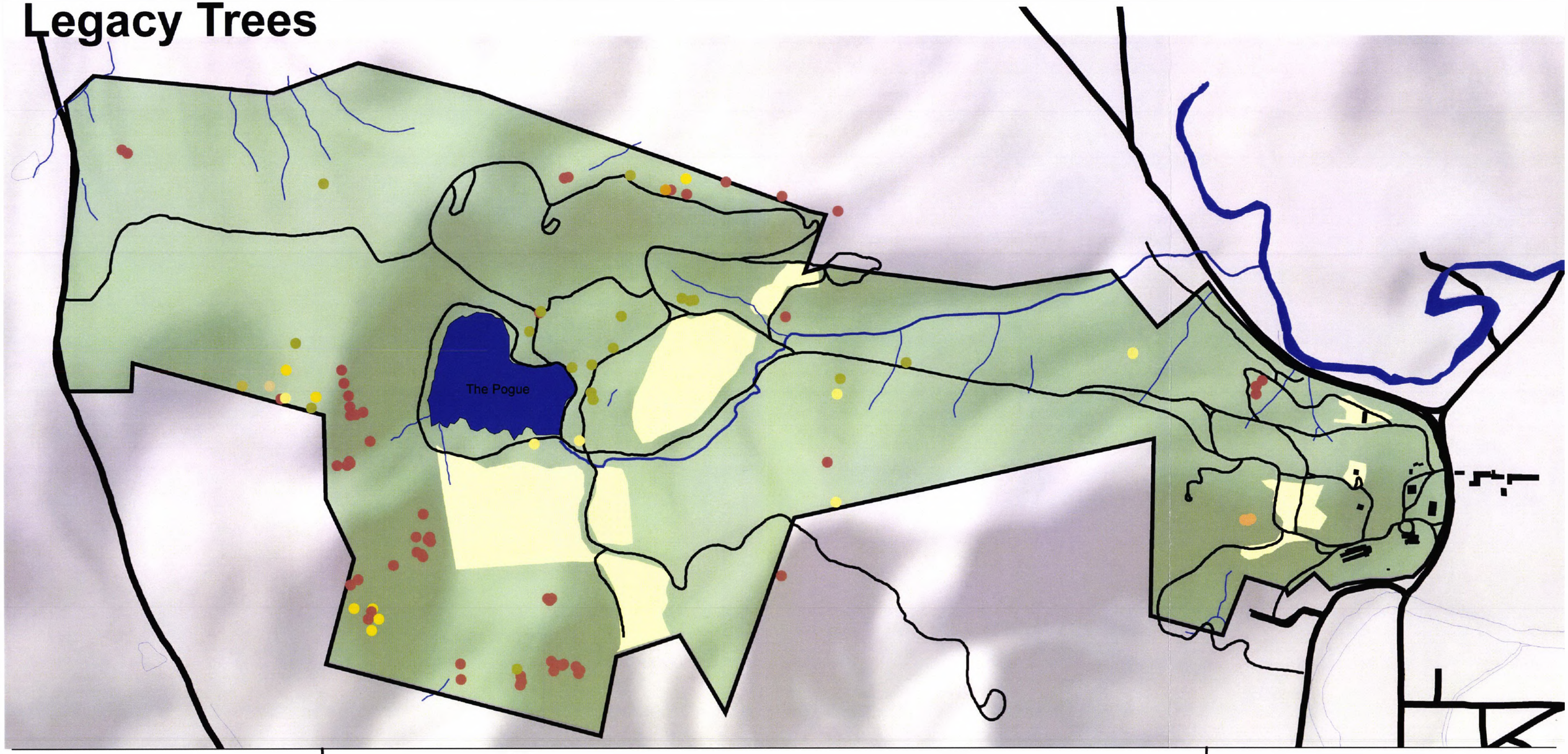
Legacy Trees



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Produced by
Marsh-Billings-Rockefeller National Historical Park

- Sugar Maple
- White Ash
- White Pine
- Bigtooth Aspen
- Black Cherry
- Red Oak
- Eastern Hemlock

- Park Boundary
- Fields and Pastures
- Pogue
- Carriage Roads
- Town and State Roads

Legacy Trees

Data Sources:
Carriage Roads & Forest Stands: USFS 2003,
Streams, Surface waters: TRORC 1:5000 orthophotography
Roads: TRORC 1:5000 orthophotography
Legacy Trees: Keeton 2003

All digital data layers are represented in Nad 83, UTM Zone 18N

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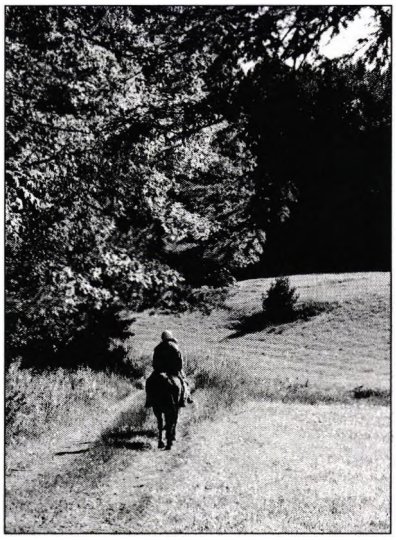
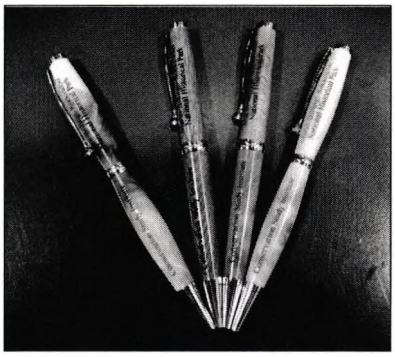
Data layers may change due to updates and edits.

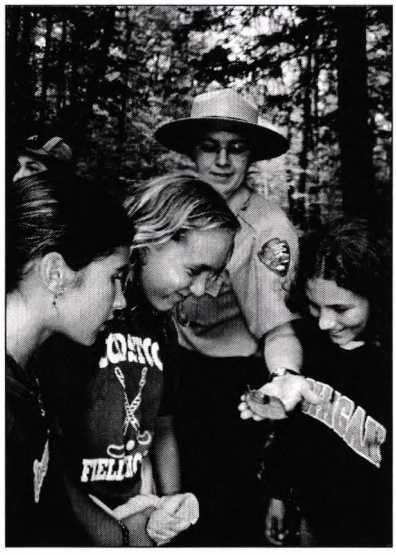
November 2005

(OCLP 2003)

PART 3: THE FUTURE OF THE MOUNT TOM FOREST







Part 3: The Future of the Mount Tom Forest

This chapter begins with a discussion of the broad vision that is guiding the Park as it carries forward the stewardship legacy of the Mount Tom Forest, and outlines seven specific goals related to historic character, ecological health, sustainable management practices, education and interpretation, visitor use and recreation, watershed and community connections, and adaptive management. The chapter then presents four alternative approaches to management. Key aspects of the alternatives are summarized in a table.

This chapter also outlines management actions that will be pursued regardless of which alternative is ultimately selected. The chapter concludes with a brief discussion of several other management approaches that were considered during the planning process, but ultimately rejected from further analysis.

From top: Equestrians in the Elm Lot (OCLP 2003); pens made from forest products (MABI 2003); park ranger with school group (MABI 2003); marked crop tree (MABI 1999).

3.1 DIRECTION FOR FUTURE MANAGEMENT: BROAD VISION AND MANAGEMENT GOALS

Inspired by Marsh's call to stewardship in Man and Nature, Frederick Billings believed that a sustainable approach to forest management, embracing aesthetics, conservation, education, recreation, and productivity, would enhance the social and economic well-being of Vermont communities. This vision and forest management ethic was carried forward by Billings' wife and daughters, and Mary and Laurance S. Rockefeller. The uninterrupted practice of conservation has maintained a sustainably managed forest for more than a century, creating a forest that evokes a powerful sense of place and history.

The Park will carry forward this stewardship legacy in the following ways:

- *Perpetuate the long standing tradition of sustainable forest management.* Frederick Billings reforested Mount Tom as a model of sustainable, innovative forestry. Throughout the tenure of his daughters and Mary and Laurance S. Rockefeller, the science and practices of forestry continued to evolve. Each generation drew upon the best thinking and practices of its time to continue the sustainable management of Mount Tom. The Park will continue to actively manage the Mount Tom Forest, and draw upon contemporary forest management thinking and practices as it seeks to demonstrate sustainability for public education.

"In reclaiming and reoccupying lands laid waste by human improvidence or malice, [man must] become a co-worker with nature in the reconstruction of the damaged fabric."

George Perkins Marsh, *Man and Nature*, 1864

- *Take a long-term perspective on the changing composition and character of the Forest.* The character and composition of the Forest is the result of both human intervention and natural succession that has occurred over the past 135 years. The nature of forest change involves cycles of tree establishment, growth, death, and decay that unfold over decades and centuries. Given the long-term nature of these processes, the Park recognizes that it must work with the dynamics of forest change in timeframes of at least 100 to 200 years in order to effectively retain forest characteristics that illustrate the rich history of Mount Tom.

- *Value the Forest as both a natural and cultural resource.* The Forest is both a cultural resource with nationally significant historical associations and features, and a natural resource with complex biological processes and ecological diversity. Older legacy trees, for example, are both an important historical feature of early settlement and valuable ecological habitat. The Park will pursue a management approach of both individual features and broad Forest-wide patterns that integrates cultural and ecological considerations.

"If the complete manufacture of wooden-wares was generally carried on in this state, and our timber consumed that way, it would add greatly to the prosperity of this state, and we think would increase rather than diminish the timber supply as it would demonstrate its value and encourage cultivation."

Report of the Forestry Commission to the Vermont Legislature, October 31, 1884. Frederick Billings, co-author

- *Emphasize the connection of forest management to broader community well-being and sustainability.* Throughout the property's history, foresters, woodsmen, gardeners, farmers, and others have worked in the forest of

"The true importance of Marsh, Billings, and those who follow in their footsteps goes beyond simple stewardship. Their work transcends maintenance. It involves new thought and new action to enhance and enrich and even repair the errors of the past. This may be the real importance of what we can be taught and learn at Marsh-Billings. We can not rest on the achievements of the past. Rather, each generation must not only be stewards, but activists, innovators, and enrichers... We look forward to the day when the message and vision of conservation stewardship and its importance for the future will, once again, go out across the nation from the hills of Vermont."

Laurance S. Rockefeller, 1993

Mount Tom—cultivating and harvesting wood and growing agricultural products that were used on the estate and sold in local markets. This tradition was established by Billings in his quest to reinvigorate the economic vitality and well-being of Vermont rural communities. Carrying forward this philosophy, the Park will seek out local markets for forest products and opportunities to create added value through association with place, sustainable management, and craftsmanship (i.e., value-added products).

- ***Strengthen civic engagement and stewardship.*** Since Billings opened the carriage roads to the public in the 1880s, the Mount Tom Forest has been a place for the local community and visitors from afar to take in the beauty of Mount Tom while learning about the best current thinking and practices in forest stewardship. This civic mission envisioned by Billings and carried forward by his heirs and Mary and Laurance S. Rockefeller, will be expanded by the Park. The Park will be a "learning laboratory" for all ages, from school groups to adult learners, to explore concepts and techniques in conservation stewardship and sustainable forestry.

Within the context of the vision described above, the Park is committed to the seven management goals listed on the next page.

3.2 Alternatives for Future Management

This section presents different scenarios for implementing the management direction. Alternative A would continue the Park's current short-term approach to forest management. This is a "no action" alternative as required by the National Environmental Policy Act. Alternatives B, C, and D, the "future oriented alternatives," represent much longer-term, proactive approaches to forest management and offer different philosophical approaches for preserving historic character in light of the dynamic nature of forest change and natural succession. Alternative B focuses on preserving existing historic features as they currently exist. Alternative C focuses on continuing the tradition of applying best thinking and practices in forest management. Alternative D integrates approaches common to both B and C. It retains some features and historic characteristics by working with the nature of forest change and applying best thinking and practices in forest management. Alternative D is the NPS-preferred and environmentally preferred alternative.

Management actions that would be the same under Alternatives B, C, and D are described in Section 3.3, Management Actions Common to All Future-Oriented Alternatives.

MANAGEMENT GOALS

Retain Historic Character: The Forest will be managed as a cultural landscape to retain features and characteristics that illustrate the evolution of reforestation and forest management on Mount Tom, interpret the stewardship ethic promoted by the Marsh, Billings, and Rockefeller families, and preserve the essential characteristics of a model nineteenth-century country estate.

Sustain and Enhance Ecological Health: The Park will sustain and seek to enhance the forest's ecological health using best thinking and practices in ecological science and forest management.

Model Sustainable Management Practices: The Park will draw upon contemporary sustainable forestry and agricultural practices in managing the Mount Tom Forest.

Provide Diverse Place-Based Education and Interpretation Opportunities: The Park will provide programs and opportunities for Park visitors, school groups, private woodland owners, conservation professionals, and others to learn about the history of conservation and the principles of contemporary forest management through hands-on, place-based programs.

Promote Visitor Use and Recreation: The Park will continue to manage the Forest for diverse recreational experiences and visitor enjoyment.

Enhance Watershed and Community Connections: The Park will continue to pursue opportunities to work in concert with others to sustain the forest's diverse values and achieve greater watershed and community benefits.

Utilize Adaptive Management to Evaluate and Refine Management Activities: The Park will employ a program of adaptive management to better understand change in the Forest, and to evaluate and refine forest management activities by integrating new science, results from monitoring programs, and best management practices of the day. Ongoing public involvement will encourage a dialogue on the evolving nature of land stewardship and help to inform the Park's forest management.

Most of these goals are compatible with each other. Situations or places where goals overlap or conflict with each other represent opportunities to learn, to further explore innovative approaches to forest management, and to broaden public understanding of the complex nature of contemporary stewardship decisions.

3.2.1 ALTERNATIVE A: CONTINUE CURRENT MANAGEMENT OR "NO ACTION"

This alternative represents a continuation of forest management practices and educational programs that have been implemented since the Park opened to the public in 1998. These include responding to immediate needs such as preservation maintenance, interpretation programs, visitor safety, and continuing with projects having a short-term emphasis (i.e., hazardous tree removal, mowing of vistas and fields, and cleanup of storm-damaged trees).

3.2.1.1 Philosophy

Under the continuation of current management, there would be no long-term philosophy for managing landscape character. The Park would maintain character on a short-term basis, such as preserving visitor experiences along roads and trails by removing dead trees and slash (i.e., treetops and non-merchantable logs) resulting from hazard tree management and mowing fields and pastures.

3.2.1.2 Management Actions

Under this alternative, there would be no long-term focused management activities for plantations, hardwood and mixed forests, or legacy trees. Pastures and hayfields would be mowed or grazed annually, and some vistas would be maintained through periodic mowing. Along the carriage roads and trails, management activities would be limited to removing and slash that result from hazardous tree management; no understory vegetation would be removed to create or retain views into the forest. In the event of catastrophic forest loss due to insects and diseases, fire, or weather events, the Park would salvage merchantable lumber and allow the area to naturally regenerate with native hardwood and conifer trees.

3.2.1.3 The Future Forest

There would be no long-term vision for the future landscape character under this alternative. This existing overall pattern of forested areas and fields would be retained, but historical features such as the plantations and legacy trees would eventually disappear due to gradual decline and decay or potential catastrophic loss. Areas currently in plantations would regenerate to mixed hardwood forest, resembling other second-growth forests in Vermont.

3.2.2 ALTERNATIVE B: ADOPT A "REPLACEMENT IN-KIND" APPROACH TO HISTORIC PRESERVATION

This alternative would focus on preserving landscape features essentially as they existed in 1997, the end of the period of historic significance, which coincides with the end of Laurence S. Rockefeller's tenure on the property.

3.2.2.1 Philosophy

This alternative emphasizes maintaining the current composition and location of existing features to convey the property's historic significance. Management activities would focus on replacing existing features (e.g., plantations, hardwood and mixed forest stands, legacy trees, and views) in-kind and in the same location. The tradition of applying best thinking and practices in forest management and using the Forest as a demonstration of sustainable forest management would be discontinued. Rather, management emphasis would be on maintaining, to the greatest extent possible, a most exact representation of what is essentially seen today.

3.2.2.2 Management Actions

To maintain the overall pattern of plantations, hardwoods, mixed forests, and fields in their current configuration, this strategy would require an intensive forest management program to mitigate the forces of natural succession and ecological change.

Plantations: The existing 150 acres of plantations, ranging in size from 1-acre to 22-acre stands, would be thinned periodically to maintain the health of plantation trees and favor the most vigorous trees. As plantations age and no longer resemble single-species, even-aged plantings (i.e., historic trees make up less than 60 percent of the existing overstory trees), these areas would be cleared of all trees and replanted using the same species and in the same planting pattern. Competing regeneration of native plants would have to be suppressed by using herbicides or mechanical removal during the reestablishment of plantations and after thinning of mature plantations.

Hardwood and Mixed Forest Stands: Hardwood and mixed forest stands would be managed to maintain a resemblance of the current species composition. This would be attempted through silvicultural techniques designed to retain the overall species mix and roughly the same stand structure that currently exist in each stand. In some cases, understory planting might be necessary to achieve the desired composition of tree species.

Legacy Trees: This alternative would maintain the current distribution of legacy trees. Existing legacy trees related to the designed elements of the landscape (i.e., maple trees planted along roads) would be retained as long as possible, in some cases using advanced horticultural techniques (i.e., pruning, cabling, etc.). As these trees deteriorate and become hazardous, they would be replaced using single-tree plantings of the same species and in the same location. If the original species was no longer viable in the Park because of the threat of insect or disease pests, a similar species would be used.

Legacy trees within the plantations and hardwood and mixed forest stands that reflect the historical evolution of the landscape (e.g., large, old hemlock trees)

would be maintained by removing competing vegetation whenever necessary and possible. When needed, replacements for these types of legacy trees would be created by recruiting and growing a few trees within the stand to large-diameter sizes. When planting or recruiting new legacy trees, the Park would also seek to use and promote genetic legacies (i.e., replacement trees either propagated through cuttings or cultivated from the regeneration of the original historic trees).

Hayfields and Pastures: These spaces would be maintained in their current size, location, and species configuration through late-season annual mowings or grazing, nutrient enhancement (e.g., fertilizing), and reseeding, if needed.

Carriage Road Corridors and Vistas: This alternative would carry forward the most exact replication of the carriage road aesthetic characteristics that were present in 1997. All views and vistas would be retained through periodic mowings and forest clearing. To maintain the park-like character along the roads, understory vegetation and downed woody debris visible from the roads would be removed or chipped in those areas where it was typically done during the latter part of the Rockefeller era.

Wildlife Habitat: Under this alternative, wildlife habitat would be maintained over the long term, but not enhanced. Areas in and around vernal pools, riparian areas, and wetlands would retain their current forest and field composition. Coarse woody debris, standing deadwood, and hard and soft mast trees (e.g., oak, beech, black cherry, shadbush) would be retained at their current levels and distributions.

Response to Catastrophic Events: In the event of a catastrophic loss of forest trees due to insects and disease, fire, or weather events, plantations would be replanted with the same species and in the same pattern as the original planting. For hardwood and mixed forest stands, regeneration of the same species mix would be promoted and supplemental plantings would be used if needed. If the loss was due to pests and diseases and the susceptibility of the original species remained high after the catastrophic loss, the Park would replant or manage for the most similar species available as replacements.

3.2.2.3 The Future Forest

Under this alternative, in 100 to 200 years the pattern of fields, plantations, and areas of hardwood and mixed forest would exist essentially as it appears today. As visitors travel the carriage roads and trails, they would see a diversity of forest stands and features that most closely reflects the history of forest management on the property from 1874 to 1997. This would include large areas of single-species plantations at various stages of even-aged growth in distinctive planting patterns, and hardwood and mixed forest stands in their current composition. Visitors to the Park would not have opportunities to see demonstrations of contemporary best thinking and practice in forest management.

3.2.3 ALTERNATIVE C: CONTINUE THE TRADITION OF APPLYING THE BEST CURRENT THINKING AND PRACTICE IN FOREST MANAGEMENT

This alternative emphasizes the use of best current thinking and practices of sustainable forest management in order to carry forward the philosophy of progressive forest management that has informed the stewardship of Mount Tom from Billings' time forward.

3.2.3.1 Philosophy

In this preservation approach historic character would be preserved through continuing the tradition of practicing and demonstrating contemporary progressive forest management established by Frederick Billings and continued by his wife and daughters, and Mary and Laurance S. Rockefeller. Management activities would emphasize use of best current thinking and practices in forest management, creating a landscape character that continually evolves to reflect the forest management practices of each new era. While this approach would continue the philosophy of forest management, it would not perpetuate many individual landscape features that illustrate the historic continuum of forest management practices from the early nineteenth century to late twentieth century.

3.2.3.2 Management Actions

This alternative would maintain a program of applying the best current thinking and practices in forest management. This approach to interpreting the property's history would require that the Park alter its management approach, and the resulting character of the landscape, in response to trends in sustainable forestry and ecological change.

Plantations: This alternative recognizes that plantation management is no longer considered best forest management for areas in the northeastern United States that are able to rapidly regenerate and grow quality native species without planting. Therefore, the existing plantations would be grown to the end of their rotation and slowly transitioned to mixed hardwood and conifer forests of native species that would regenerate naturally on the site. Periodic thinnings of plantations would be carried out to promote the growth of the healthiest, most vigorous plantation trees. With each thinning, hardwood regeneration would be allowed to advance, eventually becoming a dominant component of the overstory and ultimately transitioning the stand to a diverse forest of native species.

Hardwood and Mixed Forest Stands: In hardwood and mixed forest stands, uneven-aged management would be practiced to promote a greater diversity of age classes and vertical structure. Most trees would be harvested when considered mature by conventional silvicultural standards, while some trees would be retained for their ecological value. In some stands or portions of stands where stocking is dense, tree quality is high, and stand age is relatively young, even-aged

management approaches may be used until the stand nears the end of its current rotation.

Legacy Trees: This alternative would maintain existing legacy trees through their natural lives. Intensive horticultural measures would not be used to retain these trees, nor would they be replaced when they die. However, in the plantations and hardwood and mixed forest stands, a few trees would be grown to large-diameter sizes because of their value as wildlife habitat.

Hayfields and Pastures: With changes in the economic realities of agriculture, the small size and remoteness of the fields on Mount Tom make their use for hay production or grazing problematic. However, fields of this type have great potential as wildlife habitat. Therefore, this alternative would maintain the existing open character of these areas, but transition them from non-native perennial grasses to meadows of native herbaceous and woody plant and shrub species that would provide additional wildlife habitat benefits. These meadows would be maintained by late-season mowing every two to three years.

Carriage Road Corridor and Vistas: Contemporary best current thinking and practices in forest management emphasize balancing ecological and silvicultural values, but not to the exclusion of other forest values such as recreation and aesthetics. Therefore, in this alternative vistas would be maintained through mowing or forest clearing. However, managers would have the flexibility to change the location of vistas in response to internal or external needs and constraints (e.g., needing to foster regeneration to replace aging overstory trees, or responding to adjacent development that degrades views). There would be no removal of understory vegetation, downed woody debris, or slash because of their ecological and silvicultural value.

Wildlife Habitat: Under this alternative, wildlife habitat would be considerably enhanced. Levels of coarse woody debris, standing deadwood, slash, and large-diameter trees would be increased throughout the Park, especially within buffer zones of vernal pools, riparian areas, and wetlands. Opportunities to promote trees that provide a high value to wildlife, such as hard and soft mast trees (e.g., oak, beech, black cherry, shadbush), would be explored. Reforestation would be considered along the Pogue Stream to expand the existing forest buffer and enhance amphibian habitat.

Response to Catastrophic Events: In the event of catastrophic forest loss due to insects and disease, fire, or weather events, the affected area would be allowed to naturally regenerate with native species. In the event of loss due to pest and diseases, forest management would favor the retention and growth of those non-susceptible species best suited to the site.

3.2.3.3 The Future Forest

Under this alternative, in 100 to 200 years the forested areas in the Park would become more homogeneous as some of the historic features and aspects of the current patchwork character defined by plantations are lost. However, the overall pattern of forested areas and fields that currently exists would be maintained. As visitors travel the carriage roads and trails, they would see demonstrations of contemporary forestry techniques and experience a landscape with more native hardwood and mixed forest stands punctuated by scattered large, remnant plantation and hardwood trees. However, they would not have the opportunity to explore forest stands that illustrate the evolution of forest management from the late nineteenth century to the end of reforestation in the 1950s.

3.2.4 ALTERNATIVE D (NPS-PREFERRED) ALTERNATIVE: RECOGNIZE AND WORK WITH ECOLOGICAL CHANGE IN PRESERVING THE HISTORIC CHARACTER OF THE FOREST

This alternative would preserve broad landscape patterns and representative features that contribute to the distinctive historic character of the Forest, while working with the forces of ecological change and continuing to apply best current thinking and practices in forest management. The approach would respect the legacy of forest management begun by Frederick Billings and continued by his wife and daughters and Mary and Laurance S. Rockefeller.

3.2.4.1 Philosophy

By emphasizing the overall "sense of place" as defined by broad landscape patterns rather than specific features, the continuum of history from Billings' era to the present would be retained. This approach would preserve the distinctive historic character of the forest as a whole, while recognizing that in some cases individual features or stands may change. Overall, this strategy reflects the forward thinking stewardship approach of Mary and Laurance S. Rockefeller, and the care they took in preserving the historic forest character and understanding and working with ecological change.

3.2.4.2 Management Actions

This alternative would maintain the overall mix of plantations, hardwood and mixed forest stands, and fields on the landscape. However, in adapting to changing ecological site conditions and opportunities some individual features may change in character, location, and extent over time.

Plantations: The approach to plantation management in this alternative would be diverse and would seek to capitalize on specific site conditions. Periodic thinning of existing plantations would be conducted to promote the growth of the healthiest, most vigorous trees. As the plantations age, management would shift to renewing broad, distinctive patterns and characteristics of the property as

a whole.[1] Plantations along principal carriage roads (from the Mansion Grounds and McKenzie Farm areas to The Pogue and South Peak) or that frame key views (e.g., the 1887 Norway spruce and larch plantations framing the French Lot overlook) would be managed to illustrate the character of reforestation techniques used on Mount Tom from 1887 to 1952. Opportunities would be pursued to retain the edges of these plantations through the removal of competing hardwood regeneration, or to seek out new locations along field edges or in small sections of existing plantations where smaller plantings of new softwoods might be established. New plantings would use historic species and planting patterns or suitable alternative native species that would thrive under the specific site conditions. A representation of historic plantation types (i.e., red pine, European larch, Norway spruce, mixed conifer) would be maintained throughout the Park, although it would not be necessary for all new plantations to reestablish historic species. A few key plantations, such as those adjacent to the Mansion Grounds, would be renewed through single tree replacement using direct descendants or genetic legacies.

In plantations outside of the main carriage road corridors and Mansion Grounds, conifer regeneration would be encouraged in areas where existing conditions (i.e., tree health, regeneration, stand conditions) would allow it to thrive. If necessary, competing hardwoods would be thinned to favor conifer regeneration. This approach would create forest stands dominated by large-diameter conifers interspersed with smaller conifers and some hardwoods, resembling the character of some of the oldest plantations currently on the property such as those adjacent to the Mansion Grounds. If stand conditions do not support conifer regeneration, management approaches would follow best current thinking and practices in forest management as described in Alternative C, which would eventually transition these areas to a diverse forest of native species.

Hardwood and Mixed Forest Stands: As in Alternative C, in hardwood and mixed forest stands uneven-aged management practices would be used to promote a greater diversity of age classes and vertical structure. However, as in Alternative C, even-aged management may be used in some stands or portions of stands where stocking is dense, tree quality is high, and stand age is relatively young.

Legacy Trees: The approach to legacy tree management under this Alternative will be similar to Alternative B. However, this alternative would increase the number of legacy trees throughout the property because a greater number of trees within the plantations and hardwood and mixed forest stands would be grown to large-diameter sizes. The approach would encourage the growth of large trees that could convey a sense of the long-term nature of the forest change and provide ecological value.

Hayfields and Pastures: As in Alternative B, the general open character of the fields and pastures would be retained by cultivating perennial grasses through annual mowings or grazing and nutrient management. As stated above, some sections of the field edges adjacent to existing plantations might be used to create new small-scale plantations. These would be positioned as to not preclude existing views.

Carriage Road Corridors and Vistas: As in Alternative C, this alternative would maintain existing vistas through mowing or forest thinning; locations could be changed in response to internal or external needs and constraints (e.g., needing to foster regeneration to replace aging overstory trees, or responding to adjacent development that degrades views). This alternative would also evaluate overgrown historic vistas and consider reopening them where feasible.

Along the main carriage road corridors, some areas of dense understory regeneration would be thinned to create selective views into the forest. Large-diameter downed woody debris would be retained, and slash would be either lopped closed to the ground and distributed throughout the stand so that it is not readily visible from the road, or removed.

Wildlife Habitat: Under this alternative, wildlife habitat would be enhanced. Levels of coarse woody debris, standing deadwood, slash, and large-diameter trees would be increased throughout the Park, especially within buffer zones of vernal pools, riparian areas, and wetlands. Along the main carriage road corridors retention of large-diameter logs would be favored over smaller coarse woody debris, and amounts of slash would be limited. Opportunities to promote trees that provide a high value to wildlife, such as hard and soft mast trees (e.g., oak, beech, black cherry, shadbush), would be explored. Limited reforestation would be considered along the Pogue Stream to expand the existing forest buffer and enhance amphibian habitat.

Response to Catastrophic Events: In the event of a catastrophic loss due to insects, disease, fire, or weather events, this alternative would use different approaches depending on the area of the Forest affected. In the event of forest loss within the Mansion Grounds area, along the main carriage road corridors, or along field edges, managers would consider creating small-scale new plantations in situations where understory hardwood competition is limited. Such new plantations would favor the use of historic species and planting patterns, unless these species would not survive under the site conditions and similar native species can be used as substitutes. If the loss occurs in a plantation away from the main visitor corridor, conifer regeneration would be encouraged in areas where existing site conditions would allow it to thrive. In all other areas, the forest would be allowed to naturally regenerate with species native to the site.

3.2.4.3 The Future Forest

Under this alternative, in 100 to 200 years visitors to Mount Tom would see a diversity of forest stands and a complex pattern of fields, plantations, hardwood and mixed forest stands, and legacy trees comparable to the general pattern that visitors currently experience from the main carriage road corridors. However, individual forest features would not exist as they do today—they may be found in new locations, cover greater or lesser extents of the landscape, and exist in different stages of maturity. Outside of the main corridors, the landscape would become dominated by hardwoods and mixed forest stands in most areas as best current thinking and practices in forest management are used to cultivate a greater diversity of native species. Throughout the Forest, visitors would see demonstrations of contemporary forest management techniques.

3.2.5 COMPARISON OF ALTERNATIVES

A comparison of the alternatives described above is presented in a table format in Table 1 below.

Table 1
Comparison of Alternatives

	Alternative A Continue current management	*Alternative B* Adopt a "replacement-in-kind" approach to historic preservation	*Alternative C* Continue the tradition of applying the best current thinking and practice in forest management	*Alternative D (NPS-preferred)* Recognize and work with ecological change in preserving the historic character of the forest
Philosophy				
	No long-term philosophy for management.	Maintain the most exact representation of historic landscape features as they existed in 1997, the end of the period of historical significance.	Interpret and practice the tradition of progressive forestry and allow the landscape character to continually evolve to reflect best current thinking and practices in forest management.	Maintain a sense of the Forest's history through broad landscape patterns and representative historic features while working with ecological processes and continuing to apply best current thinking and practices in forest management.
Management Actions				
Plantations	Passive transition to native species.	Replacement in-kind using same species and planting patterns.	Retain through current rotation, then transition to native species.	Maintain portions of some plantations along the main carriage road corridors; recruit softwood regeneration in others; elsewhere retain plantations through current rotation and then transition to native species.
Hardwood and mixed forest stands	Passive transition to uneven-aged stands.	Conduct even-aged management to attempt to retain existing species composition and structure.	Promote greater age and structural diversity using predominately uneven-age management techniques. Harvest at silvicultural maturity with some large-diameter trees retained for wildlife.	Same as Alternative C.

TABLE 1
COMPARISON OF ALTERNATIVES

	Alternative A Continue current management	*Alternative B* Adopt a "replacement-in-kind" approach to historic preservation	*Alternative C* Continue the tradition of applying the best current thinking and practice in forest management	*Alternative D (NPS-preferred)* Recognize and work with ecological change in preserving the historic character of the forest
Legacy trees	No preservation measures.	Retain existing legacy trees as long as possible. Replace related to the designed elements of the landscape in-kind. Otherwise, recruit new legacy trees from within the plantations and hardwood and mixed forest stands to maintain existing distribution of legacy trees throughout the property.	Retain existing legacy trees through their current lives, without any intervention. Allow a few large-diameter trees to be retained in forest stands for their wildlife value.	Same as Alternative B, but recruit a greater number of trees within the plantations and hardwood and mixed forest stands to convey a sense of the long-term nature of forest change and provide ecological value.
Hayfields and pastures	Mow or graze annually.	Mow or graze annually, fertilize and reseed if needed to maintain quality of hay production and pasture.	Mow every two to three years and transition to meadows of native herbaceous and woody shrub species.	Same as Alternative B, except small portions of some fields may be used to establish new plantations.
Carriage road corridors and vistas	Maintain some vistas through periodic mowing. Remove slash from along carriage roads.	Maintain existing vistas. Thin understory vegetation and remove downed woody debris from along carriage roads.	Maintain existing vistas, but relocate if needed to achieve other management objectives. No removal of understory vegetation or downed woody debris from along carriage roads.	Maintain existing vistas as in Alternative C and consider reestablishment of historic vistas. Thin understory along some road sections. Retain large-diameter downed wood along corridor, but reduce the height or remove slash.
Wildlife habitat	No long-term wildlife habitat management strategies.	Maintain existing habitat over the long-term, but not enhance.	Transition to higher quality habitat.	Same as Alternative C.
Catastrophic events	Allow areas to naturally regenerate.	Replace lost stands or features using the same species.	Same as Alternative A. However, in the event of loss due to insect and disease, regeneration of non-susceptible species would be encouraged.	Same as Alternatives A and C. However, if loss occurs along main carriage road corridors, then establishment of small-scale plantations would be considered.
The Future Forest (100-200 years)				
	The overall pattern of fields and forest would be retained along with some large legacy trees, but forest areas would become more homogenous as plantations transition to native hardwoods and mixed forests.	The pattern of fields, plantations, and hardwood and mixed forests would exist essentially as it appears today. Visitors would see a diversity of forest stands and features that most closely reflect the history of forest management from 1874 to 1997.	The overall pattern of fields and forest would be maintained. However, the Forest would become more homogeneous as aspects of the current patchwork character defined by plantations are lost. Visitors would experience a landscape with more native hardwood and mixed forest stands punctuated by scattered large, remnant plantation and hardwood trees, and would see demonstrations of best current thinking and practices in forest management.	The general pattern of diverse forest stands and a mix of fields, plantations, hardwood and mixed forest stands, and legacy trees experienced from the main carriage roads would be retained. However, individual forest features may change over time: existing in new locations, cover greater or lesser extents of the landscape, and exist in different stages of maturity. Outside of the main corridors, the landscape would become dominated by hardwoods and mixed forest stands as best current thinking and practices in forest management are used to cultivate a greater diversity of native species.

3.3 Management Actions Common to All Future-Oriented Alternatives (Alternatives B, C, and D)

This section of the Plan identifies a wide range of management actions that would occur under all of the future-oriented alternatives (i.e., Alternatives B, C, and D). These actions are clustered by the seven categories of long-term management goals presented in Section 3.1, although many actions are relevant to more than one category.

3.3.1 CULTURAL RESOURCES AND HISTORIC CHARACTER

From top: The Pogue Loop; dry-laid stone retaining wall along the main carriage road; remnant barbed wire fence line in an old sugar maple. (OCLP 2003, 2004)

Carriage Road and Trail Corridors: Slash from forestry operations along carriage road and trail corridors will be kept below three feet.

Structures: Culverts, causeways, and retaining walls associated with the circulation system, stone walls, and well structures will be preserved.

Small-scale Features: Watering troughs, boundary markers, irrigation lines, and other small-scale features will be preserved.

Archeological Resources: Working with the Vermont State Historic Preservation Office and the University of Vermont Consulting Archeology Program, the Park will identify areas with sensitive archeological resources and implement measures to ensure their protection.

Programmatic Agreement and National Register Listing: The Park will develop a programmatic agreement with the Vermont State Historic Preservation Office that will address Section 106 compliance review for forest management activities, treatment of historic structures, and protection of archeological resources. The Park will also seek to update the National Register of Historic Places documentation on the Park to include information about the significance of the Forest.[2]

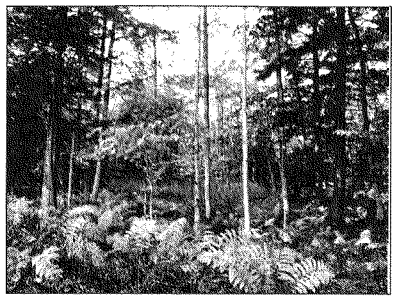
3.3.2 ECOLOGICAL HEALTH

Rare, Threatened, and Endangered Species: Federally or state-listed rare, threatened or endangered species and their habitats will be protected by restricting potentially adverse forestry and visitor activities within those habitats. In particular, forestry activities will be excluded from areas west of The Pogue that have identified rare plants.

Natural Communities of Special Management Concern: Forestry treatment activities will be limited in certain natural communities that contribute to the

overall biological diversity of the Park and where site conditions are not suitable for active management. These would include such communities as rich northern hardwood forests, hemlock-red oak forests, dry oak forests, temperate calcareous cliffs, and temperate calcareous outcrops.

Wetlands and Vernal Pools: Forestry activities will be excluded from wetland areas. Best management practices and Park-specific resource studies will be used to designate vernal pool and wetland buffer areas and establish guidelines for habitat management and forestry activities. (See Appendix C for more specific management guidelines.)



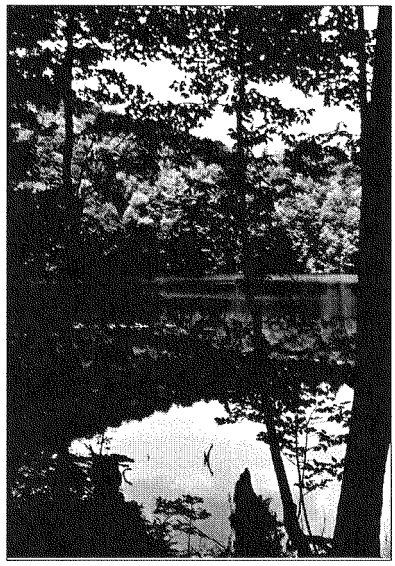
Wetland area east of The Pogue. (Tom Lautzenheiser 2002)

Riparian Areas, Seeps, and the Pogue: Treatment guidelines developed from the Vermont Acceptable Management Practices for Maintaining Water Quality on Logging Jobs and findings from Park-specific resource studies will be used to establish buffers and guide forestry activities along all streams, seeps, and The Pogue. (See Appendix C for more specific management guidelines.)

Best Management Practices and Acceptable Management Practices (also known as BMPs and AMPs) are terms that are often used interchangeably in the forestry profession to describe state-designated guidelines developed to minimize soil erosion and other adverse impacts on water quality from forest management activities.

Grassland Breeding Birds and Open Land Management: At a minimum, the Park will delay mowing of fields and vista openings until July 1st to provide time for grassland birds to fledge their first brood.

Downed Coarse Woody Debris and Snags: Levels of downed coarse woody debris and snags representing a diversity of size and decay classes will be maintained or increased. (See Appendix C for more specific management guidelines.)



The Pogue. (Tom Lautzenheiser 2002)

Invasive Exotic Plants: Working with the NPS Northeast Temperate Inventory and Monitoring Network (NETN), Northeast Region Exotic Plant Management Team (EPMT), and local partners, the Park will implement a program of invasive plant inventory, early detection, treatment, and monitoring. Treatment of invasive plants will be prioritized using a system developed by NETN. Populations of highly invasive exotic plants will be controlled to the extent possible and continually monitored. Special consideration for treatment and monitoring will be given areas where forestry activities will create ground disturbances and changes in canopy cover that could increase invasive plant populations in the area. Treatment activities will include both mechanical and chemical control measures, and will be in accordance with NPS Natural Resource Management Manuel, guidelines for Integrated Pest Management (#77-7).

Exotic Species of Historical Significance: Non-native tree species used in historic plantations will not be deliberately eliminated from the landscape because they are historically significant plants, are important for interpretive purposes, and are non-invasive. The distribution and relative abundance of exotic plantation species will be monitored.

Wildland Fire Management: The small size of the Park and proximity to the village of Woodstock and surrounding residential properties precludes allowing wildland fire to burn through the landscape, and the infrequent fire history does not warrant using prescribed fire for ecosystem maintenance. Therefore, wildland fires, regardless of ignition source or location, will be fully suppressed. The Park will work in conjunction with other NPS sites and local fire departments to develop response strategies. In accordance with NPS policy, the Park will use Minimum Impact Suppression Tactics (MIST). Specific strategies for wildland fire management have been developed through a Wildland Fire Management Plan.[3]

Top, SCA volunteer removing invasives (MABI 2004); bottom, monitoring forest growth and change (MABI 2001).

Pests and Diseases: The Park will monitor and develop threshold action levels for forest pests that pose a risk to forest health through an Integrated Pest Management Plan, currently under development. Treatment actions will follow NPS Natural Resource Management Manuel, guidelines for Integrated Pest Management (#77-7). Annual forest pest surveys will be conducted and in-depth tree health monitoring will be incorporated into ongoing silvicultural assessments.

Genetically Modified Organisms (GMOs): GMOs will not be introduced into the forest.

Herbivory from Deer: The Park will work with the NPS Northeast Temperate Inventory and Monitoring Program and the Vermont Agency of Natural Resources to assess the impact of deer browse on forest regeneration. Management of forest stands in state-identified deer wintering areas will take state guidelines into consideration.

Sensitive Soils: Forestry operations on sensitive soils identified by the Natural Resource Conservation Service (NRCS) will be consistent with the NRCS recommendations for each soil type and slope category, including seasonal limitations on forestry activities where appropriate.[4] In cases where NRCS mapped soils appear to differ from site conditions (e.g., soils appear less limiting than those mapped), management decisions will be made based on actual site assessments.

Hand-turned bowls created from wood harvested from the Mount Tom Forest. (MABI 2004)

3.3.3 SUSTAINABLE MANAGEMENT PRACTICES

Value-added Products: The Park will pursue management activities that promote "value-added" products. These are products that have added economic value because of their association with place, sustainable management, local production, and craftsmanship. Management activities that would support the creation of value-added products would include sustainable timber harvesting, on-site milling and drying of lumber, and supplying local craftspeople and manufacturers with wood. Lumber may also be supplied to other NPS sites, state and local government agencies, and nonprofit organizations for unique historic

preservation and education projects (e.g., restoration of covered bridges and barns requiring large-dimension beams).

Third-Party Forest Certification: The Forest will remain part of the American Tree Farm system, continuing a certification tradition started when it was enrolled as Vermont's first Tree Farm in 1956. The Park's forest management will also be third-party certified through the Forest Stewardship Council (FSC) (see further discussion in Section 4.3). Continuing assessment of the Park's forest management through these two systems will be used as a tool to demonstrate the value of certification in encouraging sustainable management, value-added conservation, and public accountability.

Forestry Techniques and Equipment: A variety of forestry techniques and equipment will be used to achieve overall management objectives for the Park. Treatments will be tailored to the objectives for each stand, stand conditions (e.g., age, species composition, health), and site conditions (e.g., slope, aspect, soil type, access). Treatment activities may include both even-aged management (e.g., planting, intermediate thinning, and partial overstory removal) and uneven-aged management (e.g., single tree and group selection). Additional techniques such as crop tree release and timber stand improvement may also be used. For each of these, a range of strategies and equipment will be considered (e.g., winching, horse logging, conventional skidding, and forwarding). (See Appendix C for further details.)

Standards for Harvest Practices: At minimum, harvesting activities will meet or exceed Vermont Acceptable Management Practices (e.g., maintaining and enhancing riparian buffers, preventing non-point-source pollution, minimizing erosion, and reducing sediment and temperature changes in streams). (See Appendix C for more specific guidelines.)

Harvest Volumes: Overall, average annual harvesting will be conducted at a rate at or below average annual net growth (i.e., sustained yield). However, as the existing even-aged stands transition into uneven-aged structure, some annual cuts may need to be greater than average annual net growth to reduce stand density and allow regeneration.

Salvage after Catastrophic Events: In the event of a catastrophic loss of forest due to insects, disease, fire, or weather events, any remaining merchantable wood in the affected area will be harvested. Logs of minimal lumber value will be considered for retention as standing deadwood or coarse woody debris in areas where the amount of this material in the Forest is considered less than desirable based on Park-specific forest monitoring data and in comparisons with other managed forests in the northeast.

Forest certification. Several forest certification systems are in place in North America. Forest Stewardship Council (FSC) certification relies on performance-based monitoring of on-the-ground practices and an assessment of the property's forest management plan. The standards used for FSC certification address environmental, silvicultural, social, and economic issues.

The American Tree Farm System was created in 1941 to promote the growing of renewable forest resources on private lands while protecting environmental benefits and increasing public understanding of all benefits of productive forestry.


American Tree Farm System

THIS CERTIFIES THAT THE FOREST LANDS OF

Billings Farm

as described on the reverse of this certificate are being managed in a manner which will assure continuous production of forest crops in accordance with forestry practices approved by American Forest Products Industries, Inc. and the Vermont Forest Industries Committee.

In recognition thereof, these lands are hereby designated a TREE FARM and so to remain so long as the owner complies with the said approved standards of forest practices.

TREE FARM

The Tree Farm certificate awarded to the Billings Farm as Vermont's Tree Farm #1 in the American Tree Farm System, 1956. (Billings Farm & Museum Library and Archives)

Tree Nursery: To continue the genetic legacy of historic plantings, the Park will create a nursery to propagate replacement trees from the historic specimens on the property.

Agricultural Practices: At a minimum, hayfield and pasture management will be conducted in a manner that meets or exceeds compliance with Vermont's Accepted Agricultural Practices (10 V.S.A. 4810). Livestock will continue to be excluded from streams and stream banks, and hayfields will not be cut before July 1 to allow grassland birds to fledge their first broods.

3.3.4 EDUCATION AND INTERPRETATION

From top: Park ranger leading a discussion; forest demonstration sign. (MABI 2000)

The Forest as a Setting for Learning: The Forest will be used to interpret the history of conservation and the principles of contemporary forest management for Park visitors, school groups, private woodland owners, conservation professionals, and others. Educational activities will address the complex social, economic, and ecological issues associated with forest management and use from both local and global perspectives.

Management Transparency: Forest management will be conducted in a way that makes the intent and process of management practices as visible and interpretable to the public as possible. Programs and interpretive displays will be created in association with management activities to provide further explanation of the Park's forest management objectives and approaches. Whenever possible, management operations will be conducted as public activities, providing hands-on learning opportunities at the Park for both the general public and conservation professionals.

Demonstrate Innovative Practices in Forest Management: As outlined above in Section 3.3.3 Sustainable Management Practices, the Park will demonstrate and interpret the role of third-party certification and value-added conservation in promoting sustainable forest management. The Park will consider establishing a solar kiln for drying lumber on site to further demonstrate and interpret the process of creating value-added products.

Interpretive Gateways to the Forest: The 1876 Woodbarn, at the foot of the carriage road near the Park entrance, will be rehabilitated to provide an interpretive exhibit on the Mount Tom Forest and to display the Park's collection of sixteen historic carriages. An adjacent educational/classroom structure will be built as an indoor meeting space for schools and other educational groups visiting the Forest. This project will use wood harvested from the Forest and be a demonstration of sustainable or "green" building techniques.[5] The Park will also develop interpretive displays about current forest management activities to post at pedestrian gateways and the Park's visitor center.

Citizen Science and Participatory Management: The Park will serve as a learning laboratory, encouraging the involvement of the local community, educators, interested professionals, and the broader public as active participants in the management of the Forest. The Park will continue to offer programs such as "Forest for Every Classroom" and "Working Woodlands," as described in Section 4.4. Additional opportunities could include hands-on workshops, creation of citizen-science monitoring programs, and forums with conservation professionals to encourage discussion about new research and best practices in forest management.

Top, participants in a Forestry for Every Classroom program (MABI 2002); discussion during a Working Woodlands program (MABI 1998).

3.3.5 VISITOR USE AND RECREATION

Permitted and Restricted Uses: Recreational activities such as hiking, horseback riding, bird-watching, nature study, and picnicking will continue to be permitted and encouraged. During winter months, the trails and carriage roads will continue to be operated under easement by the Woodstock Resort Corporation as a component of its wider network of cross-country skiing trails. In accordance with deed restrictions associated with the gift of the property to the people of the United States, mountain biking, hunting, fishing, swimming in The Pogue, camping, campfires, and use of motorized vehicles (except for necessary Park operations) will continue to be prohibited.[6]

Public Access and Forestry Operations: Forest management and forestry practices will be conducted in a manner that maintains or enhances the overall quality and diversity of recreational activities. The Park will continue a hazardous tree management program concentrated on high-visitor-use areas and guided by monitoring and treatment protocols developed in the Hazardous Tree Management Plan.[7] Certain carriage roads and trails will be subject to temporary closures when needed during forestry operations to ensure visitor safety, avoid resource damage, or minimize conflicts with recreational activities. (See Appendix C for more specific guidelines.) A program of visitor notifications will be created to update Park users of when and where forestry activities will occur in order to increase visitor awareness and provide opportunities to select alternative trails.

Maintenance of Carriage Roads and Trails: The Park will continue the program of annual carriage road and trail maintenance. Specifications for rehabilitation and maintenance protocols will be developed through a Carriage Road and Trail Assessment and Maintenance Plan. The Park will work with partner organizations such as the Woodstock Ski Touring Center, Billings Park Commission, Student Conservation Association, Vermont Youth Conservation Corps, Appalachian Trail Conservancy, and the Green Mountain Club to enhance trail management and foster broader connections with area trail networks.

Top, Landmark and SCA trail crew; bottom, trail work by VYCC. (MABI 2004)

3.3.6 ADAPTIVE MANAGEMENT AND PARTNERSHIPS

Adaptive management—embracing uncertainty. Adaptive management has been defined as "a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs" (Bormann et al. 1996).

Applying Best Current Thinking and Practices of Management: The Park will seek to stay abreast of developments in the fields of forest management, conservation practice, cultural landscape management, etc., including the results of research and new management models and practices. The Park will integrate this knowledge into its management of the Mount Tom Forest as appropriate and feasible. The Park will also cultivate long-term relationships with consulting foresters and forestry professionals to ensure that forest management continues to be informed by professionals with in-depth understanding of Park resources and a commitment to applying best current thinking and practices in forest management.

Civic Engagement: The Park is committed to finding new ways to involve community residents, visitors, and conservation professionals in sustaining the mutual learning process about management of the Forest and similar landscapes. The Park will continue to offer meaningful opportunities for the public to participate in conversations about the management of the Mount Tom Forest and contemporary forest stewardship. For example, the Park may hold annual public forums to discuss relevant research and advances in thinking and practice of sustainable forest management, and offer guided hikes and workshops that examine past and future management activities.

Partnerships: The Park will continue to build a network of partners to enhance research, management, and educational efforts related to forest stewardship. In particular, recognizing that the Forest's ecological, recreational, and historical connections extend beyond the Park boundary, the Park will seek opportunities to work with local landowners and community organizations on collaborative projects such as the development of an integrated community trails system, enhancing ecological connections, and protecting historic resources.

Research and Monitoring Programs: Working with the NPS Northeast Temperate Inventory and Monitoring Network, other governmental agencies, academic researchers, and other partners, the Park will establish research and monitoring programs related to forest management and ecosystem health. These efforts are likely to include assessment of forest growth and structural changes, regeneration, biological diversity, forest pests and diseases, invasive plant populations, and air and water quality. More specifically, the Park will continue to inventory long-term forest dynamic monitoring plots and develop a five-year forest health and silvicultural assessment program. Monitoring programs will also be explored to analyze change over time for the cultural landscape characteristics. These efforts will help to ensure that ongoing forest management reflects insights gained from on-site monitoring and research. (See further discussion in Section 4.7.)

Top, measuring coarse woody debris; bottom, Forest Certification Team at the Park. (MABI 2001)

3.3.7 CONSISTENCY WITH GUIDING LAWS, POLICIES AND PLANS

Forest management will be consistent with the requirements and guidance of federal statutes, policies, and plans that are relevant to the NPS and the Park. In addition to these federal requirements, the Park's management of the Mount Tom Forest will be consistent with the intent of existing applicable local and state regulations (such as Vermont Wetlands Rules and the Vermont Acceptable Management Practices for Maintaining Water Quality on Logging Jobs). (See Section 7.2 for descriptions of Guiding Laws and Policies.)

3.4 ALTERNATIVES CONSIDERED BUT REJECTED

In addition to the four alternatives that are described in Section 3.2, the planning team also considered several other management scenarios that were ultimately rejected from detailed analysis. These scenarios, and the reasons for which they were rejected, are summarized below.

3.4.1 PERIOD RESTORATION

A period restoration approach would attempt to restore the property to represent what the Forest looked like at the time of Frederick Billings' death in 1890, or another specific period of the Park's history. The GMP rejected a period restoration approach because returning the Park's structures and landscape to an earlier historic appearance would be counter to the intent of the enabling legislation, which identifies the continuum of stewardship by George P. Marsh, Frederick and Julia Billings, their heirs, and Mary and Laurance S. Rockefeller. A restoration approach would limit the interpretation of the property's continuous use and would not be practicable due to ecological changes that have occurred over time.[8]

3.4.2 ECOLOGICAL RESTORATION

An ecological restoration approach would involve deliberately removing all non-native species, transitioning all plantations to native communities, and imposing greater limitations on forestry activities. This approach would be contrary to the Park's GMP and would conflict with the Park's legislative mission to protect culturally significant landscape values and history. Like the period restoration alternative, it would prevent the presentation of the historic continuum and the evolution of forestry.

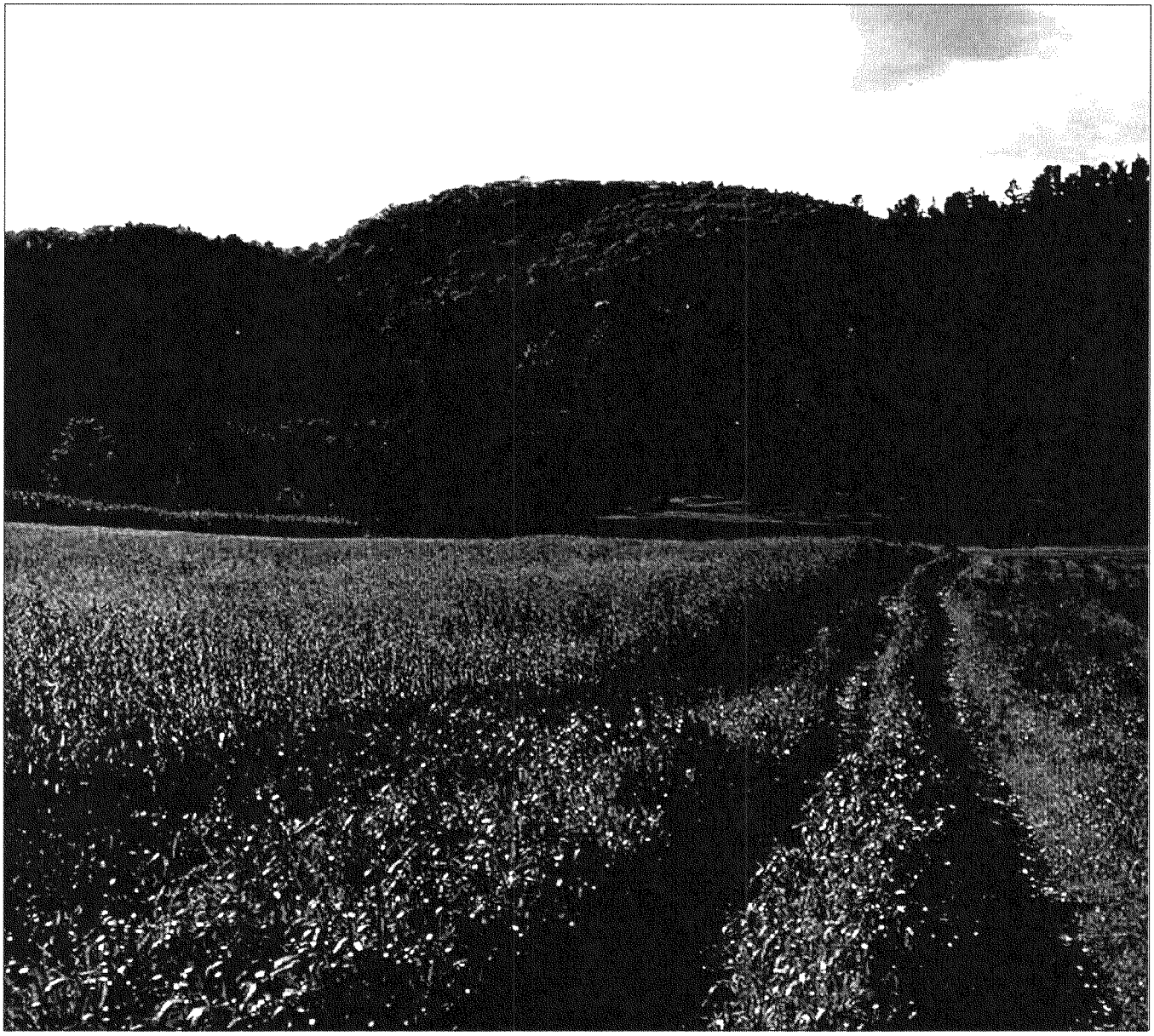
3.4.3 "NO CUT" OR "HANDS OFF" APPROACHES

With a "no cut" or "hands off" approach, there would be no forest management activities, such as thinning, pruning, or harvesting of wood products. Active

forest management is central to the Park's national significance and the historical association of the property to the conservation philosophies and stewardship practices of Marsh, Frederick and Julia Billings, their heirs, and Mary and Laurance S. Rockefeller. There is a clear mandate in the Park legislative history and the GMP to continue the historic legacy of forest management and to use forestry to preserve and interpret the cultural landscape.[9]

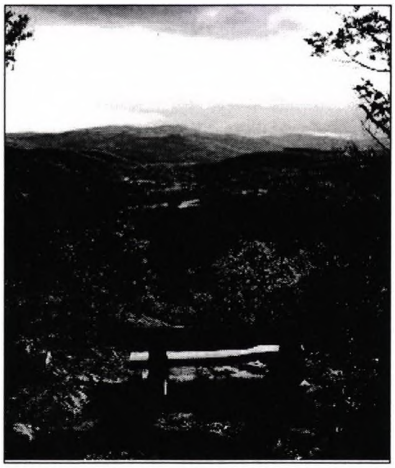
Endnotes to Part 3

[1] This work would be initiated before the historic plantations decline because it will require decades if not a generation of work to successfully effect this transition.
[2] The Marsh-Billings-Rockefeller mansion and forty surrounding acres were designated as a National Historical Landmark in 1974, but the remainder of what now constitutes the Park was not. Because of its designation as a National Historical Park, the entire property including the forest is now administratively listed on the National Register, but it has not been documented on a parkwide National Register form as part of a formal nomination and review process.
[3] NPS 2005.
[4] NRCS 2004.
[5] NPS 2005.
[6] NPS 1999.
[7] NPS 2005, draft.
[8] NPS 1999, 32.
[9] NPS 1999, 8-9.



(MABI 1999)

Part 4: Description of the Mount Tom Forest



Part 4: Description of the Mount Tom Forest

This chapter examines the physical composition and current management of the Forest to provide background on the resources that could be affected by implementing each of the alternatives described in Section 3.2. This includes a review of the Forest's historical significance; descriptions of cultural landscape and ecological characteristics; summaries of educational programs and visitor use; and overviews of the Park's current sustainable management practices, connections with the surrounding community, and adaptive management programs.

From top: View west from the South Peak (Laura A. Cohen 2004); painted turtles at The Pogue (Tom Lautzenheiser 2002); Park ranger and visitors around a Norway spruce (MABI 2003); dry-laid stone causeway south of The Pogue (OCLP 2003).

4.1 CULTURAL RESOURCES AND HISTORICAL SIGNIFICANCE

4.1.1 HISTORIC SIGNIFICANCE

Historical significance is the ability of a property to convey its importance through physical attributes. In accordance with the National Register of Historic Places criteria, significance is manifested in a property through its historical association with events that have contributed to the broad patterns of American history (Criterion A), through association with persons significant in history (Criterion B), through physical traits that embody distinctive characteristics of design (Criterion C), or through its ability to yield information in prehistory or history (Criterion D).

The Park was established to recognize and interpret the significance of the Billings Estate in the history of American conservation and individuals significant in that history, including George Perkins Marsh, Frederick Billings, and Laurance S. Rockefeller. The Park's legislation recognized Frederick Billings' pioneering conservation stewardship of the property founded on principles introduced by Marsh, as well as the remarkable continuity of conservation stewardship carried forward over the ensuing century by Billings' wife and heirs, and Mary and Laurance S. Rockefeller. Research undertaken since the Park was established has identified additional areas of significance for the property related to landscape architecture and agriculture. Together, these areas of significance span a period beginning with Marsh's birth in 1801 through the end of Laurance S. Rockefeller's residency on the property in 1997.

The character of the Forest clearly contributes to the significance and integrity of the property in the areas of conservation, landscape architecture, and agriculture.[1] Overall, the Forest contributes to the integrity of the property in its location, design, setting, materials, workmanship, feeling, and association. While the overall character of the landscape most clearly demonstrates Rockefeller-era management practices, many features also illustrate significance related to the following historic associations: pioneering reforestation practices; forestry practices of the early and mid-twentieth century; model (gentleman's) farms; and late-nineteenth-century landscape design. The following three sections identify the key characteristics of the Forest that convey these areas of historic significance.

4.1.1.1 American Conservationists (Criterion B)

George Perkins Marsh: The property is significant in the history of conservation through its association with George Perkins Marsh, a pioneering American conservation philosopher who was born on the property in 1801, and whose family farm it remained through 1869. The Mansion Grounds and the eastern half of the Forest, including The Pogue, comprised what was the Marsh Place.

In order to convey historic significance, the property must retain historic integrity. Aspects of historic integrity include:

- Location: the place where the historic property was constructed or the historic event occurred
- Design: the combination of elements that create the form, plan, space, structure, and style of a property (e.g., the design of the carriage road system, views and vistas, The Pogue, etc.)
- Setting: the physical environment of a historic property
- Materials: the physical elements of a particular period, which include plant materials, paving, and other landscape features (e.g., species selected for forest plantations, stone used for retaining walls, cultivated regeneration, etc.)
- Workmanship: the physical evidence of the crafts of a particular period (e.g., forestry techniques of different periods, stonework along carriage roads, etc.)
- Feeling: a property's expression of the aesthetic or historic sense of a particular period (e.g., sense of an actively managed forest, nineteenth-century landscape design, a well-maintained country estate, etc.)
- Association: the direct link between an important historic event or person and a historic property.

George Perkins Marsh. (Library of Congress)

Defining landscape characteristics are those prominent or distinctive aspects, qualities, or characteristics of the Forest that contribute significantly to its historic character. Such characteristics may include landscape patterns, forest management practices, vegetation, materials, and designed elements. In other cultural landscape references, these may also be known as "character-defining features" (NPS 1996).

Top, Frederick Billings (1873); bottom, Laurence and Mary Rockefeller (c.1980s). (MABI)

Defining landscape characteristics and features related to the Marsh era include field boundaries, legacy trees and groves, and the old farm road that leads to The Pogue.

Frederick Billings: The property is significant in the history of conservation through its association with Frederick Billings, a Vermont native, captain of industry, and pioneer conservation practitioner who expanded the Marsh Place into a country estate and model farm between 1869 and his death in 1890. Billings developed a pioneering forestry program to address major conservation imperatives of utility, aesthetics, and recreation. Overall, the current composition and character of the Forest was strongly influenced by Billings' vision and forestry work. Although the Forest had a more open and agricultural character during his lifetime and had a heavier emphasis on utility (agricultural and timber production), many of the defining landscape characteristics of Billings' work remain. These include the carriage road system and associated features, designed views and vistas, the Woodbarn, The Pogue, plantations around the Mansion Grounds and French Lot, and managed hardwood and mixed forest stands.

Laurance S. Rockefeller: The property is significant in the history of conservation through its association with Laurance S. Rockefeller, a noted conservationist of the mid-twentieth century, who along with his wife, Mary French Rockefeller, granddaughter of Frederick Billings, continued to manage the Forest in conjunction with Billings Farm, Inc. from the late 1950s through the 1990s. The Rockefellers maintained the Forest much as Frederick Billings and his wife and daughters had developed it, combining utilitarian forestry with aesthetics and recreation. The Forest strongly evokes Laurance S. Rockefeller's concept of "Conservation for People," in which he sought to balance environmental preservation, then gaining widespread support in the mid-twentieth century, with responsible use. Believing much as Marsh and Billings had that nature could be improved, Rockefeller hired a professional forester to manage the Forest to enhance its aesthetic and recreational value by continuing active management to maintain views, thin conifer plantations and hardwood and mixed forest stands, expand recreational infrastructure, and generally create a well-tended appearance. Wood continued to be harvested from the Forest for firewood, veneer, utility poles, pulp, and dimensional wood. Defining landscape characteristics of the Forest associated with Laurance S. Rockefeller include the continuity and expansion of the carriage road and trail system, designed views and vistas, and managed plantations and hardwood and mixed forests.

4.1.1.2 American Conservation Movement (Criterion A)

Pioneering Nineteenth-century Forestry (1874 - 1910): The Forest is significant in the history of conservation as a pioneering example of scientific forestry, begun by Frederick Billings in 1874 and developed into the first decade of the twentieth century prior to the institutionalization of the American forestry profession. Billings initiated his forestry program at a time that coincided with

the earliest private and public efforts to address conservation through forestry and reforestation in particular: one year after the first federal reforestation act was passed, one year before the founding of the American Forestry Association, two years before the arrival of the first professional forester in America, and over fifteen years before the first widely acknowledged professional forestry program was begun on the Vanderbilt Estate at Biltmore, North Carolina.

After 1884, Billings was assisted by his semi-professional farm manager, George Aitken, who continued the estate's reforestation program through 1910 as state governments throughout the Northeast were instituting parallel programs. Both Frederick Billings and George Aitken played key roles in the development of the State of Vermont's forestry program. The Billings Estate was also recognized in the early twentieth century in Vermont and in other New England states as a model of reforestation, primarily due to its early plantations that were some of only a few examples that had sufficiently matured by that time to provide forestry experts with tangible evidence of the benefits of reforestation.

While the Forest has changed considerably over the past 100 years, it retains many defining landscape characteristics related to pioneering nineteenth-century forest management. The early record of forestry practice on the property is most clearly conveyed through intact plantations set out by Frederick Billings and George Aitken between about 1874 and 1910 (including three on the Mansion Grounds and three along the French Lot), and the infrastructure for forestry work that includes the carriage road system and the Woodbarn and its adjoining work yard.

An Example of Continuous Forest Management (1910 - 1997): The Forest is significant in the history of conservation as a representative example of developments in American forestry practice from the early twentieth century to the end of the Rockefeller era in 1997. Following the pioneering work carried out on the property from the 1870s through about 1910, Frederick Billings' wife and daughters continued the reforestation program through about 1952, continuing to balance utility with aesthetics and recreation. The forest plantations remaining from this period (six from the 1910s, two from the 1930s, and two from the 1950s) are representative of the fulfillment of Frederick Billings' pioneering practices as reforestation became institutionalized and widely practiced in the first decade of the twentieth century throughout the Northeastern states.

In Vermont, this institutionalization included the establishment of a state tree nursery and appointment of the first forest commissioner in 1906, the establishment of the first state forest in 1909, and the beginning of the state's reforestation work in 1910. By the 1920s and 1930s, reforestation had become widely acknowledged throughout the state as one of the best means to solve the economic problems of rural communities, with over 27,000,000 trees planted in the Vermont by the late 1930s.

Following a lull during the Second World War, reforestation in Vermont and throughout the Northeast reached an annual high during the 1950s, but by the mid-1960s it had declined significantly in response to public demand for preservation of open spaces and the establishment of wilderness preserves where trees would not be harvested. This decline in reforestation was also evident in the Mount Tom Forest: planting ceased after about 1952 and forest management transitioned to maintaining and enhancing the health and productivity of the plantations and naturally regenerated hardwood and mixed forest stands.[2] During this period "multiple-use" forest management was broadly advocated and practiced within the forestry profession. The approach sought to integrate forest productivity with other management values such as recreation, ecological health, and aesthetics.

The changes in the forestry profession echoed Laurance Rockefeller's philosophy of "Conservation for People" and his pragmatic approach to management, which favored the integration and balance of multiple values including aesthetics, ecological protection, and historic preservation. During the Rockefeller period, the Forest continued to operate under the Vermont Tree Farm System; a professional forester, John Wiggin, was hired to assist with the stewardship of the property; wood continued to be grown and harvested; and recreational activities were expanded.

These management activities are responsible for the character of the plantations and hardwood and mixed conifer stands as they exist today. Without it, forest stands would have become overcrowded, forest health would have suffered, and many trees would likely have died or been lost during natural disturbances such as wind and ice storms.

The character of the plantations and hardwood and mixed conifer stands as they exist today convey their association with the height of plantation forestry as a conservation practice during the first half of the twentieth century, and the changes in forestry practices through the later half of the century. Other defining landscape characteristics related to the Forest's association as an example of continuous forest management include recreational trails, vista clearings, forestry skid trails, and remnant log landings.

4.1.1.3 Agriculture and Landscape Architecture (Criterion C)

Late Nineteenth-century Model Farm: Together with the Mansion Grounds and Billings Farm & Museum, the Forest is significant in the area of agriculture as a representative component of a late-nineteenth century model (gentleman's) farm that includes agricultural land, managed forests, and a forest park developed for demonstrational, utilitarian, aesthetic, and recreational purposes. The property also contains remnants of some of the vernacular farms that Billings purchased and incorporated into his estate. Such remnants include stone walls, roads, and legacy trees. The overall character of the Forest as a component of a model farm

remains intact, with the exception of the conversion of many of the working agricultural fields to forest.

Landscape Design During the Country Place Era: The Forest is significant in the area of landscape architecture as a distinctive example of landscape design during the Country Place Era (1870–1930), illustrating late-nineteenth-century interest in the picturesque. Billings' interest in the picturesque and his vision for the estate was informed, in part, by his association with Robert Morris Copeland and other landscape architects of the time. The aesthetic sensibilities of the Country Place Era are represented in the Forest by its network of carriage roads and trails; rustic bridges, culverts, and walls; views and vistas; placement of some of the plantations; and creation of The Pogue. These features are largely unchanged from their original design. The overall character of the Forest as an example of late-nineteenth-century landscape design remains largely intact.

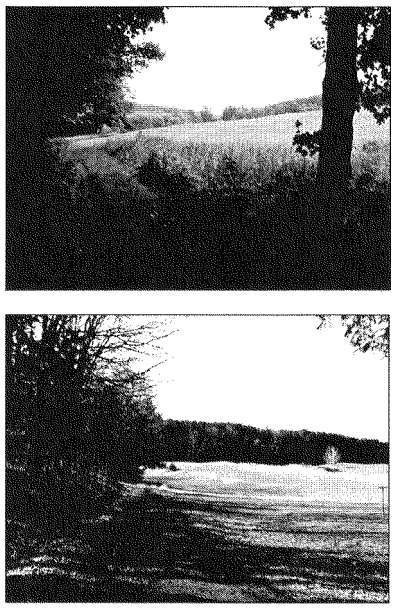
4.1.2 LANDSCAPE CHARACTER

As a rural landscape encompassing more than 500 acres, the Forest's large-scale patterns, such as landforms, fields, streams and seeps, road corridors, forest edges, and diverse forest architecture, are dominant characteristics. Yet because it is also a designed landscape and managed forest, details in the Forest such as the tree species, planting patterns, and even-aged character of plantations; vista clearings; the construction of The Pogue; and the alignment, surface materials, and masonry structures of the carriage roads, are also significant. Together with the broad patterns, these details are key to illustrating the property's significance in the areas of conservation, agriculture, and landscape architecture. The key landscape characteristics can be grouped into three broad categories: spatial organization, circulation, and vegetation.

4.1.2.1 Spatial Organization

The historic character of the Forest is defined by a mosaic of spaces formed by the interrelationship of hills and valleys, road corridors, naturally regenerated and planted forest stands, fields, The Pogue, and vista clearings. As discussed in Section 2.2, this patch-like character reflects the results of over 135 years of continuous forest management, the agricultural origin of the landscape, and the influence of late-nineteenth-century landscape design. The spatial organization of the landscape largely reflects the evolution of land use into the mid-twentieth century, as agriculture and reforestation declined. The Rockefellers subsequently maintained the extant patchwork of forest and field. Key features and characteristics that comprise the landscape patchwork and spatial character of the Forest include:

- *Road corridors:* These illustrate the integration of utility, recreation, and aesthetics that were key to Frederick Billings' conservation practices. The road corridors are primarily enclosed within the forest canopy, except



Top, trail on north side of Elm Lot; bottom, carriage road on east side of Elm Lot. (OCLP 2003)

From top: Remnant stone walls identify former field and pasture edges; vista clearing looking north from the North Ridge Road; view looking south from the French Lot. (OCLP 2003, 2004)

alongside meadows, at vista overlooks, or around The Pogue. On many main roads, corridors were managed by the Rockefellers to maintain a well-tended appearance and allow views into the forest and to natural features such as streams through thinning of the understory. Public roads, including Elm Street on the east and Prosper Road on the west, provide discernable edges and primary fronts to the Forest, lined primarily by intact conifer plantations.

- *Fields:* These represent the historic development of the Forest as an agricultural property, and form the dominant open spaces within the Forest. Typically covering gently rolling or sloping ground around The Pogue, the fields were maintained by the Rockefellers with clearly defined forest edges. They were maintained with a generally uniform character either through grazing or mowing.

- *Forest:* Unlike a natural forest, the Mount Tom Forest has a complex spatial character due to its wide variety of stands that reflect a long period of management and former agricultural land use. The variety of stands imparts a diverse spatial quality to the interior of the Forest, ranging from open understory and high canopy (such as in the intact conifer plantations and mature woodlots) to enclosed through heavy undergrowth and mixed age structure (such as in younger woodlots and naturalized plantations). Traces of lost spatial character are evident in the Forest through stonewalls that once lined fields and pastures, as well as by the boundaries of plantations that often correspond with the limits of old fields.

- *Vista clearings:* These provide spatial and visual connection from the Forest to the surrounding countryside. Along with the carriage roads, vista clearings contribute to the significance of the Forest in the area of landscape architecture. The vista clearings are all small openings that were maintained in the Forest at topographic highpoints, except for the French Lot Overlook. This overlook offers a broad view to Mount Ascutney through an open field that is intentionally framed by two mature conifer plantations.

4.1.2.2 Circulation

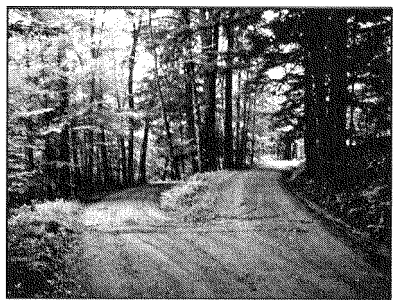
The historic character of the Forest is defined in large part through a circulation system that connects the mosaic of spaces and provides the primary way of experiencing the landscape. The roads and trail system was conceived by Frederick Billings in 1869 and expanded by his heirs through about 1914, with additional recreational components added under the Rockefellers through the 1990s. It illustrates the combined utilitarian and recreational/aesthetic characteristic of conservation practices during those periods, as well as aspects of late-nineteenth-century landscape design. The roads and trails have been open for public use since Frederick Billings' day. Overall, it retains the defining characteristics that were present during the Billings era, and reflects additional recreational use of the Forest under the Rockefellers. Key features and

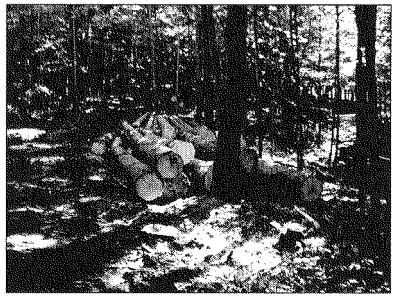
characteristics of the circulation system in the Forest include:

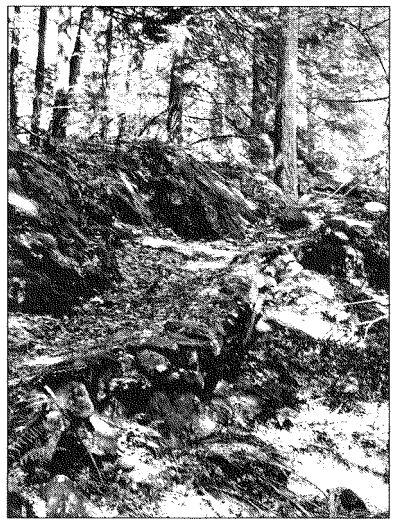
- *Carriage roads:* The network of carriage roads that weaves through the Forest was designed for both utilitarian and recreational purposes, and represents a key component of the designed landscape. Built partially upon the alignment of earlier farm roads (incorporating some early structures such as retaining walls and culverts), the carriage roads feature winding alignments following the natural topography, broad corridors, rustic stone structures, graded gravel/earthen surfaces, extensive drainage systems, and overlooks. Most of the system remains intact within the boundaries of the Park, except for sections of three roads that extend onto adjoining properties. Along the roads are rustic log benches, stone water troughs, and wood directional signs that primarily reflect the historic recreational use of the Forest.

- *Skid roads:* Several roads were built and/or maintained as secondary circulation features primarily for utilitarian forestry and agricultural purposes during the Rockefeller era and perhaps before. These were generally characterized by two tracks in an earthen surface through narrow corridors, without significant grading or major built features. Skid roads revegetate if they are not continually maintained. It is likely that other skid roads existed on the property during different times and that the layout of skid roads has changed in response to the location and type of forestry work occurring throughout the property. The existing pattern of skid roads reflects the utilitarian forestry work that occurred during the Rockefeller era.

- *Trails:* The network of trails, built for pedestrian and equestrian purposes, represents the importance of recreation in the Forest, most notably increased recreational use under the Rockefellers. The trails in part parallel the carriage roads and also access difficult terrain and topographic highpoints. They typically consist of single earthen tracks through narrow clearings in the forest, include some minor grading and stone walls, and in several cases access overlooks. The cross-country ski trail system was established by the Woodstock Resort Corporation in 1977 by adding a number of new trails to the property and grooming existing carriage roads, skid roads, and hiking trails. Some of the trails are former skid roads that were maintained or upgraded for recreational purposes and are characterized by their wider clearings and limited use of built drainage features. Several trails are no longer actively used or managed, and are thus disappearing.





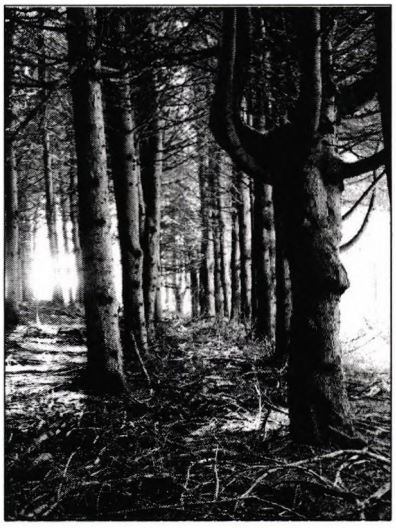


From top: Intersection of two carriage roads (OCLP 2003); skid road off of the McKenzie Road (MABI 2004); typical cross-country/hiking trail (OCLP 2003); hiking trail with low stone wall (OCLP 2003).

4.1.2.3 Vegetation

Vegetation not only dominates the forest landscape, but also most clearly conveys the significant role of the Forest in the history of reforestation (both through plantations and natural succession) and forest management in American conservation practice through the mid-twentieth century. As discussed in Section 2.2, the plantations and hardwood forest stands, and the associated evidence of

management activities, strongly convey the Forest's historic associations. Indeed, the maturation of both forest stands and individual trees impart a strong sense of age and continuity to the landscape. Overall, the Forest retains its historic character related to conservation and forestry practice through the twentieth century. Key features and characteristics of the Forest's vegetation include:



Top, Norway spruce plantation near the McKenzie Farm; bottom, big-tooth aspens and sugar maples in Stand #23. (OCLP 2003)

- *Plantations:* These illustrate a continuum of reforestation practice from the 1870s through the 1950s, representing the beginnings and maturation of American conservation practice. Through their designed attributes, several plantations also contribute to the significance of the property in the area of landscape architecture. The earliest plantations set out by Frederick Billings and George Aitken through 1910 generally retain sufficient materials and elements to reflect the original planting patterns and thus illustrate their association with pioneering reforestation practices. Plantations set out between 1910 and 1954 generally retain characteristics related to their association with forestry practices of the period and the continuum of reforestation work undertaken on the estate through the 1950s. Several from this later period represent the only completely intact plantations within the Forest. All of the plantations exhibit evidence of continual thinning and forest management. However, due to decades of management and natural succession, a few plantations are less distinguishable from the surrounding northern hardwood forest and no longer convey their original planting pattern or species composition.

- *Northern hardwood and mixed forests:* Along with reforestation (plantations), hardwood and mixed forest stand management was a key component of the forestry program established by Frederick Billings in the 1870s and carried on by his wife and daughters and Mary and Laurance S. Rockfeller. Compared to the plantations, hardwood and mixed forest management typically had a more subtle, but still noticeable, impact on the character of the landscape. Annual harvest using single-tree and group selection were conducted removing quantities of firewood, veneer, pulp, and dimensional lumber. This management resulted in distinguishable patterns, such as greater spacing between trees, stumps in various stages of decay, skid trails with the occasional "bumper" trees along their edge, and trees with fewer defects, wounds, and signs of disease. These stands retain their overall character related to forest management practices prominent from 1910 to 1997, primarily those related to the Rockefeller era (1954–1997). Additionally, the patchwork of forest stands, and distribution of tree species and age classes illustrate the property's continuity of forest management.

- *Legacy trees, groves, and allees:* In addition to the plantations and woodlots, there are legacy trees, groves, and allées that illustrate traces of lost character as well as aspects of the Forest's designed and agricultural landscape. Among the oldest are several 300–400-year-old hemlocks that may be remnants

from the prehistoric forest. Throughout the plantations and woodlots are large trees with massive, spreading lower branches that convey the open agricultural origins of the landscape dating as far back as the late eighteenth century. Some of these trees are clustered in groves, such as the oak grove retained by Marsh family on the south hillside west of their home. Rows of trees, particularly sugar maples, line old farm roads as well as roads built by Frederick Billings and his heirs as part of the designed landscape. Others are remnants of hedgerows and fence lines.

4.1.3 ARCHEOLOGICAL RESOURCES

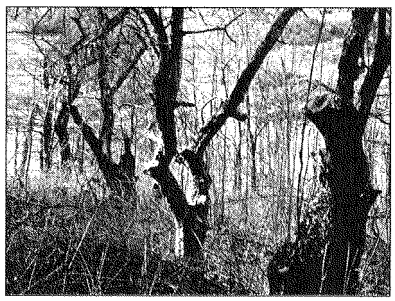
Archeological resources are the remains of past human activity and the records documenting the scientific analysis of those remains.[3] An archeological site(s) can be eligible to be listed in the National Register of Historic Places if the site(s) has yielded, or may be likely to yield, information important in prehistory or history. Archeological sites contribute to the significance of the Mount Tom Forest. An Archeological Overview and Assessment is currently being conducted by the University of Vermont Consulting Archeology Program. Preliminary results indicate that there are no known prehistoric Native American sites within the limits of the Park. However, several areas are considered archeologically sensitive for prehistoric Native American sites. These areas tend to be along streams or drainages, near springs, and the area around The Pogue.[4] Additionally, identified historic archeological sites include above-ground features associated with the McKenzie Farmstead, Hilltop Farm, and sugarhouse.[5]

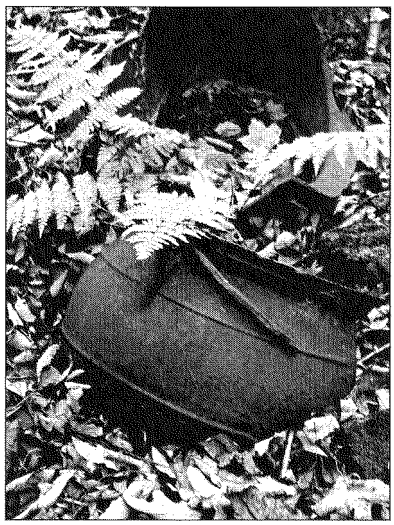
4.1.4 ETHNOGRAPHIC RESOURCES

As defined by the National Park Service, an ethnographic resource is a site, structure, object, landscape, or natural resource feature assigned traditional, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it.[6]

The relationship between the Mount Tom Forest and the local community has been a vital part of the property's history. Local residents associate the property with Woodstock's long-established way of life as a retreat and tourist community. Use of the property for pedestrian and equestrian recreation and as an environment for learning about natural history and sustainable forest management are important aspects of the ethnographic character of the property.[7] The property is also an important visual component of the local landscape, both as a distinctive setting for the village of Woodstock and as a prominent feature in many views throughout the area (see Section 4.6.3 below). In addition, forestry activities on the property have contributed to the local economy since Billings' time.

With respect to Native American ethnography, traditional associations between the Abenaki and resources within or adjacent to the Park are not known.[8]





From top: Legacy tree in Stand #6 (OCLP 2004); apple trees in Stand #12 (MABI 1999); remnant sugaring artifacts (OCLP 2003).

For locations of many of the cultural landscape features discussed above, see the fold out map "Cultural Landscape Features" at the end of this chapter.

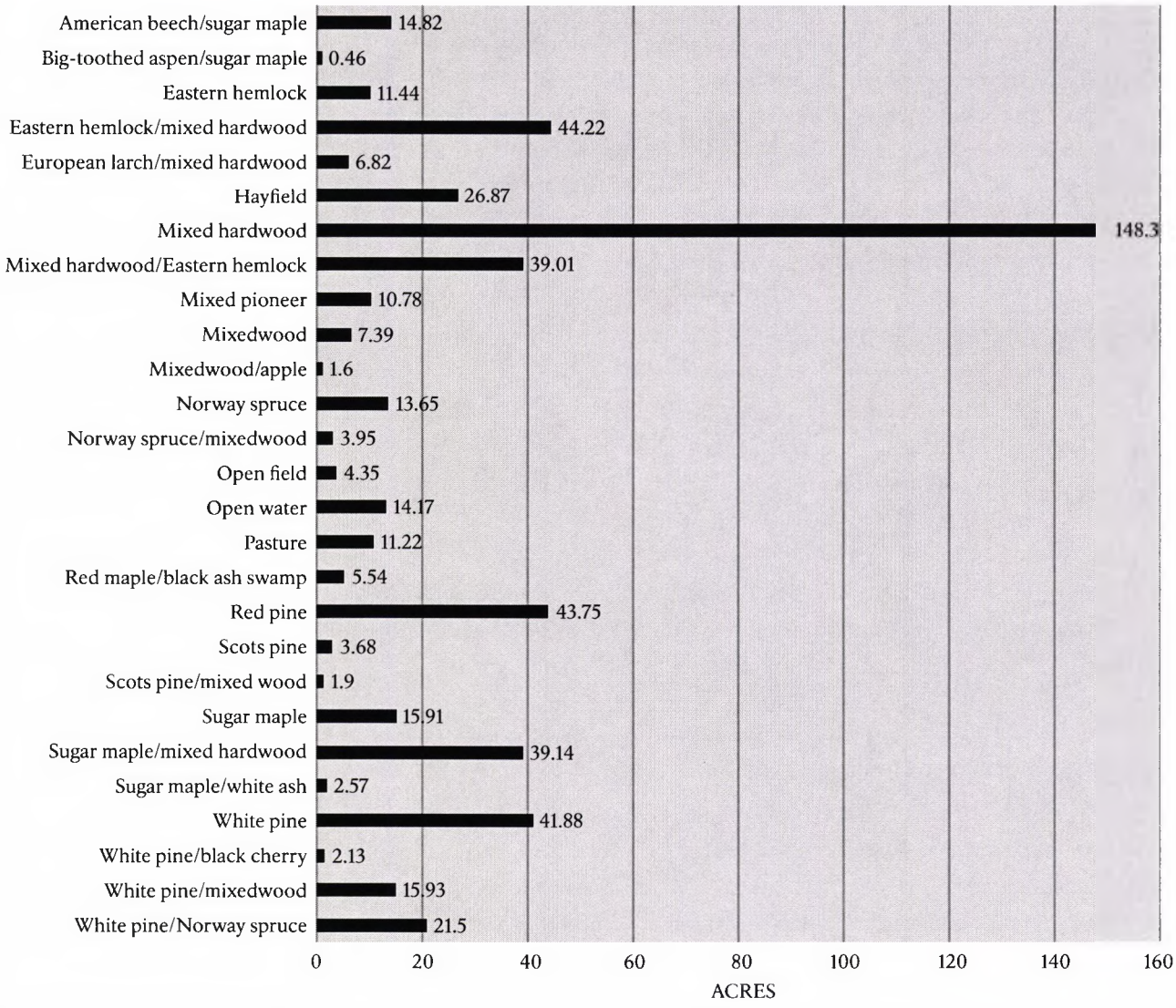
4.2 Natural Resources

4.2.1 VEGETATION

4.2.1.1 Forest Stands

Forest stands are the basic organizational unit used to describe forest management at the Park. Forest stands are contiguous groups of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit. The Mount Tom Forest

Table 2
Stand Types and Acreage



is divided into forty-seven forested stands (averaging 10.56 acres per stand) and several distinct pastures, hayfields, and meadows. Naturally regenerated forest stands dominate the Forest, comprising 63 percent of the forested land. The majority of these stands are mixed hardwoods (146 acres or 29 percent of the forested area), followed by plantations, which comprise 26 percent of the Forest. Table 2 lists all of the forest types on Mount Tom and the acreages they cover. For a detailed list of stands and their forest types, see Appendix D.

Top, winter view of tree crowns (MABI 1999); bottom, hemlock forest along the Pogue stream (Tom Lautzenheiser 2002).

4.2.1.2 Natural Communities

Natural communities are interacting assemblages of species and their environment (e.g., soils, slope, aspect, and climate). Although natural communities are typically defined as areas without significant disturbance by humans for the past seventy years or more, the Park's managed forest retains enough characteristics to assess the natural community classification of most existing stands and to estimate the potential natural communities that could develop in existing conifer plantations and fields.[9] The Park includes sixteen natural communities, with more than half of the natural forest stands classified as Northern Hardwood Forests. With limited management and intervention, the number of communities will likely be reduced and plantations will be succeeded by similar forests occurring on the adjacent natural stands.[10] Table 3 details the acreage and distribution of the park's natural communities. A map of these communities can be found at the end of this chapter.

TABLE 3
ACREAGE AND DISTRIBUTION OF NATURAL COMMUNITIES [11]

	Type of natural community	Acres	Percent	General location/Distribution
Terrestrial Habitat	Northern Hardwood Forest	57	10.3	Northern and western portions of the Park
	Sugar Maple-White Ash Forest	43	7.7	North Ridge, West Ridge
	Rich Northern Hardwood Forest	14	2.5	West Ridge
	Northern Hardwood Limestone Forest	9	1.6	West Ridge
	Hemlock Forest	55	9.9	Pogue Stream valley
	Hemlock- Northern Hardwood Forest	136	24.5	Eastern parts of the Park
	Dry Oak Forest	0.1	0	Mount Tom Ridge
	Hemlock-Oak Forest	6	1.1	Mid-slope of Mount Tom
	Temperate Calcareous Outcrop/Cliff	1	0.2	Eastern face of Mount Tom/ Southern end of West Ridge
	Native Conifer Plantations	112	20.2	Mansion grounds, Pogue Stream valley, west of West Ridge, near Elm Lot and French Lot overlook, north of Pogue, Prosper Road entrance
	Exotic Conifer Plantations	40	7.2	Mansion grounds, French Lot overlook, north of Pogue, McKenzie Farm, Prosper Road entrance
	Maintained Fields/Pasture	43	7.7	South and east of the Pogue
Aquatic/ Wetland Habitat	See Section 4.2.3, Water Resources and Wetlands, below			

From top: Rich hardwood forest on the West Ridge (Tom Lautzenheizer 2002); SCA and VYCC volunteers removing invasive plants (MABI 2004).

4.2.1.3 Natural Communities of Special Concern

There are several natural communities within the Park that have enhanced biological diversity or are sensitive to forestry practices as to warrant special management precautions. In addition to those areas discussed under Section 4.2.3 Water Resources and Wetlands, natural communities of special concern for forest management also include Rich Northern Hardwood Forest. These areas often host a great degree of species diversity and are characterized as containing sugar maple, white ash, blue cohosh, and maidenhair fern.[12] This natural community type is common in Vermont and considered resilient to selection harvests if patch cuts are kept small and precautions taken against invasive plants.[13] However, the largest area of this community type in the Park is located west of The Pogue and is largely unsuitable for forestry because of its extreme slope (35 to 60 percent), which creates severe erosion hazard and equipment limitations.[14]

4.2.1.4 Native Plant Species of Special Concern

A 1997 study identified eleven plant species of special concern in the Park. Four of these species grow wild and seven grow exclusively in cultivated or semi-cultivated areas. Wild-growing plants included such species as Minnesota sedge, leathery grape fern, and broad beech fern. Leathery grape fern and broad beech fern were not located in the actual survey, but were included because they were reported to have been recently found in the area west of The Pogue.[15] Of the eleven rare plants found, only the male fern is a state-listed threatened species, and it grows under cultivated conditions. There are no federally listed threatened or endangered plant species known to occur within the Park.

4.2.1.5 Invasive Exotic Plants

Over twenty exotic plants of concern have been inventoried in the Park, several of which are listed as Class I, highly invasive, by the Vermont Nongame and Natural Heritage Program. The species include: bush honeysuckle, Japanese honeysuckle, barberry, common buckthorn, glossy buckthorn, Norway maple, wild chervil, swallowwort, garlic mustard, and autumn olive.[16] Distribution of invasive plants coincides with areas of recent forest disturbances, field edges, and borders with adjacent residential lands.[17] Over the past two years, Park staff have treated populations of invasive plants of high priority with the assistance of the Student Conservation Association and the Vermont Youth Conservation Corps.

Conifer regeneration in red pine stand (Stand #26). (MABI 2005)

4.2.1.6 Forest Stand Structure

The structure of the Park's forest stands varies widely, providing a diversity of wildlife habitats and other ecological functions.[18] Many forest stands are developing greater vertical diversity as intentional forest thinning and natural aging of the stands opens up the canopy, increasing light for shade-tolerant trees in the understory. Early monitoring and forest inventories suggest that forest management in the Park appears to have mimicked some natural disturbance processes in both plantations and hardwood and mixed forest stands, supporting

increased structural and species diversity within these stands. Some of the Park's oldest plantations are starting to develop late-successional structural characteristics.[19]

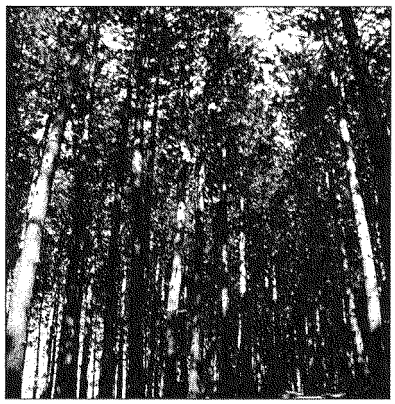
4.2.1.7 Stocking, Growth, and Yield

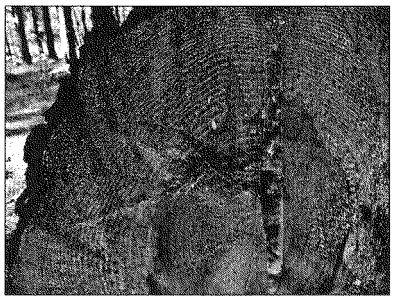
Stocking, growth, and yield are important silvicultural terms that describe the productivity of the forest and provide fundamental measurements for sustainable forest management. If wood is harvested faster than it is grown, then forest management is considered unsustainable. While harvests in any individual year are likely to exceed the growth during that year, in a sustainably managed forest *average annual harvests* do not exceed *average annual growth and yield.*

A recent survey of forest diversity and tree volume indicates that the Park's forests are fully to over stocked, with stocking levels near, above, or well above the USDA Forest Service recommended residual stocking level, or "B" line, in all cases.[20] (See Appendix D for an overview of stocking levels for each stand.)

Forest stands within the Park show little or no reduced vigor due to age, although some of the oldest plantations are probably slowing their overall growth rate.[21] There are approximately 7,000,000 board feet of timber and 4,500 cords of pulpwood in the forested stands of the Park, most of which is found in the small and large sawtimber class sizes.[22] On average, total volume production is higher in hardwood and mixed forest stands, but board feet production is higher in plantations due to the greater number of larger-diameter trees with desirable growth forms in those stands.[23]

The USDA Forest Service estimates that the average annual growth of timberland in Vermont is approximately a third of a cord per acre.[24] Site-specific data gathered in sixteen reference stands within the Park and analyzed for a three-year period indicate that annual volume production is 1.47 cords per acre, well above the statewide average.[25] In the future, site index data will also be gathered as part of regularly scheduled forest inventories. These data will be used to generate stand-specific estimates of growth and provide more accurate determinations of yield and allowable cut.[26]

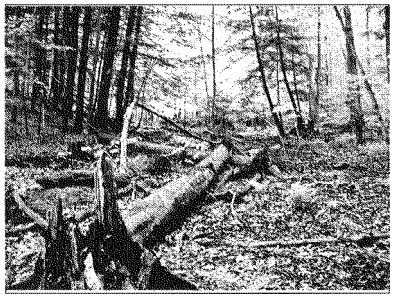




Top, crowded red pine stand with stocking well above the B-line; bottom, growth rings of red pine cross-section showing decrease in growth rate. (MABI 2004)

4.2.1.8 Downed Coarse Woody Debris (CWD)

CWD is an important structural feature that influences wildlife habitat, nutrient cycling, tree regeneration, below-ground communities, and other ecological functions associated with forest ecosystem health.[27] In streams, CWD also provides important aquatic habitat and nutrient regulation.[28] CWD volumes vary substantially throughout the Park; however, overall CWD volumes are less than half the mean values recorded for moderate to highly productive mature northern hardwood forests throughout the region.[29]



Downed coarse woody debris in wetland east of The Pogue. (MABI 2001)

Top, thriving and dead legacy trees in Stand #6; bottom, dead legacy tree in Stand #8. (OCLP 2004)

4.2.1.9 Snags

The Park's forests contain snags (i.e., standing dead wood) with a full range of decay stages. However, decay class distributions vary considerably among stands. Snags in several stands consist mostly of less-decayed material, resulting from recent tree mortality. Other stands are weighted toward more moderate or well-decayed material, while several stands have fairly even distributions of snags among decay classes. Spatial variability across the Park limits population sizes of territorial snag-associated wildlife, such as most woodpecker species.

4.2.1.10 Legacy Trees

The land use history of the Park has resulted in the retention of numerous remnant open-grown pasture trees and hemlock over 300 to 400 years old. As discussed in Section 2.2.3, these "legacy trees" biologically enrich the Park's forested ecosystems. They provide an abundance of habitat values including cavities utilized by a host of species and enhance vertical structure of forest stands.[30] Diameter distributions of the legacy trees in the Park extend well beyond the sizes reported for natural hardwood and old-growth northern hardwood–hemlock forests in the Northeast. Most legacy trees appear to be vigorous and healthy despite their age, providing opportunities for continued retention.[31]

Dying legacy trees can also enhance forest health and wildlife use. Large snag structures are ecologically important for a wide array of species.[32] As these trees continue to decay and fall, they become an important source of downed coarse woody debris of exceptional size.

4.2.2 TOPOGRAPHY, SOILS, AND GEOLOGY

The topographical elevations in the Park range from about 700 to 1,450 feet above sea level, with the ridge west of The Pogue being highest point.

The entire Park lies on Silurian-Devonian bedrock, mainly the Waits River Formation (a limestone/marble complex), and a small portion is underlain by Standing Pond Volcanics. The Shelburne Drift covered the area, and an ice dam near what is now the village of Woodstock created a large high-level lake that extended up the valley of the Ottauquechee River. Most of the Park is described as glacial till, with limited exposed bedrock.[33]

Rock cut on the North Ridge Road. (OCLP 2003)

Primary soil units found within the Forest include Dummerston, Pomfret, Glover, and Vershire. Roughly two-thirds of the Forest is composed of state-designated prime forest soils, including areas to the east and south of The Pogue and to the west, along Prosper Road. The Forest also contains pockets of state-designated prime agricultural soils, which are found to the south of The Pogue and to the west of the Mansion Grounds.[34]

4.2.3 WATER RESOURCES AND WETLANDS

The Pogue, a 14-acre pond created by an earthen dam, is located in the center of the Park surrounded by hardwood forests and an 1896 mixed conifer plantation. The Pogue receives its water from rainfall, submerged springs, and two intermittent streams that flow off the ridge to the west of The Pogue. Two sets of irrigation pipes draw water from The Pogue. One supplies two watering troughs along the main carriage road; the other provides irrigation water to the Mansion Grounds and the Billings Farm & Museum.

A perennial stream, the Pogue Stream, drains The Pogue and most of the Park into Barnard Brook, which feeds into the Ottauquechee River. Before leaving the Park, the Pogue Stream runs through hemlock-hardwood forests and a pasture, which was recently re-fenced to exclude animals from the stream channel. Results from a Level I Water Quality Inventory indicate that the overall surface water quality of The Pogue and Pogue Stream is "good," and that there are no serious sources of water pollution in the Park.[35]

Top, the Pogue Brook (MABI 2002); bottom, vernal pool near The Pogue (Tom Lautzenheizer 2002).

Several wetlands and seeps are located throughout the Park. The most extensive concentration is located north and east of The Pogue where a complex of three wetlands is linked by intermittent streams. The underlying bedrock in this area is calcareous; and as a result, the pH of this seep-wetland complex is relatively high.[36] An inventory of vernal pools, which located ten pools in or adjacent to the Park, identified this complex as one of the prime areas in the Park for breeding populations of vernal pool species.[37] No National Wetland Inventory designated wetlands are found in the Park.[38] Acreage and distribution of the park's aquatic and wetland natural communities is listed in Table 4 below. A map of wetlands, vernal pools, and seeps can be found at the end of the chapter.

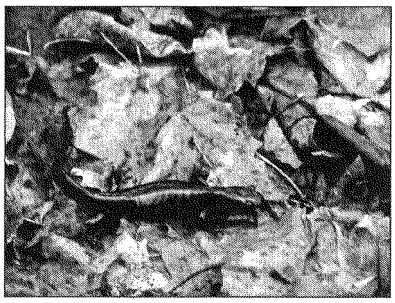
TABLE 4
ACREAGE AND DISTRIBUTION OF AQUATIC AND WETLAND NATURAL COMMUNITIES [39]

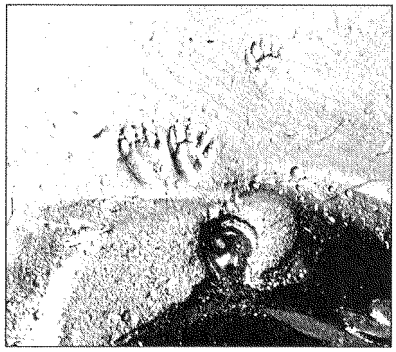
Type of natural community	Acres	Percent	General location/Distribution
The Pogue	14	2.5	Center of the Park
Red Maple-Black Ash Swamp	14	2.5	East of Pogue and near Prosper Road entrance
Hemlock Swamp	3	0.5	West of North Ridge
Seeps and Vernal Pools	n/a	n/a	Scattered

4.2.4 WILDLIFE

4.2.4.1 Amphibians and Reptiles

As of 2000, thirteen amphibian species (six salamanders, seven frogs) and five reptiles (three snakes, two turtles) were documented in the Park. Of these, eleven amphibian species (six salamanders, five frogs) and two reptile species were confirmed to have breeding populations in the Park, though all the reptiles are





From top: Jefferson salamander (MABI 2000); painted turtle (MABI 2001); raccoon prints (MABI 2002).

suspected to breed within the Park area. Significant breeding populations of the Jefferson salamander were documented at the Park, centered around the vernal pools north and east of The Pogue. The Jefferson salamander is considered a "Species of Special Concern" by the Vermont Fish and Wildlife Department Nongame and Natural Heritage Program. In addition, the Northeast Endangered Species Technical Committee recently listed the Jefferson salamander as a species of regional conservation concern.[40]

4.2.4.2 Birds

Ninety-one bird species were detected during a two-year breeding bird inventory project conducted in the Park. Of these, seventy-three species were confirmed or suspected to be breeding within the Park or on adjacent lands, fifteen species were considered local breeders that may nest occasionally or in the future on Park lands, and three species were strictly transients. No threatened or endangered species were noted during breeding bird surveys. Cooper's hawk, listed as "special concern" by the Vermont Agency of Natural Resources, was observed during surveys, but nesting was not confirmed. Twenty-three species are listed on either the Partners in Flight priority list for the northern New England region or on the Vermont list of rare and uncommon birds. Fourteen of these are forest bird species that are considered conservation priorities. All but three of these species prefer forested areas with sapling-sized or larger trees.[41] Fields contained relatively few species compared to the Park's forested areas. One field species (bobolink) was found nesting in small numbers (about five pairs) in the hayfields.

4.2.4.3 Bats

A bat biodiversity study documented seven species through mist-netting and acoustic monitoring. Neither the federally endangered Indiana myotis nor the state-threatened eastern small-footed myotis were detected during the survey. Trapping data suggest that The Pogue is the primary foraging area, which the bats access by using carriage roads as travel corridors.[42]

4.2.4.4 Large Mammals (Deer, Moose, and Bear)

Deer wintering areas are located along the northern slopes of Mount Tom and the western end of the Park along the slopes above Prosper Road.[43] A forest dynamics monitoring study indicates that browsing by deer is having an effect on forest successional dynamics, with a significantly larger effect in conifer stands (e.g., plantations and hemlock stands) than in mixed woods and hardwood stands.[44] Moose and bear are known to travel through the Park on occasion, but limited information is available to assess the regularity and extent of their use of the Forest.

4.2.4.5 Small Mammals

Field work for a small mammal inventory has been completed and a final report is expected by the end of 2005.

4.2.4.6 Fish

Two species of fish, largemouth bass and yellow perch, were documented in The Pogue. Only yellow perch is native to this area. However, because The Pogue was formerly an upland bog, both of these species were likely introduced.[45] Park streams are intermittent, and therefore do not contain fish.

4.2.4.7 Wildlife and Forest Patch Composition

As discussed previously in Section 2.2, the Forest provides diverse wildlife habitats, such as hiding/resting cover, nesting sites, and foraging habitats, which are associated with differences in forest stand density and composition.[46] The juxtaposition of diverse patches over relatively small spatial scales represents a high-quality habitat configuration for many wildlife species, especially generalists and those requiring multiple habitat types. This pattern may reduce habitat quality for some species, however, such as those associated with the interiors of specific patch types.[47]

4.2.5 REGIONAL CLIMATE

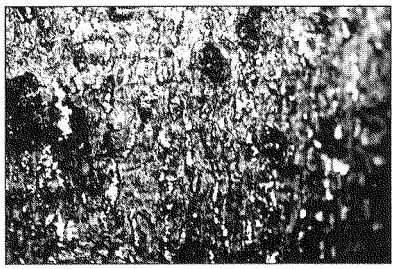
Woodstock receives approximately 40 inches of precipitation annually, evenly distributed throughout the year. The frost-free period generally lasts from late May to mid-September. One-quarter of the annual precipitation comes in the form of 90 inches of snow, which is usually on the ground from mid-December to April. Summer temperatures average 70 degrees Fahrenheit, with highs reaching the 90s. In winter, subzero temperatures are common.[48]

4.2.6 NATURAL DISTURBANCES

4.2.6.1 Pests and Pathogens

Native and non-native pests and pathogens impact Northeastern forests differently, and require diverse management approaches. Since the mid-1800s, the composition and structure of New England forests have been drastically altered by the arrival of numerous non-native insects and diseases including the chestnut blight (1904), white pine blister rust (1914), gypsy moth (1869), and Dutch elm disease (1950–60). The recent establishment of insects such as the Asian long-horned beetle and emerald ash borer within the United States has brought additional attention to the risk posed to forests by non-native pests. In addition to Asian long horned beetle and emerald ash borer, other organisms that are potential risks to the Mount Tom Forest include hemlock woolly adelgid, butternut canker, and beech bark disease. Because these organisms have not evolved as components of local ecosystems, native trees are not resistant to these pests and often there are few or no predators or competitors that counter the rapid growth of their population. This often results in widespread and severe impacts to trees and the associated ecological systems.

Levels of native pests and pathogens infection or infestation are more indicative of tree and forest health. These organisms have evolved within local ecosystems; therefore, host tree species have developed protection strategies and the ecosystem includes active predators and competitors that control populations of these organisms. Some examples of native pests and pathogens that exist at the Park include *Armillaria mellea*, *Phellinus pini*, and *Glycobius speciosus*.



Close up of beech bark nectria. (MABI 1999)

The Park is currently monitoring the effects of insects and diseases on forest health through the long-term forest dynamic monitoring program and annual site surveys from professional foresters. Site-specific data indicate significant levels of defoliation, decline, or physiological stress for six tree species in the Park: beech, butternut, green ash, white ash, red maple, and American basswood.[49] Beech bark disease is the most widespread of the insects and diseases affecting these species. Infection levels suggest that portions of the Park are within a regional "killing front" of heavy beech bark disease-related mortality. Over time, as mortality takes its toll, infection rates may recede into an "aftermath" stage, in which only a few residual, resident large beech survive. During this phase, many saplings may sprout from the roots of the dying and dead trees; these may co-exist with the few large remaining resistant overstory trees to form a two-aged beech forest.[50]

The Park is also developing a forest health monitoring program and Integrated Pest Management (IPM) Plan to refine data on native and non-native forest pests and develop management strategies that will draw upon the principles and best practices of IPM. In conjunction with these efforts, the Park recently completed a risk analysis for hemlock woolly adelgid, a non-native pest that has devastated hemlock forests in other areas of the Northeast.[51]

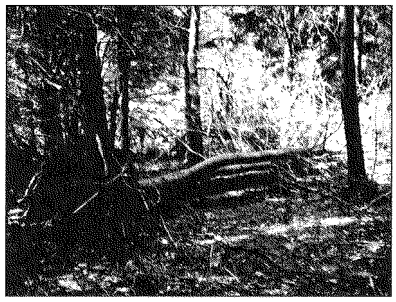
4.2.6.2 Fire

Historically, fire was not frequent or widespread for most areas in New England. Moist, rolling uplands are particularly fire resistant, averaging burns at intervals greater than 1,000 years. Fires that do occur tend to be along dry ridgelines.[52] The species composition in the Park is representative of Historic Natural Fire Regime V, which is characterized by a long interval between fires and stand replacement of over 200 years. Other area environmental historians estimate that frequency of fires in northern hardwoods averages of 800 to 1,400 years.[53] The majority of recent wildland fires that have occurred in Vermont have been less than an acre in size, and only 2 percent of these fires were the result of natural ignition sources (i.e., lightning).[54] Two wildland fires were reported to have occurred on Mount Tom, one during the beginning of the nineteenth century and the second in 1845. Both were caused by human activity.[55]

4.2.6.3 Wind Events

Historical trends of wind events in New England suggest that storms resulting in light damage (i.e., branches broken, trees damaged) are likely to occur every

ten to fifteen years. Storms of moderate intensity (i.e., trees blown down) are estimated to occur at intervals approximating 25 to 65 years. The most severe events, resulting in extensive blow-downs, occur at increments greater than 380 years.[56] Major hurricanes were reported to have caused widespread forest loss in 1821 and 1938.[57] Studies of experimental forests in the region report that nearly 80 percent of wind events result in areas of damage that are less than a hectare in size.[58] As stands age and increase in relative height, they are more prone to damage from wind events; and conifers, particularly white pine trees, are especially subject to blow-downs.[59] Most of the wind events in New England move in a southeast-to-northwestern pattern, making southern-exposed ridges particularly prone to storm damage. The white pine plantation on the south-facing slope of the ridge west of The Pogue appears to be prone to blowdown events, as evidenced in historic aerial photographs and recent activities.



Damage from 2003 windstorm. (MABI 2003)

4.2.7 AIR QUALITY

4.2.7.1 Ozone

Ozone monitoring data is available from a station in Sullivan County, New Hampshire, 35 miles from the Park. The Park is one of only four National Park Service units in the Northeast Temperate Network where ozone levels do not exceed EPA's human health-based eight-hour National Ambient Air Quality Standard (NAAQS). High levels of ozone can damage the foliage of vegetation, reducing tree vigor and vitality. Based on 1995–1999 seasonal average ozone levels, it is uncertain if ozone injury would occur at the Park. Ozone-sensitive plant species at the Park were identified by the NPS Northeast Temperate Inventory and Monitoring Program; and the Vermont Agency of Natural Resources has begun to monitor some of these plants at the Park.[60] However, site-specific data on foliar damage from ozone are not available at this time.

4.2.7.2 Visibility

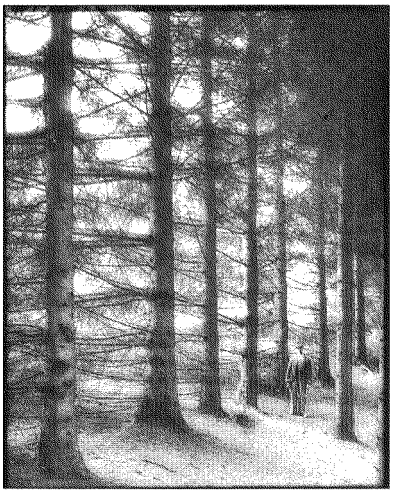
The closest monitoring sites for air quality are Lye Brook Wilderness Area, Vermont (site #LYBR1), Great Gulf Wilderness Area, New Hampshire (site #GRGU1), and Quabbin Reservoir, Massachusetts (site #QURE1). To this date, not enough data have been collected and analyzed from these sites to assess trends in visibility.[61]

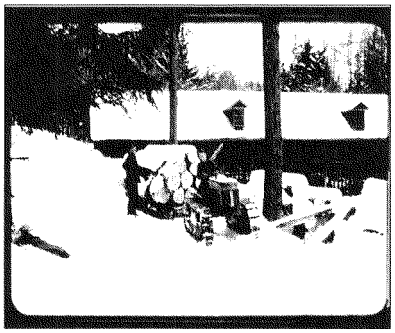
4.2.7.3 Dry Deposition

Dry deposition for the area is measured at Hubbard Brook, New Hampshire (from 1989 to present), and Lye Brook, Vermont (from 1994 to present). Both the Hubbard Brook and Lye Brook data showed no trend in nitrogen deposition levels. Sulfur deposition increased at Lye Brook, but no trends were observed at Hubbard Brook.[62]

4.2.7.4 Wet Deposition

Wet deposition for the area is measured at Hubbard Brook, New Hampshire (since 1978) and Bennington, Vermont (since 1981). Both stations show a decrease in concentration and bulk deposition of sulfate, a slight decrease in concentration and deposition of nitrate, and no overall trend in concentration and deposition of ammonium.[63]





From top: Spruce plantation on the Billings Estate, photographed in 1902 by a photographer for the Arnold Arboretum (Arnold Arboretum); hauling logs at the Woodshed by tractor in winter c.1960 (Billings Farm & Museum Library and Archives, courtesy of the Corkum Family); Tree Farm sign on main carriage road (MABI 2000).

4.3 Sustainable Management Practices

4.3.1 A TRADITION OF MANAGEMENT

Mount Tom is a place where the interaction of people and nature has played out on the landscape for nearly 200 years. Agricultural activities have included maple sugaring, haying, grazing, orchard management, mushroom growing, and gardening. Today, mature sugar maples line sections of the carriage roads and are found in many of the forest stands. Remnants of a sugar house are evident near the Woodbarn, and a remnant orchard can be found near the McKenzie Farmstead. Hay continues to be cut from the open fields.

As discussed in previous sections, sustainable forest management on Mount Tom began with Frederick Billings in the 1870s; and from that time forward, the Forest has been continuously managed using the philosophy and techniques of best forest management of the day. Historically, forest management activities included tree planting, forest thinning and pruning, and harvesting. Wood was drawn by horses, and later tractors, to the Woodbarn where it was sawn and dried. The Forest was designated as Vermont's first Tree Farm in 1953, and is today recognized as a demonstration Tree Farm in the American Tree Farm System and certified by the Forest Stewardship Council (FSC).

4.3.2 MODELING SUSTAINABLE MANAGEMENT PRACTICES

The Park has initiated several projects to continue the tradition of sustainable forest management on Mount Tom. Recent examples of sustainable management activities include:

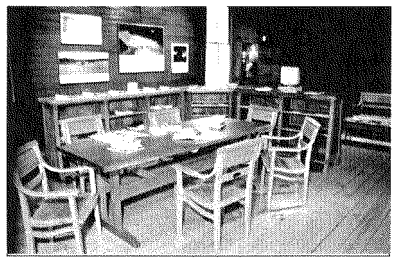
- *Third-Party Certification Pilot Project.* As part of a pilot project funded through the Pinchot Institute for Conservation, the Park participated in a voluntary assessment under the Forest Stewardship Council certification system to demonstrate and interpret certification as a new chapter in the Park's legacy of conservation stewardship. Third-party certification is one of the fastest-growing new developments in sustainable forestry. The purpose of certification programs is to provide market recognition of good forest management through credible, independent verification of sustainable forest practices.

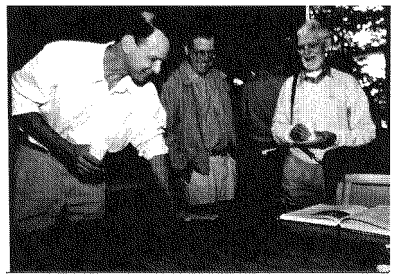
- *Value-Added Products.* As described in Section 3.3.3, value can be added to products through their association with a place, sustainable management, and craftsmanship. To interpret these important connections, the Park is working with Eastern National, the Park's cooperating association, to commission products made from wood harvested on site. Locally crafted items such as bowls and pens are sold at the Park's visitor center bookstore. Wood from Mount Tom has also been used visitor center furniture, rehabilitating historic buildings, and Park maintenance projects.

- *Integrated Pest Management.* In accordance with NPS Management Policies, the Park is developing and implementing an integrated pest management (IPM) program to reduce risks to the public, Park resources, and the environment from pests and pest-related management strategies.[64] IPM is a decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage by cost-effective means, while posing the least possible risk to people, resources, and the environment. Chemical and biological controls are only used when other available options are either not acceptable or not feasible. Additionally, all pesticide treatments (as defined by the Federal Insecticide, Fungicide and Rodenticide Act) are reviewed by the NPS Northeast Region IPM Coordinator, and all pesticide use at the Park is reported annually.

- *Crop Tree Release Demonstration Site.* A demonstration site was created to exhibit crop tree management techniques for enhancing the growth of selected forest trees, and improving wildlife habitat, recreational opportunities, and forest aesthetics. The demonstration site was developed through a public workshop held in cooperation with the USDA Forest Service and Vermont Department of Forests, Parks, and Recreation. The growth of the crop trees is annually measured to evaluate the effectiveness of the treatment.

- *Carriage Road Rehabilitation.* Annual work on the carriage roads maintains and enhances ditches, water bars, culverts, and retaining walls to stabilize the roads, prevent erosion, and maintain good drainage.





Top: Visitor center furniture made from wood from Mount Tom; bottom, local craftsmen discuss the art of their trade with visitors during the installation of the visitor center furniture (MABI 2000).

4.4 EDUCATION AND INTERPRETATION

4.4.1 A TRADITION OF LEARNING FROM MOUNT TOM

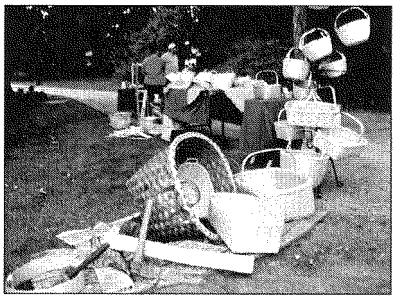
From Marsh's time forward, Mount Tom has been a place of exploration, demonstration, and contemplation. As a boy, Marsh explored the slopes of Mount Tom, learning about ecological concepts such as watersheds and identifying local flora. When Frederick Billings began his ambitious forestry program, he invited the public to explore the estate and examine his reforestation techniques in hopes of informing and inspiring them to practice similar stewardship efforts on their lands. The Billings women—Frederick's wife Julia and daughters Laura, Elizabeth, and Mary Montagu—continued in his tradition, drawing upon and demonstrating best forest management practices and encouraging the public to explore the

"I sat on a little stool between my father's knees in the two-wheeled chaise he always drove. To my mind the whole earth spread out before me. My father pointed out the most striking trees as we passed them and told me how to distinguish their varieties. I do not think I ever afterward failed to know one forest tree from another... What struck me, perhaps most of all, he stopped his horse on top of a steep hill, bade me notice how the water there flowed in different directions, and told me such a point was called a watershed. I never forgot the word, or any part of my father's talk that day."

Caroline Crane Marsh's *Life and Letters of George Perkins Marsh*

Forest. Elizabeth Billings was also a skilled naturalist. She established several gardens of ferns, mushrooms, trees, and herbaceous plants that were a sampling of local biodiversity and a study of non-native flora. Elizabeth also commissioned a biological inventory of all plants within a 6-mile radius of Woodstock. Together, she and botanist Elsie Kittredge studied and collected samples of nearly 1,500 plant species that inhabited Mount Tom and the surrounding area. Mary and Laurance S. Rockefeller continued the tradition of encouraging the public to explore and learn about the Forest. During the Rockefeller tenure, demonstrations of best forestry practices continued, including the Forest's enrollment as Vemont's first Tree Farm in 1953 and conducting a demonstration project with the Vermont Agency of Natural Resources on cabling skidding in the 1980s. The Rockefeller's consulting forester, John Wiggin, also established a native wildflower garden and interpretive brochure for local residents and visitors to learn about local biodiversity.

4.4.2 THE MOUNT TOM FOREST AS A LEARNING LABORATORY TODAY



From top: Participants with Biltmore sticks during Forest for Every Classroom (MABI 2001); baskets on display during the Forest Festival Weekend (MABI 2002); ranger-led hike passing the French Lot (MABI 1999).

The Park seeks to continue the tradition of education on Mount Tom and to strengthen the human commitment to stewardship by engaging in educational initiatives and resource management activities that tell the evolving story of conservation; demonstrate sustainable forest management; and encourage reflection, dialogue, and lifelong learning.[65] To accomplish this, the Park has developed a number of place-based education and interpretive programs to connect the Forest to the personal lives of its many audiences. Example programs include:

- *A Forest for Every Classroom (FFEC).* FFEC is a professional-development program for educators focused on place-based education. Teachers who participate in FFEC develop curricula that foster student understanding and appreciation of their communities' public lands and forest resources. The teacher-developed curricula integrate hands-on natural and cultural explorations that address concepts in ecology, sense of place, stewardship, and civics. At the heart of the FFEC program is the belief that students who are immersed in the interdisciplinary study of their own "place" are more eager to learn and be involved in the stewardship of their communities and public lands. Many of the teachers study the Mount Tom Forest as part of the training, and then bring their students for field visits as part of the curriculum that they create.

- *Forest Festival Weekend.* This is an annual event that includes two full days of workshops, walks, and demonstrations that explore the multi-faceted nature of the Forest. Presentations have included: reading the landscape using clues from the past; natural history of wood; woodcraft demonstrations; drawing and dendrology for children; and a walk with the County Forester.

- *The Paths Less Traveled.* Every season from May to October, the Park offers a series of ranger-led hikes on topics that range from land use change, the history of forest management, wildflower and invasive plant

identification, environmental values, conservation and art, to the writings of George Perkins Marsh.

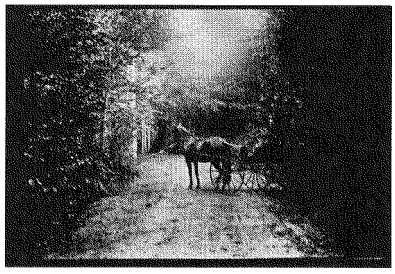
- *Working Woodlands.* In cooperation with the USDA Forest Service State and Private Forestry, the Vermont Agency of Natural Resources, and other organizations, the Park offers a series of education workshops on sustainable forest management practices for landowners and professionals.

Invasive plants workshop offered as part of the Working Woodlands series. (MABI 2005)

4.5 VISITOR USE AND RECREATION

4.5.1 A TRADITION OF RECREATIONAL ENJOYMENT

Recreation has always been an important aspect of the property's history. Frederick Billings designed the carriage road system to accommodate day-to-day forest management activities and serve as a scenic drive for himself and the community. The carriage roads also filled an even more important stewardship objective for Billings. With them, Billings encouraged the public to explore his estate and learn about practices in scientific forestry and farming that could be used to improve their own lands, restoring their appearance, environmental stability, and profitability.



Nellie Warren Kidder, a Billings family friend, driving on the Mount Tom carriage roads, c.1887-96. (Album 26, Billings Family Archives)

Since the 1870s, the roads and trails of Mount Tom have been open for the public to enjoy walking, horseback riding, and carriage drives. During the 1970s, the trail network was expanded and groomed during the winter by the Woodstock Resort Corporation for cross-country skiing and snowshoeing.

4.5.2 PROVIDING DIVERSE RECREATIONAL EXPERIENCES

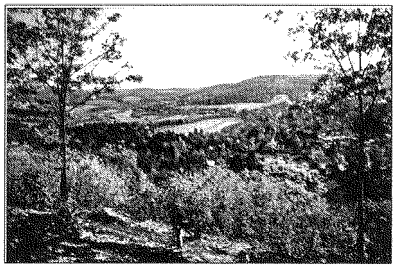
The Park's carriage roads and trails are open to free public access from dawn to dusk. During winter months, the carriage roads and many of the trails are part of a wider network of cross-country skiing trails, operated under easement by the Woodstock Resort Corporation and open to the public for a fee.

Since the Park's opening in 1998, visitation to the Park has increased from approximately 18,000 to almost 50,000 visitors a year.[66] According to the Woodstock Chamber of Commerce, an estimated 400,000 to 500,000 people visit the town each year. Visitors to Woodstock are typically interested in places of historical or cultural value and opportunities for outdoor recreation.
When the property passed to the National Park Service in 1992, recreational activities permissible under the conditions of the deed were identified. These include cross-country skiing, snowshoeing, hiking, horseback riding, and associated activities such as nature/wildlife observation. In accordance with the deed, motorized vehicles (except for Park use), hunting, biking, fishing, swimming, camping, and campfires are prohibited.

Top, hikers on the main carriage road (OCLP 2003); bottom, equestrian on the South Peak Road (MABI 2003).

4.6 Watershed and Community Connections

4.6.1 RECREATIONAL CONNECTIONS



From top: View east of Woodstock from Mount Tom (MABI 2003); view south from the West Ridge (OCLP 2003).

One of the main carriage roads and several historic footpaths connect the National Historical Park lands to the summits of Mount Tom located in the Billings Park, a town-owned forest. Billings Park, once part of the original Billings Estate, was gifted to the town of Woodstock by Mary Montagu Billings French in the 1950s.

These and other Park roads and trails are part of a community-wide system of trails and sidewalks that extend to the south and connect to Woodstock village and Mount Peg. On the Park's eastern border, a recreational path is planned to connect village sidewalks and to areas north of town, such as the Mount Tom Farmers Market and Spectrum Teen Center.

4.6.2 ECOLOGICAL CONNECTIONS

Located in the Vermont Piedmont, the Mount Tom Forest is within the Ottauquechee River Watershed, a major tributary of the Connecticut River. Most of the surface water in the Forest collects in the Pogue Stream, flowing east into Barnard Brook, then south into the Ottauquechee. Water flowing from the southern slopes of Mount Tom descends by small streams through the Billings Park and directly into the Ottauquechee. Large areas of contiguous forest lie to the west of the Park. The area has been identified as significant wildlife habitat by the Chateauguay No Town Conservation Project (a public-private partnership focused on the conservation of over 60,000 acres in the towns of Barnard, Bridgewater, Killington, and Stockbridge) and as important bear habitat for southern Vermont by the Vermont Department of Fish and Wildlife.

"Mr. Billings' drive to the summit of Mt. Tom is nearly completed, and is a surprise to everybody by reason of its easy grade. From the point where it leaves the "Pogue Hole" road, in the field a little way above the woods, to the summit a team may trot every rod, and a portion of the way one passing over it seems almost suspended in air. The outlook is grand. The road is so broad that teams may pass each other at any point and it is to be graveled and made first-class. Only think what an attraction this is to be to Woodstock! Though a private enterprise, the public are permitted to enjoy it freely."

Vermont Standard, September 1, 1887

4.6.3 SCENIC CONNECTIONS

The Park is a unique visual resource for the Woodstock area from a number of different vantage points. Viewed from the surrounding roads and overlooks from other public lands, the distinct patchwork of plantations and hardwoods offers a marked contrast from the surrounding hardwood and mixed forests, especially during the height of fall foliage color. Within the Park, the carriage road system and associated vistas offer a diversity of views to the surrounding forests and fields and the village of Woodstock.

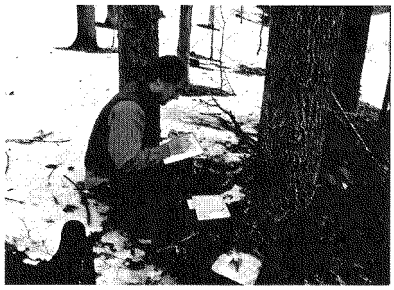
4.6.4 ADJACENT LANDS

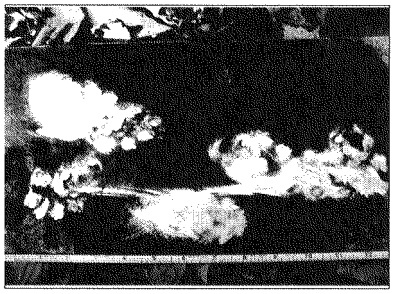
The Park lies between Route 12 to the north and Route 4 to the south. Between the Park and these major roads is a mix of public lands, private forest, agricultural

fields, and residential areas. The Park's western border is defined by Prosper Road, a town dirt road. The King Farm, owned by the Vermont Land Trust, abuts the Park along the southwestern border and includes a working farm and forest on its protected lands. The Billings Park, as mentioned in Section 4.6.1 above, abuts the Park along the southeastern border.

4.7 ADAPTIVE MANAGEMENT

Adaptive management is an approach to Park stewardship that bridges the gaps between management objectives and actions, unanticipated changes in the environment or organizational operations, and the development of new knowledge and best management practices. At its basic level, adaptive management is a process for the continual improvement of Park management based on monitoring and evaluation. Therefore, an important part of adaptive management is an inventory and monitoring program that identifies changes in Park resource conditions.





From top: collecting mammal inventory data (MABI 2004); fisher tracks from NETN mammal inventory (MABI 2004); UVM field team establishing long-term forest monitoring plot (Keeton 2004).

The first step in adaptive management is to develop a strong set of baseline inventories. Several baseline inventories have been conducted for the Park, including cultural resources (i.e., land use history, cultural landscape reports), natural resources (including birds, reptiles and amphibians, bats, natural communities, silvicultural conditions, invasive plants, and water quality), and visitor use surveys. Together, these studies provide the foundation for developing an effective adaptive management program for the Park.

The NPS Northeast Temperate Network Inventory and Monitoring Program (NETN), an initiative of the NPS Natural Resource Challenge, was created to design and implement ecological monitoring programs in eleven parks throughout the Northeast. The NETN is currently developing monitoring protocols for vital signs related to forest health, water quality, climate, etc. (see Appendix B). The Park will continue to work with NETN to integrate network-wide vital signs into the Park adaptive management framework.

Anticipating the importance of monitoring for forest management, the Park also established a long-term forest dynamic monitoring program in cooperation with the University of Vermont's School of Natural Resources. The program established sixty-four permanent plots throughout the Forest to assess successional dynamics and structural changes associated with forest stand development. The program measures a wide range of indicators, including: size class distribution and dominance, mortality processes and self-thinning, compositional dynamics and regeneration demography, deer browse impacts, crown condition, forest diseases, regeneration trends, vertical structure, downed coarse woody debris, dead tree structure, understory plant assemblages, and legacy trees.[67] Three years of baseline data have been collected through this

program thus far, and the results already have been valuable in informing forest management planning. The Park will work with cooperators to reassess these plots approximately every five years to continue to chart changes in forest development.

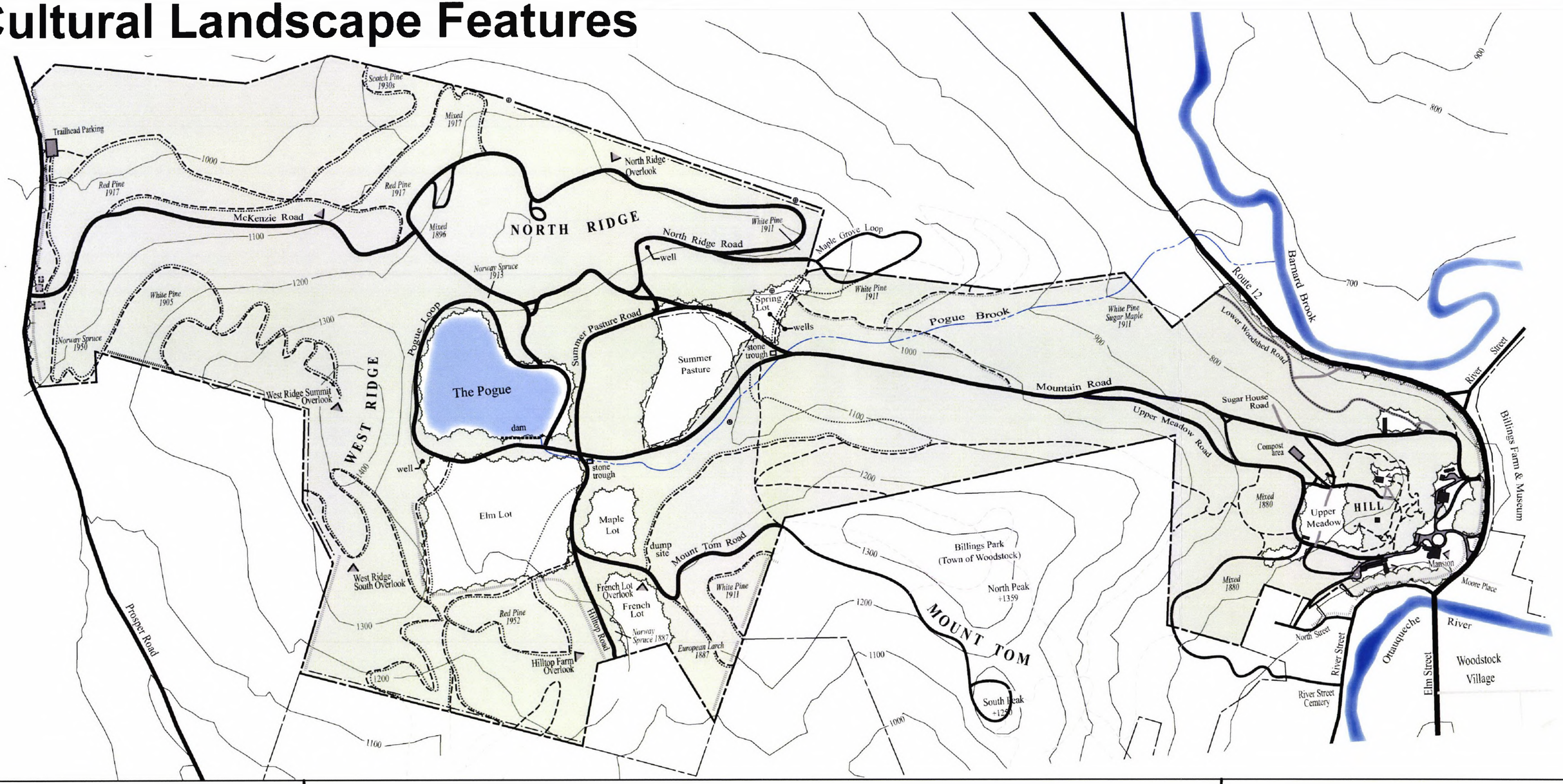
In addition to the long-term forest dynamic monitoring program, the Park is developing a program to reassess stand inventories and forest health in each stand at intervals of approximately every five years. This program will monitor the presence and impacts of native and non-native pests and pathogens, and assess standard silvicultural metrics including stocking levels, basal area, trees/acre, regeneration, coarse woody debris, and other parameters on a stand-by-stand basis.

Endnotes to Part 4

[1] The Forest's significance and integrity was assessed in a Cultural Landscape Report for the Forest, Site History (Wilkes et al. 2000) and Analysis (OCLP 2005 draft); Cultural Landscape Inventory (OCLP 2005 draft); Cultural Landscape Report for the Mansion Grounds (Auwaerter and Curry 2005 draft); historic context study on Billings' involvement in forestry (Nadenicek 2003 draft).
[2] The Rockefellers did, however, continue the tradition of establishing new plantations on abandoned agricultural lands that were part of other properties they owned in the area.
[3] NPS 1998.
[4] University of Vermont Consulting Archeology Program (UVM CAP) 2005 Draft.
[5] UVM CAP 2005 draft.
[6] NPS 1998, 181.
[7] As outlined in the Park's GMP and established in the deed that conveyed the property to the NPS, some long-standing uses of the property by local residents [e.g., hunting, fishing, camping, campfires, mountain biking, and swimming] are prohibited.
[8] NPS 1999, 51.
[9] Lautzenheiser 2002.
[10] Lautzenheiser 2002.
[11] Lautzenheiser 2002.
[12] Thompson and Sorenson 2000; Lautzenheiser 2002.
[13] Thompson and Sorenson 2000.
[14] NRCS 2004.
[15] Hughes and Cass 1997.
[16] Hughes and Cass 1997; USDA Forest Service 2004; NPS 2005 draft.
[17] NPS 2005 draft.
[18] Keeton 2005.
[19] Keeton 2005.
[20] USDA Forest Service 2004. The B-line is defined as the suggested residual stocking following a thinning, and it varies depending on the stocking chart for the species or species group being considered (e.g., larch, northern hardwood). Stocking charts are developed by the USDA Forest Service for silvicultural applications.
[21] Keeton 2005.
[22] USDA Forest Service 2004.
[23] Keeton 2005.
[24] Average annual net growth is defined as the new growth minus mortality and trees that become classified as culls over year-long period; it is normally expressed in terms of volume (e.g., board feet, cords, or cubic meters). USDA Forest Service 2005.
[25] Keeton 2005.

[26] Yield is forest mensuration estimate of the amount of wood that may be harvested from a particular type of forest stand by species, site, stocking, and management regime at various ages; allowable cut is the amount of wood that may be harvested during a given period in a sustained yield forest management approach (Helms 1998).
[27] Keeton 2005; Hunter 1999; Franklin et al. 2002.
[28] Evans et al. 1993.
[29] Keeton 2005.
[30] Hunter 1999; DeGraaff and Yamasaki, 2001; Franklin et al. 2002.
[31] Keeton 2005.
[32] Hunter 1999.
[33] Van Diver 1987; Doll 1969.
[34] NPS 1999; Hydric soils are described in the Windsor County Soils Data (NRCS 2004).
[35] Ferris and Chapman 2000.
[36] Lautzenheiser 2002, NPS 1999.
[37] Faccio 2001.
[38] VCGI 2005.
[39] Lautzenheiser 2002.
[40] Therres 1995.
[41] Faccio 2003; Vermont Department of Fish and Wildlife 2000.
[42] Reynolds and McFarland 2001.
[43] Vermont Department of Fish and Wildlife 1997.
[44] Keeton 2005.
[45] Mather et al. 2005.
[46] Keeton 2005.
[47] Keeton 2005; Curtins 1997; Franklin et al. 1997.
[48] NPS 1999; Vermont State Climate Office–ARSCO (http://www.uvm.edu/~ldupigny/sc).
[49] Keeton 2005.
[50] Keeton 2005; Gavin and Peart 1993.
[51] Machin et al. 2005.
[52] Foster and Aber 2004; Thompson and Sorenson 2000.
[53] Aber 2000.
[54] Everson et al. 1993.
[55] Dana 1889.
[56] Boose et al. 2001.
[57] Boose et al. 2001.
[58] Foster and Aber 2004.
[59] Foster and Aber 2004.
[60] Shriver et al. 2004.
[61] Shriver et al. 2004.
[62] Shriver et al. 2004.
[63] Shriver et al. 2004.
[64] NPS 2001.
[65] NPS 2003.
[66] NPS 2005.
[67] Keeton 2005.

Cultural Landscape Features



N
W E
S

0 250 500 1,000 1,500 2,000 Feet

Produced by
OCLP/SUNY, Cultural Landscape Inventory

- 100' Contour
- NPS Property Line (park boundary)
- Non-NPS Property Line
- Fence
- Stone wall
- NPS Road
- Non-NPS Road
- NPS Foot or Bridal Trail
- Non-NPS Foot or Bridal Trail
- X-C Ski Trail Easement
- Forest
- *European Larch 1887* — General Location of Historic Plantation Stand
- Building/Structure
- Stone property marker
- View/Vista

Cultural Landscape Features

Data Sources:
Cultural Landscape Inventory (OCLP/SUNY, 2005, draft); Marsh-Billings-Rockefeller National Historical Park map (NPS Harper's Ferry Design Center, c.1998); Cultural Landscape Report for the Forest (UVM, 2000) and Cultural Landscape Report for the Mansion Grounds (SUNY, 2002); Ski-Trail Easement Survey (Bruno Associates, 1992); Historic American Landscape Survey (2002)

All digital data layers are represented in Nad 83, UTM Zone 18N

This map should be used for planning purposes only and is not intended to be interpreted as an engineered plan. Data layers may change due to updates and edits.

November 2005

Marsh-Billings-Rockefeller National Historical Park
Vermont

National Park Service
U.S. Department of the Interior

Existing Natural Communities

The Pogue

N

0 250 500 1,000 1,500 2,000 Feet

Produced by
Marsh-Billings-Rockefeller National Historical Park

- Pogue
- Grounds/Fields/Other
- Orchard
- Plantation
- Temperate Calcareous Outcrop
- Cliff
- Hemlock Forest
- Hemlock-Northern Hardwood Forest
- Hemlock-Red Oak Forest
- Northern Hardwood Forest
- Rich Northern Hardwood Forest
- Northern Hardwood Limestone Forest
- Sugar Maple-White Ash-Jack-in-the-Pulpit
- Dry Oak Forest
- Red Maple-Black Ash Swamp
- Red or Silver Maple-Green Ash Swamp
- Hemlock Swamp
- Seeps

Natural Communities: Existing Communities

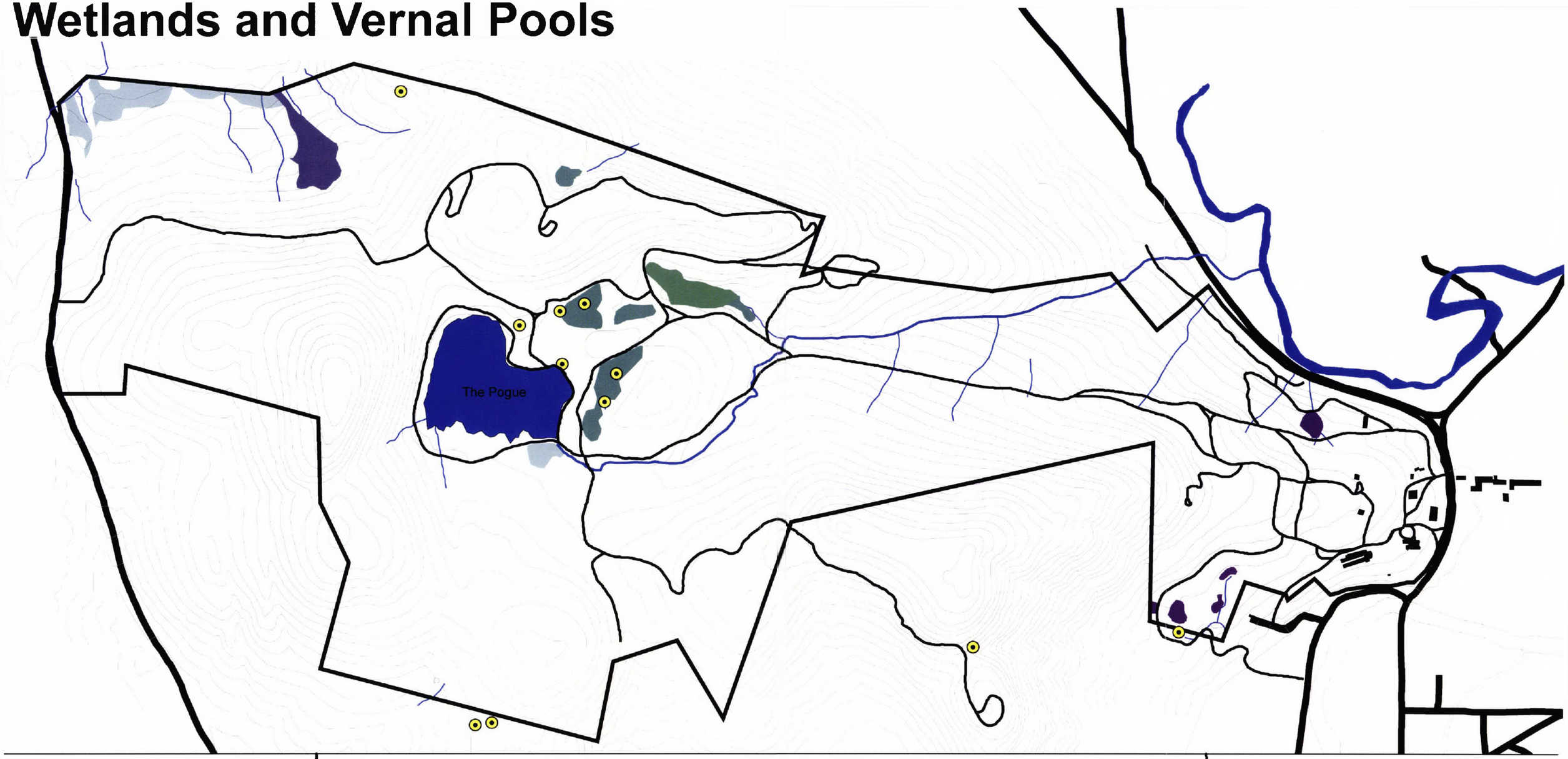
Data Source: USFS Forest Stands, USFS Carriage Roads: USFS 2003
Streams, Forest stands (newstands), Natural Communities data set 2002
Surface waters: TRORC 1:5000 orthophotography
Roads: TRORC 1:5000 orthophotography

All digital data layers are represented in Nad 83, UTM Zone 18N

This map should be used for planning purposes only
and is not intended to be interpreted as an engineered plan
Data layers may change due to updates and edits

November 2005

Wetlands and Vernal Pools



N

0 250 500 1,000 1,500 2,000 Feet

Produced by
Marsh-Billings-Rockefeller National Historical Park

- Ottauquechee River
- Pogue
- Pogue Stream and Seeps
- Park Boundary
- Structures
- Carriage Roads
- Town and State Roads
- 20' contours
- Red Maple-Black Ash Swamp
- Red or Silver Maple-Green Ash Swamp
- Hemlock Swamp
- Seeps
- Vernal pools

Wetlands, Vernal Pools, and Seeps

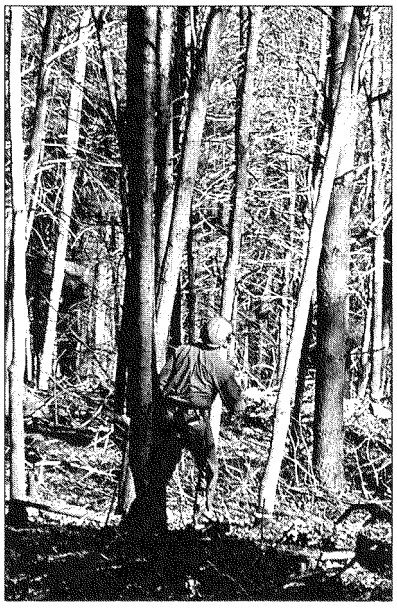
Data Source: USFS Forest Stands, USFS Carriage Roads: USFS 2003
Streams, Forest stands (newstands): Natural Communities data set 2002
Surface waters: TRORC 1:5000 orthophotography
Roads: TRORC 1:5000 orthophotography, Vernal Pools: VINS-HERPS
All digital data layers are represented in Nad 83, UTM Zone 18N

This map should be used for planning purposes only
and is not intended to be interpreted as an engineered plan.
Data layers may change due to updates and edits.

November 2005

(MABI 2002)

PART 5: POTENTIAL EFFECTS OF THE ALTERNATIVES



Part 5: Potential Effects of the Alternatives

This chapter examines the potential effects on Park resources of the four alternatives described in Section 3.2. The National Environmental Policy Act (NEPA) requires all federal agencies to analyze the potential environmental impacts of proposed federal actions, and to identify any adverse environmental effects that cannot be avoided should the proposed action be implemented. This analysis provides the basis for comparing the alternatives.

First, a brief description of methods and definitions used in the analysis is provided in Section 5.1. In Section 5.2, the effects of the alternatives on Park resources are summarized in a table. These effects then are described in greater detail in Sections 5.3 through 5.8. In both the table and the subsequent narrative description, effects on the key integrated landscape features identified in Section 2.2 are addressed first. Then the effects on other Park attributes are analyzed, including cultural resources, natural resources, sustainable management practices, education and interpretation, and visitor use and community connections.

Section 5.9 addresses other topics that were not analyzed in detail because they either do not exist at the Park or they would not be affected by any of the four alternatives. Potential cumulative effects on Park resources from the alternatives and other unrelated actions are described in Section 5.10, and the topic of potential impairment of those resources under any of the alternatives is addressed in Section 5.11. Part 5 concludes with the identification of the environmentally preferred and NPS-preferred alternatives in Sections 5.12 and 5.13.

In addition to the analysis for NEPA, Section 106 of the National Historic Preservation Act (NHPA) also requires analysis of effects on cultural resources. This is provided in Section 5.3, which will be reviewed with the Vermont State Historic Preservation Office through the development of a programmatic agreement.

From top: Logging with horses (J. Roberts 2004); forest dynamic monitoring plot (MABI 2001); field work during Trails Workshop (Chuck Wise 2004); crop tree workshop (MABI 1999).

5.1 METHODS AND DEFINITIONS

In accordance with the National Environmental Policy Act and NPS policies, the potential effects of the four alternatives on relevant aspects of the human environment were analyzed. Altogether, potential effects were considered for twenty-seven specific topics related to the resources and management of the Mount Tom Forest. These topics were identified as priorities for analysis by the planning team during the scoping phase and the refinement of the management alternatives. An additional six topics were considered but ultimately dismissed from detailed analysis (see Section 5.9). The impact analysis and conclusions were based on Park-specific resource inventories and studies; review of other relevant literature; information provided by professionals from other National Park Service offices and other agencies and organizations; and the planning team's interdisciplinary knowledge and experience.

For the purpose of the analysis, the following five definitions were used:

Intensity:

- Negligible: Impact to the resource is barely perceptible or not measurable, and confined to a small area.
- Minor: Impact to the resource or discipline is perceptible or measurable, but it is localized.
- Moderate: Impact is clearly detectable and could have appreciable effect on the resource or discipline.
- Major: Impact would have a substantial, highly noticeable influence on the resource or discipline.

Impact Type:

- Beneficial: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.
- Adverse: A change that moves the resource away from a desired condition or detracts from its appearance or condition.

Duration of Effect:

- Short-term: Impacts that would be less than five years in duration.
- Mid-term: Impacts that would last approximately fifteen to twenty years.
- Long-term: Impacts that would be more than twentyyears in duration.

Cumulative effects:

The collective impacts to a particular resource from the combination of the incremental impact of a particular action and the impacts from other past, present, and reasonably foreseeable future actions.

Impairment:

An impact so severe that, in the professional judgment of a responsible NPS manager, it would harm the integrity of park resources or values and violate the 1916 NPS Organic Act.[1]

5.2 Summary of Potential Effects of the Alternatives

Table 5
Summary of the Potential Effects of the Alternatives

	Alternative A **Continue current management**	*Alternative B* **Adopt a "replacement-in-kind" approach to historic preservation**	*Alternative C* **Continue the tradition of applying the best current thinking and practice in forest management**	*Alternative D (NPS-preferred)* **Recognize and work with ecological change in preserving the historic character of the forest**
Integrated Features				
Landscape Patchwork: Cover Types	Over the long term Alternative A would maintain the general configuration of forest, agricultural fields, and open water.	Same as Alternative A, but some short-term changes in the patchwork character when areas are cleared to reestablish plantations.	Same as Alternative A, but a small portion of the Maple Lot would be reforested to expand the forested buffer along the Pogue Stream.	Same as Alternative C.
Landscape Patchwork: Forest Stand Types	Over the long term, the diversity of stand types would decrease as plantations and early-successional forest stands transition to native forest dominated by later-successional, native hardwood and mixed forest stands.	Over the long term, the most exact representation of the existing cover types would be retained.	Same as Alternative A, but the change would occur more quickly because of active forest management.	Same as Alternative C, with some aspects of Alternative B because some plantations or portions of plantations would be maintained as long as possible, encouraged to regenerate with conifer species, or replanted.
Forest Architecture: Stand Age, Structure, and Diversity	Over the long term, both plantations and hardwood and mixed forest stands would develop an uneven-aged character and greater diversity.	Over the long term, the most exact representation of the existing forest stand structure and diversity would be maintained.	Same as Alternative A, but the change would occur more quickly because of active forest management.	Same as Alternative C, with some aspects of Alternative B because some plantations or portions of plantations would be maintained as even-aged, single-species, and in other areas even-aged conifer regeneration would be encouraged.
Forest Architecture: Downed Coarse Woody Debris and Snags	In the long term, Alternative A would generate the greatest amount of deadwood throughout the Park.	Current levels and distribution of dead wood throughout the Park would be maintained. Therefore, this alternative would provide the least increase in CWD or snags over the long term.	Over the long term, amounts of CWD and snags would be less than in Alternative A. However, in the short and mid-term, Alternative C would create the greatest amount of deadwood because harvesting would generate more CWD that would be left to decay.	Over the long term, amounts of CWD and snags would be similar to Alternative C. However, CWD along some segments of the carriage roads would be removed, and a higher number of snags would be retained in forest stands.
Legacy Trees	Over the long term, Alternative A would create the greatest abundance and distribution of legacy trees with old-growth characteristics. However, legacy trees associated with the designed characteristics of the Forest would be lost.	The overall diversity, abundance, and relative distribution of the legacy trees of both cultural and ecological value would be comparable to what currently exists.	Alternative C would have the fewest legacy trees because active forest management would encourage the removal of most mature, well-formed trees.	Over the long term, Alternative D would create the greatest diversity and abundance of legacy trees of both cultural and ecological value.

TABLE 5
SUMMARY OF THE POTENTIAL EFFECTS OF THE ALTERNATIVES

	Alternative A Continue current management	*Alternative B* Adopt a "replacement-in-kind" approach to historic preservation	*Alternative C* Continue the tradition of applying the best current thinking and practice in forest management	*Alternative D (NPS-preferred)* Recognize and work with ecological change in preserving the historic character of the forest
Cultural Resources				
Cultural Landscapes	Alternative A would have a major adverse effect on cultural landscape resources and a Section 106 determination of adverse effect.	Alternative B would have moderate beneficial effects on cultural landscape resources and a Section 106 determination of no adverse effect.	Alternative C would have a moderate adverse effect on cultural landscape resources and a Section 106 determination of adverse effect.	Alternative D would have a minor beneficial effect on cultural landscape resources and a Section 106 determination of no adverse effect.
Archeological Resources	None of the alternatives would negatively affect archeological resources.			
Ethnographic Resources	None of the alternatives would negatively affect ethnographical resources.			
Natural Resources				
Soils	Alternative A would have negligible effects on soil resources.	Alternative B would have the potential to cause moderate adverse effects on soil resources in the long term. Mitigation measures may need to be extensive and might not be successful.	Alternative C would have the potential for causing minor adverse effects. These impacts could be easily mitigated if the best management practices outlined in Appendix C are implemented.	Same as Alternative C
Water Resources and Wetlands	Alternative A would have negligible effects on water and wetland resources.	Alternative B would have the potential to cause moderate, adverse effects on water and wetland resources in the long term. Mitigation measures may need to be extensive and might not be successful.	Alternative C would have the potential to cause minor adverse effects. These impacts could be easily mitigated if the best management practices outlined in Appendix C are implemented.	Same as Alternative C.
Wildlife: Species of Concern	None of the alternatives would negatively affect wildlife species of concern.			
Wildlife: Reptiles and Amphibians	Alternative A would provide moderate beneficial impacts to reptile and amphibian habitat and populations in the long term.	Alternative B is unlikely to have any noticeable impact on reptile and amphibian habitats or populations over the long term.	Same as Alternative A, although some potential minor impacts from soil compaction.	Alternative D would provide beneficial impacts to reptile and amphibian populations, but to a lesser extent than Alternatives A and C.
Wildlife: Birds	Alternative A would provide moderate beneficial impacts to the greatest number of bird species in the long term.	Alternative B is unlikely to have any noticeable impact on bird populations over the long term.	Alternative C would provide moderate beneficial impacts to bird species that require cavities for nesting, forest interior, and edge habitats. Alternative C would also provide some early-successional habitat that is absent from the other alternatives.	Same as Alternative C, except Alternative D would not create any additional early-successional habitat.
Wildlife: Mammals	Alternative A would provide moderate beneficial impacts to mammal populations over the long term.	Alternative B is unlikely to have any noticeable impact on mammal populations over the long term.	Same as Alternative A, but Alternative C would begin to provide these beneficial impacts in the short and mid-term.	Same as Alternative C, but to a lesser extent because some plantation areas would be retained.

Table 5
Summary of the Potential Effects of the Alternatives

	Alternative A Continue current management	*Alternative B* Adopt a "replacement-in-kind" approach to historic preservation	*Alternative C* Continue the tradition of applying the best current thinking and practice in forest management	*Alternative D (NPS-preferred)* Recognize and work with ecological change in preserving the historic character of the forest
Wildlife: Fish	None of the alternatives would negatively impact fish populations at the Park.			
Vegetation: Natural Communities	Alternative A would have the greatest beneficial impacts on the development of natural communities to their full potential.	Alternative B would not provide any noticeable beneficial impacts to natural community development.	Similar to Alternative A, but to a lesser extent because some natural communities may not develop to their full potential.	Same as Alternative C, but to a lesser extent because some plantation areas would be retained.
Vegetation: Native Plant Species of Special Concern	Alternative A would have moderate beneficial impacts on habitat associated with native plant species of special concern over the long term.	Alternative B would be unlikely to have any noticeable impact on native plant species of concern over the long term.	Alternative C would have minor beneficial impacts on habitat associated with native plant species of special concern over the long term.	Same as Alternative C.
Vegetation: Invasive Exotic Plant Species of Concern	Alternative A would have the least potential for increasing invasive plant introduction and distribution.	Alternative B would have the greatest potential to increase invasive plant introduction and distribution. These effects would be moderate. They could be mitigated using invasive plant treatments but the treatments would need to be extensive, would likely require the use of chemical herbicides, and might not always be successful.	Alternative C would have some potential to increase invasive plant introduction and distribution, but the effects would be minor and could be mitigated through mechanical treatments.	Same as Alternative C.
Forest Pests and Pathogens	Alternative A would increase the Forest's resilience to impacts from forest pests and pathogens, and would not increase potential introductions of pests and pathogens.	Alternative B would have the greatest vulnerability to pest and pathogens, and the greatest increase in potential introductions of pests and pathogens. Mitigation measures would likely require extensive use of pesticides, and might not always be successful	Same as Alternative A.	Alternative D would provide the greatest increase in the Forest's resilience to pests and pathogens, and only a minor increased potential for introduction of pest and pathogens. Mitigation measures under this alternative would likely not involve extensive use of pesticides, and would likely be successful.
Natural Disturbances: Fire	Alternative A has the potential to create the greatest vulnerability of the Forest to wildland fires.	Alternative B would have no change on the Forest's vulnerability to wildland fires.	Alternative C would have the potential to increase the Park's vulnerability to wildland fires, but the increases would be minor and could be easily mitigated.	Same as Alternative C.
Natural Disturbances: Weather Events (wind, ice, and snow)	Alternative A would increase the Forest's resilience to impacts from weather events.	Alternative B would have the least degree of overall resilience to, and greatest potential of catastrophic loss from, weather events.	Same as Alternative A.	Alternative D would provide the greatest increase in the Forest's resilience to impacts from natural disturbances.

TABLE 5
SUMMARY OF THE POTENTIAL EFFECTS OF THE ALTERNATIVES

	Alternative A Continue current management	*Alternative B* Adopt a "replacement-in-kind" approach to historic preservation	*Alternative C* Continue the tradition of applying the best current thinking and practice in forest management	*Alternative D (NPS-preferred)* Recognize and work with ecological change in preserving the historic character of the forest
Sustainable Management Practices				
Integrated Pest Management: Herbicide Use	Alternative A would likely require minimal herbicide treatments.	Alternative B would require the greatest use of herbicides.	Same as Alternative A.	Alternative D could require limited applications of herbicides in some small-scale areas, but this could likely be avoided by using mechanical treatment instead and in any case would be to a much lesser extent than Alternative B.
Relationship with the Local Forest Economy and Opportunities for Value-Added Products	Alternative A would offer limited opportunities to contribute to value-added product markets and would require minimal involvement of skilled forestry professionals and laborers to implement.	Alternative B would have a greater emphasis on growing softwoods, which would have less opportunity to contribute to local value-added markets, and would require extensive use of forestry work crews.	Alternative C would offer the greatest emphasis on hardwood value-added markets, and would require a diversity of skilled forestry professionals and laborers to implement.	Alternative D would contribute to the greatest diversity of value-added markets than any of the alternatives, and would require a diversity of skilled forestry professionals and laborers to implement.
Financial Sustainability of Forestry Operations	Alternative A would be the least costly to implement	Alternative B would be the most costly of the alternatives to implement and would be unsustainable with the Park's current budgets.	Alternative C would be less costly to implement than Alternative B and would be able to be sustained with the Park's current budgets.	Same as Alternative C.
Effects on Education and Interpretation				
Education and Interpretation Opportunities	Alternative A would provide the fewest opportunities to offer interpretive and education programs related to the Park's mission.	Alternative B would favor interpretation of the history of forest stewardship, but would offer few opportunities to demonstrate contemporary forest practices.	Alternative C would favor the demonstration of contemporary forest practices, but would offer limited opportunities to interpret the history of forest stewardship.	Alternative D would create the greatest diversity of learning opportunities related to the Park's mission.
Effects on Visitor Use and Community Considerations				
Public Access and Recreation	There would be no impacts on recreational uses under Alternative A.	Alternative B would have minor impacts on recreational activities. However, these impacts would be short-term, would only impact small areas in the Park at any one time, and would not restrict the overall use of the Park for any of the permissible recreational activities.	Same as Alternative B.	Same as Alternative B.
Visual Experience	Alternative A would reduce the overall visual diversity of the Forest and would create higher levels of slash throughout the Forest, which could be considered a minor negative visual impact.	Alternative B would maintain the existing visual diversity, but would have major visual impacts when plantations need to be cleared and replanted.	Same as Alternative A.	Alternative D would retain the greatest visual diversity and offer the least visual impacts of the alternatives.

Table 5
Summary of the Potential Effects of the Alternatives

	Alternative A Continue current management	*Alternative B* Adopt a "replacement-in-kind" approach to historic preservation	*Alternative C* Continue the tradition of applying the best current thinking and practice in forest management	*Alternative D (NPS-preferred)* Recognize and work with ecological change in preserving the historic character of the forest
Soundscapes	Alternative A would have a negligible increase in noise.	Under Alternative B, increase in noise due to forest management activities would be occasional, intermittent, and last for relatively short periods of time. This would result in a minor impact on the soundscapes of the Forest and adjacent areas.	Same as Alternative B.	Same as Alternative B.

5.3 Effects on Integrated Features

As discussed in Section 2.2, there are several key features of the Mount Tom Forest that reflect the influence of both human management and natural processes, and that are integral to both the cultural and ecological integrity of the Park. These features were further described in Sections 4.1 and 4.2. Changes in these "integrated features" could have multiple and diverse effects on other cultural and natural resources at the Park. This section describes how each of the alternatives would influence these integrated features and identifies the specific cultural and natural resources that could be impacted by these changes. The more specific resource impacts are analyzed in Sections 5.4 to 5.8 below.

5.3.1 LANDSCAPE PATCHWORK: COVER TYPES

5.3.1.1 Overview

Cover types describe broad vegetation or land use patterns and include categories such as forest, fields, and open water. The landscape patchwork illustrates the various historical influences that created the Forest, and contributes to the relative abundance and distribution of different animal and plant species.

5.3.1.2 Comparison of Alternatives

Over the long term, all alternatives would maintain the general configuration of forest, agricultural fields, and open water that currently exists. Under Alternative B, there would be some mid-term changes in the patchwork character when plantations are cleared and reestablished. Under Alternatives C and D, a small portion of the Maple Lot bordering the Pogue Stream would be reforested to expand the riparian buffer. The planting would result in a small reduction of the Maple Lot's size at its northern edge over the long term, but would not impact the overall open character of the Lot as experienced from the carriage roads.

5.3.1.3 Effects on Related Resources

See Sections 5.4.2 Cultural Landscape Character, 5.5.1 Soils, and 5.5.5 Wildlife: Birds for more in-depth analysis of the various ways changes in cover types would influence related Park resources.

5.3.2 LANDSCAPE PATCHWORK: FOREST STAND TYPES

5.3.2.1 Overview

Forest stand types describe in more specific terms the composition of the forested portions of the landscape patchwork. The forest type is defined by the species composition within the overstory of the forest stands (e.g., northern hardwood forest, Norway spruce plantation, or mixed hardwood and hemlock forest). The Forest is currently composed of seventeen forest types, organized into over fifty different forest stands for management. From a cultural landscape perspective, the diversity and distribution of the forest types are important for illustrating the history of forest management. From an ecological perspective, maintaining the existing forest type in some cases is difficult because of the processes of aging and natural succession. Additionally, management of even-aged, single-species stands is difficult because they are more prone to insects and disease or may offer less desirable habitat for wildlife.

5.3.2.2 Comparison of Alternatives

Under Alternatives A and C, the diversity of stand types would decrease as plantations and early-successional forest stands begin to transition to native forest dominated by later-successional, native hardwood and conifer species. The transition will occur more rapidly under Alternative C because plantation trees and early-successional native species that are considered mature by silvicultural standards would be harvested and management would favor native species. These changes would accelerate the natural processes of forest succession, creating a more ecologically diverse and resilient forest. However, these changes would also diminish the overall historic character that distinguishes Mount Tom as a nationally significant cultural landscape.

Alternative B would retain the most exact representation of the existing stand types. Stands would be harvested and replanted in order to maintain the existing stand types in their current location and to their fullest extent. This would result in short- to mid-term, periodic changes in stand types as cleared plantation areas become reestablished. Over the long term the historic character would be maintained, but the approach would require intensive control of natural regeneration and invasive plants; may leave the Forest more susceptible to insects, diseases, and catastrophic loss; and would reduce the Forest's ecological diversity and wildlife habitat.

Under Alternative D, there would be some change in forest stand types from plantations and early-successional native forest stands to later-successional native hardwoods, but not to the extent of Alternatives A and C. Some plantations or portions of plantations would be maintained as long as possible, encouraged to regenerate with conifer species, or replanted. In a few stands, there would also be some retention of early-successional species, such as in the area surrounding the McKenzie Farmstead where these species illustrate past human habitation (e.g., black locust). Overall, all existing stand types would continue to be represented, but their size and location would change over time. These changes would sustain a rich representation of historic character while enhancing the Forest's ecological diversity and resilience.

5.3.2.3 Effects on Related Resources

See Sections 5.4.2 Cultural Landscape Character, 5.5.4 Wildlife: Reptiles and Amphibians, 5.5.5 Wildlife: Birds, 5.5.6 Wildlife: Mammals, 5.5.8 Vegetation: Natural Communities, 5.5.9 Vegetation: Native Plant Species of Special Concern, 5.5.11 Forest Pests and Pathogens, 5.5.13 Natural Disturbances: Weather Events (Wind, Ice, and Snow), and 5.6.1 Integrated Pest Management: Pesticide Use for more in-depth analysis of the various ways changes in forest stand types would influence related Park resources.

5.3.3 FOREST ARCHITECTURE: STAND AGE AND STRUCTURAL DIVERSITY

5.3.3.1 Overview

Forest architecture describes the overall composition and structural characteristics of individual stands. Stand structure includes vertical structure (e.g., even or uneven-aged) and the distribution of size classes (e.g., sapling, pole, sawtimber).

Presently, most of the Park's forest stands are even-aged. Even-aged forest stands tend to have uniform canopy heights and trees of relatively the same age (e.g., date planted in the case of plantations, or date of abandonment for natural stands that have reverted from pasture). Some of the plantations, in particular, are noteworthy for their uniform tree age, size, species composition, and planting pattern, which are an important part of the historic character of the Forest. However, as the plantations and even-aged hardwood stands begin to mature and continue to be harvested, they develop uneven-aged stand characteristics and greater structural diversity. In fact, some of the Park's oldest plantations are beginning to develop late-successional stand characteristics that are notable for their complex vertical structure, including a diversity of tree ages and sizes. As these successional changes occur, the historic integrity of the Forest diminishes, while the ecological benefits increase.

Attempting to maintain even-aged stand structure is highly difficult in light of the natural cycle of tree growth and decline, and the underlying forces of forest growth and change. To maintain this structure requires even-aged management techniques such as overstory removals (i.e., "clear-cutting") that are no longer widely used in the northeastern United States due to a variety of factors including the abundance of natural regeneration, ecological impacts of clear-cutting, and the higher value of hardwood species best grown under uneven-aged conditions.

5.3.3.2 Comparison of Alternatives

With its emphasis on uneven-aged management, Alternative C would result in the greatest and fastest change in overall age classes and structural diversity of the stands. This would occur in both plantations and hardwood and mixed forest stands. Uneven-aged management under Alternative C would increase forest stand resilience to natural disturbances, provide for a continuous yield without heavy removals of the overstory, and allow for timber harvesting in a pattern that is similar to natural disturbance. Alternative A would also result in a more uneven-aged forest composition as trees slowly age, die, and are replaced by younger, more shade-tolerant trees of mostly native species. However, this transition will occur at a much slower rate under Alternative A, which is driven by natural process and not active management as in Alternative C. Under Alternatives A and C, the Forest would develop late-successional forest characteristics and provide greater ecological benefits, but it would lose the representation of single-species, even-aged plantings that were the hallmark of early forestry practices.

Alternative B would attempt to maintain the existing structural conditions of the forest stands as the most exact representation of reforestation techniques and the character of even-aged stands that have naturally regenerated on abandoned agricultural lands. While this would be difficult in light of the ecological forces at work, if it was successful there would be no change in the structural condition of the Forest and it would continue to be composed of primarily even-aged stands with the present distribution of size classes. This Alternative would retain the greatest character of early forestry techniques. However, by limiting the Forest's development, it would also limit the potential to demonstrate the evolution of sustainable forest management or enhance ecological diversity.

Under Alternative D, some areas would be maintained as even-aged plantations, and in other areas even-aged conifer regeneration would be encouraged to grow and provide a new overstory. Therefore, this alternative would have less uneven-aged forest than Alternatives A and C, but more than Alternative B. In this way, representations of the even-aged character that currently exists would still exist in the future, but in different locations and over smaller areas. Uneven-aged stands would cover a greater portion of the landscape, making the Forest more diverse and resilient. Overall, the diversity of stand composition and structure would provide illustrations of historical practices while also demonstrating how

a sustainably managed forest could evolve over centuries of management and enhancing ecological conditions.

5.3.3.3 Effects on Related Resources

See Sections 5.4.2 Cultural Landscape Character, 5.5.5 Wildlife: Birds, 5.5.6 Wildlife: Mammals, 5.5.9 Vegetation: Native Plant Species of Special Concern, 5.5.11 Forest Pests and Pathogens, and 5.5.13 Natural Disturbances: Weather Events (Wind, Ice, and Snow) below for more in-depth analysis of the various ways changes in forest stand age and structural diversity would influence related Park resources.

5.3.4 FOREST ARCHITECTURE: DOWNED COARSE WOODY DEBRIS AND SNAGS

5.3.4.1 Overview

Deadwood, which includes downed coarse woody debris and snags (i.e., standing deadwood), are important ecological attributes that provide habitat for a wide range of organisms from bacteria and fungi to cavity-nesting birds and den-dependent mammals (e.g., raccoons, porcupines). Forest assessments indicated that the Forest has a "low" amount of CWD compared to other forests in the region.[2] However, the amount of dead wood in the Forest could impact the cultural landscape character by altering the park-like aesthetic (e.g., views into the forest, well-maintained appearance in the understory).

5.3.4.2 Comparison of Alternatives

Under all of the alternatives the Park would continue to remove snags deemed hazardous to visitor safety in high-use areas, such as the carriage roads. This action represents a continuation of management practices, and therefore would not contribute to changes in the number of snags in the Park relative to current conditions.

However, each Alternative will have different effects on CWD and snags over time. In the long term, Alternative A would generate the greatest amount of CWD and snags because without any active management, large trees would gradually age, decay, and become snags and then eventually CWD. Alternatives C and D would increase CWD levels throughout the Park in the short and long term, because both of these alternatives recognize that retention of deadwood is important to demonstrating best contemporary management practices. Alternative D would limit the type and amount of CWD along some segments of the carriage road corridors in order to maintain a well-kept understory appearance that is important for cultural landscape objectives. However, Alternative D would also create slightly higher numbers of snags in areas where large trees would be retained.

Under Alternative B, CWD and snags would be removed during forest stand treatments and along carriage roads in order to maintain current levels and distribution of deadwood throughout the Park. Therefore, with this alternative there would be no change in CWD or snags over the long term.

5.3.4.3 Effects on Related Resources

See Sections 5.4.2 Cultural Landscape Character, 5.5.4 Wildlife: Reptiles and Amphibians, 5.5.5 Wildlife: Birds, 5.5.6 Wildlife: Mammals, and 5.5.12 Natural Disturbance: Fire for more in-depth analysis of the various ways changes in downed coarse woody debris and snags would influence related Park resources.

5.3.5 LEGACY TREES

5.3.5.1 Overview

As discussed in Sections 2.2.3, 4.1.2.3, 4.2.1.10, legacy trees are some of the most identifiable historical features of the landscape, creating an interpretable connection to the past, while also providing valuable habitat to a variety of species and contributing the structural diversity of the Forest. Maintaining existing legacy trees is difficult in light of the natural aging of trees, and cultivating new legacy trees is also challenging because of changes in the landscape (e.g., open areas needed for open-grown growth form are much more limited than 100 years ago).

5.3.5.2 Comparison of Alternatives

Over the long term, Alternative A would create the greatest abundance and distribution of legacy trees with old-growth characteristics because there would not be any active management and most of the stands would begin to develop late-successional forest characteristics. Ecological benefits would increase over time as trees grow, decline, die, and pass through the various stages of decay, each of which supports a diversity of wildlife, insects, fungi, bacteria, and other species. However, certain types of legacy trees associated with the designed characteristics of the Forest, such as sugar maples along the carriage roads, would be lost.

Over the long term, Alternative C would have similar effects as Alternative A but to a lesser extent because active forest management would encourage the removal of mature, well-formed trees. As with Alternative A, under Alternative C certain types of legacy trees related to the designed elements of the landscape would be lost.

Alternative B would maintain legacy trees with both cultural and ecological value. The overall diversity, abundance, and relative distribution of the legacy trees would be comparable to what currently exists.

Alternative D would also maintain legacy trees of both cultural and ecological value, and overall would create the greatest diversity and abundance of legacy trees over the long term. As in Alternative B, legacy trees related to the designed

features of the landscape would be maintained through replanting (e.g., sugar maples along roads), and others would be recruited from within forest stands. Additionally under this alternative, legacy tree recruitment would be used extensively as a tool to retain representative historic trees and their genetic offspring in portions of the plantations that would transition to hardwood and mixed forests.

5.3.5.3 Effects on Related Resources

See Sections 5.4.2 Cultural Landscape Character, 5.5.5 Wildlife: Birds, and 5.5.6 Wildlife: Mammals for more in-depth analysis of the various ways changes in legacy trees would influence related Park resources.

5.4 Effects on Cultural Resources

5.4.1 METHODS FOR ASSESSING THE EFFECTS ON CULTURAL RESOURCES

In this section, the impact analyses are intended to comply with the requirements of both NEPA and Section 106 of the National Historic Preservation Act. In accordance with the Advisory Council on Historic Preservation's (ACHP) regulations implementing Section 106 (36 CFR Part 800, Protection of Historic Properties), established criteria were applied to determine potential effects on cultural resources either listed in, or eligible to be listed in, the National Register. The process begins with an identification and evaluation of cultural resources for National Register eligibility, followed by an assessment of effect on those eligible resources, and concluding with a consultation process with the state historic preservation office.

If an action could change the characteristics that qualify the resource for inclusion in the National Register, it is considered to have an effect. As defined by ACHP, *no adverse effect* means there could be an effect, but the effect would not be harmful to those characteristics that qualify the resource for inclusion on the National Register. *Adverse effect* means the effect could diminish the integrity of the characteristics that qualify the resource for the National Register. The intensity definitions presented in Section 5.1 have been modified below to integrate ACHP definitions of no adverse effect and adverse effect, and therefore serve the requirements of both NEPA and NHPA Section 106. These definitions are used for all assessments of potential effects on cultural resources within this section.

- Negligible:
  The impact would be barely perceptible and not measurable, confined to small areas or affecting a single contributing element of a National Register property. Determination of effect for Section 106 would be *no adverse effect*.

- Minor:
  A **minor adverse impact** would alter a single contributing element, pattern, feature or site, but the impact is slight and would not diminish overall integrity. Determination of effect for Section 106 would be *no adverse effect.*
  A **minor beneficial impact** would result in the preservation and maintenance of a feature or historic landscape pattern in accordance with the Secretary of the Interior's Standards. Determination of effect for Section 106 would be *no adverse effect.*

- Moderate:
  A **moderate adverse impact** would be readily apparent; the effect would be harmful to those characteristics that qualify the property for inclusion on the National Register and would diminish the overall integrity of the resource. Determination of effect for Section 106 would be *adverse effect.* A memorandum of agreement with the state historic preservation office to minimize or mitigate adverse impacts would be needed.
  A **moderate beneficial impact** would result in the stabilization or rehabilitation of the cultural resource in accordance with the Secretary of the Interior's Standards. Determination of effect for Section 106 would be *no adverse effect.*

- Major:
  A **major adverse impact** would result in the alteration of a pattern or feature or site disturbance that would diminish the overall integrity of the cultural resource and National Register-listed property. Determination of effect for Section 106 would be *adverse effect.* These adverse impacts would be difficult to mitigate.
  A **major beneficial impact** would result in the restoration and protection of a cultural resource. Determination of effect for Section 106 would be *no adverse effect.*

Several studies were instrumental in identifying and evaluating cultural resources at the Park. These included the Cultural Landscape Report for the Forest, Volume 1 Site History and Volume 2 Existing Conditions and Analysis, and an Archeological Overview and Assessment, among others. These studies were used to assess the potential impacts of the proposed alternatives.

The findings regarding potential effects of the management alternatives for the Mount Tom Forest described in the rest of this section will be shared with the Vermont State Historic Preservation Office (SHPO) in conjunction with the development of a programmatic agreement between the Park and the SHPO for forestry activities and protection of archeological resources once an alternative is selected.

5.4.2 CULTURAL LANDSCAPE CHARACTER: SPATIAL ORGANIZATION, CIRCULATION, AND VEGETATION

5.4.2.1 Overview

In order to continue to maintain the historical significance of the property in the areas of conservation (association with Marsh, Billings, Rockefeller, nineteenth-

century pioneering forestry, and as an example of continuous forest management), landscape architecture, and agriculture, the property must retain its historical character and integrity. As discussed in Section 4.1.1, the character of the Forest is an important component of the property in conveying this significance. Issues of concern for the Forest's historic character include changes in defining landscape characteristics related to spatial organization, circulation system, and vegetation. Potential overarching changes in the Forest's historic character under the different alternatives are described in Sections 5.3.1–5.3.5 above. This section summarizes how those and other changes would affect the Forest's historic character.

5.4.2.2 Effects Common to All Alternatives

Under all of the alternatives, the property will retain the defining landscape characteristics of the historic carriage road and trail circulation system. This historic circulation system is associated with all aspects of the property's historical significance.

5.4.2.3 Comparison of Alternatives

The alternatives differ in the way they would address and maintain defining characteristics of the spatial organization, views from the circulation system, and vegetation associated with the Park's various areas of significance (e.g., association with Marsh, Billings, Rockefeller, nineteenth-century pioneering forestry, continuous forest management, nineteenth-century landscape architecture, and agriculture). Changes in defining landscape characteristics are summarized in Table 6 below.

Table 6
Comparison of Effects on Cultural Landscape Character

	Alternative A Continue current management	*Alternative B* Adopt a "replacement-in-kind" approach to historic preservation	*Alternative C* Continue the tradition of applying the best current thinking and practice in forest management	*Alternative D (NPS-preferred)* Recognize and work with ecological change in preserving the historic character of the forest
American Conservationists (National Register Criterion B)				
Marsh (1801–1869)	With a few exceptions, the defining landscape characteristics related to the Marsh period are no longer evident and would not be present in the future. Exceptions include legacy trees that date to the Marsh period, evidence of field boundaries and property markers, and sections of old farm roads. These features would be preserved in all alternatives.			
Billings (1869–1890) and Rockefeller (1954–1997)	Defining landscape characteristics, including the forest plantations and managed character of the hardwood stands, would be lost.	Defining landscape characteristics established by Billings and preserved and expanded by Rockefeller, including the plantations, older hardwood stands, views, and the circulation system would be maintained. However, some characteristics that reflect the continuation of best current thinking and practices in forest management would diminish because management would focus on perpetuating extant features.	Same as Alternative A. However, some views and characteristics that reflect the continuation of best current thinking and practices in forest management would be retained.	Most defining landscape characteristics, including some highly visible plantations, hardwood stands, views, and the circulation system, would be maintained. Although, some plantations would eventually transition to mixed hardwood stands in the long term, and characteristics that reflect the continuation of best current thinking and practices in forest management would be retained.

TABLE 6
COMPARISON OF EFFECTS ON CULTURAL LANDSCAPE CHARACTER

	Alternative A Continue current management	*Alternative B* Adopt a "replacement-in-kind" approach to historic preservation	*Alternative C* Continue the tradition of applying the best current thinking and practice in forest management	*Alternative D (NPS-preferred)* Recognize and work with ecological change in preserving the historic character of the forest
American Conservation Movement (National Register Criterion A)				
Pioneering Nineteenth-Century Forestry (1873–1910) and An Example of Continuous Forest Management (1910–1997)	Defining landscape characteristics associated with historic forestry practices would be lost.	Defining landscape characteristics of the plantations and hardwood and mixed forest stands would be maintained. As plantations age and decline, they would be replaced. However, some characteristics that reflect the continuation of best current thinking and practices in forest management would diminish because management would focus on perpetuating extant features.	Same as Alternative A. However, some characteristics that reflect the continuation of best current thinking and practices in forest management would be retained.	Same as Alternative B. Although, some plantations would eventually transition to mixed hardwood stands in the long term, and characteristics that reflect the continuation of best current thinking and practices in forest management would be retained.
Agriculture and Landscape Architecture (National Register Criterion C)				
Model Farm	Defining landscape characteristics associated with the spatial organization and circulation of the model farm would remain evident, including the carriage road system, fields, and The Pogue.	Same as Alternative A. In addition, aspects of early forestry activities associated with a model farm would also be retained.	Same as Alternative A. However, some defining characteristics of the vegetation would be lost and spatial organization would be altered as existing hayfields and pastures would be allowed to convert to shrub-dominated fields.	Same as Alternative B.
Landscape Design During the Country Place Era, (1869–1917)	Defining landscape characteristics of the carriage road system, The Pogue, and overall spatial organization would be retained. However, some views and the designed characteristics associated with the plantations and hardwood and mixed forest stands would be lost.	Defining landscape characteristics of the carriage road system, The Pogue, overall spatial organization, views, and the designed characteristics of the plantations and hardwood and mixed forest stands would be retained.	Same as Alternative A. However, some views and vistas would be retained, although they may not exist in their current location.	Same as Alternative B.

Alternative A would result in the gradual loss of historic landscape character and have the greatest negative impact. Under this alternative, many key historic landscape characteristics related to the property's association with Frederick Billings, Laurance S. Rockefeller, pioneering nineteenth-century forestry, and as examples of continuous forest management would disappear over time. The existing fields would remain open, but the mosaic of distinct plantations would no longer be evident as historic plantations gave way to forest succession. Eventually the plantations and hardwood forest stands would lose the distinctive planting patterns and evidence of forest management, and resemble other second-growth forests in the southern Vermont region. This alternative would retain some landscape characteristics related to the property's significance as a model farm

and as an example of landscape design during the Country Place Era, because road and trail circulation systems and small-scale features would be maintained. However, designed views and the characteristics associated with a managed forest would be lost.

Alternative C would diminish the historic landscape character and result in a negative impact similar to Alternative A. However, since this alternative would continue the practices of contemporary forestry it would retain some defining landscape characteristics associated with the Rockefeller period and the property's significance as an example of a continuously managed forest. This alternative would also maintain some of the views from the carriage roads, and therefore would retain some additional characteristics related to the property's significance as a model farm and example of landscape design during the Country Place Era.

Alternative B would offer the greatest preservation of the Forest's historic character associated with all areas of property's significance. The mosaic and structural character of forest plantations and hardwood and mixed forest stands would be retained through replacement in-kind. All of the existing views would be maintained, and road and trail circulation corridors would include understory and coarse woody debris removal to maintain interior forest views and the existing aesthetic character related to the Rockefeller era. Plant species would include a mix of native and non-native species corresponding to the plants intentionally introduced or regenerated during the historic period. However, under this alternative other defining landscape characteristics associated with the Rockefeller period and continuous forest management would diminish because management would focus on the preservation of existing features, and would no longer continue to apply and demonstrate best contemporary thinking and practices in forest management.

Alternative D offers similar benefits as Alternative B, and would maintain additional landscape characteristics associated with the Rockefellers and continuous forest management. The retention and reestablishment of plantations would occur primarily along the main carriage road corridors and in areas where opportunities exist for encouraging regeneration of plantation species or establishing new small-scale plantings. This would maintain the most defining landscape characteristics of the Forest mosaic (though the exact location and edges would vary over time). While some characteristics may be change over the long term, overall this approach would retain the Forest's historical associations while providing the flexibility to accommodate ecological change. Additionally, by continuing to practice contemporary forest management practices throughout much of the landscape, this alternative would perpetuate additional defining characteristics of the management practices associated with the Rockefeller period and allow the property to evolve as an example of continuous forest management.

5.4.2.4 Section 106 Summary and Conclusions

Overall, Alternative A would have a major adverse effect on the cultural landscape as a result of the loss of the Forest's historic character related to the property's association with Billings, pioneering nineteenth-century forestry, continuous forest management, and landscape design. Under ACHP criteria (36 CFR 800), the Section 106 determination would be an adverse effect. Alternative C also would result in a loss of historic character related to the property's historical significance. However, compared to Alternative A, this alternative would maintain additional defining landscape characteristics of the Forest's association with Laurance S. Rockefeller and continuous forest management. Under this alternative, there would be a moderate adverse impact, and Section 106 determination of adverse effect. Alternatives B and D are consistent with the *Secretary's Standards for the Treatment of Historic Properties*, and would both retain most of the defining landscape characteristics of the Forest related to all areas of property's significance over the long term. Alternative B would retain the most exact representation of historic characteristics through preservation and rehabilitation, and therefore would have a moderate beneficial effect on the cultural landscape resources and a Section 106 determination of no adverse effect. Alternative D would retain representative defining landscape characteristics through preservation and rehabilitation, and would also maintain additional characteristics associated with management under Laurance S. Rockefeller and the property's significance as an example of continuous forest management. This alternative also allows the greatest flexibility to work with the dynamic nature of forest change to ensure the Forest's historic associations are retained over the long term. Therefore, Alternative D would have a minor beneficial effect on cultural landscape resources, and a Section 106 determination of no adverse effect.

5.4.3 ARCHEOLOGICAL RESOURCES

5.4.3.1 Overview

The National Historic Preservation Act requires agencies to take into account the potential effects of their actions on existing or potentially unidentified archeological resources. As discussed in Section 4.1.3, an archeological overview and assessment for the Park is currently underway.

5.4.3.2 Effects Common to All Alternatives

The protection of archeological resources would be the same for all of the alternatives, as described in Section3.3.1. Special considerations for any potential effects to archeological resources will be identified and reviewed in consultation with the Vermont State Historic Preservation Office in conjunction with the development of a programmatic agreement.

5.4.3.3 Section 106 Summary and Conclusions

Under ACHP's criteria (36 CFR 800), actions associated with the implementation of any of the alternatives will be reviewed with the Vermont State Historic Preservation Office and any needed mitigating measures will be applied so that all actions would result in a Section 106 determination of no adverse effect on archeological resources. Therefore, any of the alternatives would have a negligible effect on, and thus will not impair, archeological resources.

5.5 Effects on Natural Resources

5.5.1 SOILS

5.5.1.1 Overview

A summary of soils found in the Park was presented in Section 4.2. All available information on soils was compiled from the NRCS Windsor County Soil Survey and map locations of sensitive soils were compared with locations of proposed forest management treatments. Considerations related to soils included landuse changes on prime agricultural soils, potential erosion or compaction of soils from management activities, and changes in soil nutrients, particularly nutrient exhaustion.

5.5.1.2 Effects Common to All Alternatives

There would be no effects on soils common to all alternatives.

5.5.1.3 Comparison of Alternatives

Prime agricultural soils: The Council on Environmental Quality directs that federal agencies must assess the effects of their actions on farmland soils classified by the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS) as prime or unique. Prime farmland is defined as soil that particularly produces general crops such as common food, forage, fiber, and oil seed. As discussed in Section 5.3.1 on Cover Types, Alternative D would establish a plantation in a small portion of the Elm Lot. This area is comprised of state-designated prime agricultural soils, and the action would convert a small section of hayfield to a plantation in the long term. There would be no long-term effects on state-designated prime agricultural soils in Alternatives A, B, and C.

Erosion and Loss of Soil: Alternative A would result in the least potential for erosion from forestry activities because active forest management would be minimal, limited to hazardous tree removal along the carriage roads. Alternative C could result in erosion from forestry activities including ground disturbance during harvesting and establishment and use of skid trails. However, if the best management practices outlined in Appendix C are properly implemented, the erosion would be minimal and mitigated on site. Erosion control measures would

be relatively easy to implement and have a high likelihood of being successful. Alternatives B and D have the same potential to contribute to soil erosion from forestry activities as Alternative C. However, Alternative B and, to a considerably lesser extent, Alternative D would have additional impacts because of the process of reestablishing plantations. In order to reestablish plantations under Alternative B, preparation for replanting would include removing all existing trees and slash. This would expose bare soils during the preparation, a condition which will exist until the time the seedlings and a cover crop (e.g., buckwheat or rye) could be established. On-site erosion control measures during this period would be extensive and may not necessarily be successful. Alternative D also calls for the reestablishment of plantations, but only on a small-scale. Since the areas to be replanted are smaller, erosion could likely be mitigated directly on site to prevent loss of soil.

Nutrient Change/Exhaustion: The potential for nutrient change and/or exhaustion is difficult to predict because of the diversity of variables that influence soil chemistry (including larger climatic patterns such as acid deposition). However, the likelihood for changes in soil nutrients is directly linked to drastic changes in vegetation. Management activities that remove large quantities of vegetation over short time-frames, such as the clear-cutting of a stand to reestablish it as a plantation, could result in a rapid release and potential loss of certain nutrients, such as nitrogen.

Over the long term, Alternatives A and C would create the most stable soil nutrient conditions. Some fluctuations of soil nutrients may result as stands age (transitioning from early-successional to mature forests), or immediately after a harvest. However, these changes would be negligible. Alternative B, and to a considerably lesser extent Alternative D, have the potential to create more intensive, long-term alterations to soil nutrients in areas where plantations would be reestablished. However, the overall effect in Alternative D would be minor because the area treated would be small. Under both of these alternatives, nutrient exhaustion could be mitigated by treating the area with nutrient supplements. The treatment for Alternative B would be extensive and have the potential to result in other adverse impacts (e.g., nutrient runoff into waterways.

5.5.1.4 Conclusions

Overall, Alternative B would have the greatest potential for causing moderate adverse effects on soil resources in the long term. These effects could be mitigated with the application of cover crops and the use of best management practices outlined in Appendix C. However, the mitigation measures may need to be extensive and might not be successful. Alternatives C and D have the potential for causing minor adverse effects, which could be easily mitigated if the best management practices outlined in Appendix C are successfully implemented. Alternative A would have negligible effects on soil resources. None of the

alternatives would have major adverse impacts on soil resources and, therefore, would not impair this resource.

5.5.2 WATER RESOURCES AND WETLANDS

5.5.2.1 Overview

Management of Park wetlands are subject to and guided by the Clean Water Act, Executive Order 11990 Protection of Wetlands, and Natural Resource Management Manuel, #77-1 Wetland Protection. These laws and policies direct the NPS to protect and enhance the natural and beneficial values of wetlands, and to avoid or minimize potential impacts to wetlands. Additionally, NPS Management Policies direct the Park to minimize impacts to watershed processes (e.g., runoff, erosion, vegetation, and soil disturbance) and stream processes that create habitat features (e.g., riparian systems, woody debris accumulations, gravel bars, riffles, and pools).[3]

As discussed in Section 4.2.3, there are no National Wetland Inventory (NWI) classified wetlands in the Park. However, more detailed inventories of wetlands, springs, seeps, streams, and vernal pools were mapped and assessed as part of several Park resource studies. Impacts to water quality and quantity are related to management practices near and adjacent to these resources, and/or cumulatively throughout the watershed. The potential effects of each alternative on water resources and wetlands were evaluated by assessing the proximity of proposed management activities to these resources, and the potential cumulative effects of collective actions within the watershed. Considerations related to water resources and wetlands included sediment loading, pollution, nutrient change, alteration of baseflow volumes, and thermal changes.

5.5.2.2 Effects Common to All Alternatives

There would be no effects on water resources and wetlands common to all alternatives.

5.5.2.3 Comparison of Alternatives

Sediment Loading: Sediment loading describes the amount of soil particulates entering a waterbody. Sediment is one of the main pollutants that affect freshwater bodies in the Northeast. Sedimentation of streams and ponds can cause adverse effects by changing patterns in water flow, filling macroinvertebrate and fish habitats, covering breeding areas and eggs, and altering the availability or abundance of light reaching aquatic vegetation. Forest management activities can contribute to sediment loading through ground disturbances and loss of vegetative cover resulting in soil erosion. Potential impacts on soil erosion were analyzed in Section 5.5.1 above. In general, Alternative B has the potential to cause the greatest sediment loading in Park streams, seeps, and wetlands; and Alternative A has the least potential for impact. Under all of the alternatives, best

management practices discussed in Appendix C would be applied to mitigate some of these impacts. However, mitigation measures for Alternative B would be extensive and might not be successful.

Nutrient Changes: Nutrients, such as nitrogen and phosphorus, are important to the health of the Park's streams and The Pogue. However, in excess they can become a pollutant, adversely affecting these waterbodies. Alterations in vegetation within a watershed can directly affect nutrient levels in surface water. Changes in nutrients were discussed under soil nutrient change/exhaustion above (Section 5.5.1). Overall, Alternative B has the greatest potential to alter soil and water nutrient balances during plantation removal and reestablishment. If soil enhancements are used to mitigate soil exhaustion, this could potentially increase the amount of nitrogen, phosphorus, and other nutrients entering surface waters. Alternative D has the potential for the same type of negative effects, however any that did occur would likely be minor. Alternatives A and C would create negligible impacts on water nutrient changes.

Thermal Changes: Another important function of vegetation is to shade surface water. Streams, seeps, and wetlands without vegetative cover experience greater fluctuations in temperatures that negatively affect aquatic life. Under all of the alternatives, best management practices described in Appendix C would be followed, which includes maintaining vegetative buffers along streams, seeps, wetlands, and open water. These measures should be adequate to mitigate potential negative impacts from forest management activities under Alternatives A, C, and D. However, even with proper implementation of best management practices, Alternative B would result in minor short-term increases in water temperatures when plantations are cleared and reestablished because the runoff from of these sites would be exposed to greater sunlight and warmer soils.

Water Quantity and Distribution: In addition to alterations in water quality, changes in vegetation can directly alter water quantity, particularly baseflow of streams, seeps, wetlands, and streams. Baseflow is precipitation (e.g., rain, snowmelt) that percolates through the soil and into the groundwater before being slowly released into surface waters. Alteration in baseflow may result when there are changes in the amount of vegetation in an area and stormwater can directly enter streams, seeps, etc. This direct runoff can overwhelm the system, creating greater stream channel erosion, spikes in pollutants and nutrient levels, and diminish the amount of water entering ground reserves. Vegetation assists in regulating baseflow by intercepting runoff, allowing it time to percolate into the soil and groundwater or absorbing it directly through their roots. Alternative B would create the greatest fluctuations in baseflow during the removal and reestablishment of plantations. These changes would be moderate and short-term, persisting until the area is revegetated. The forest management activities proposed in Alternatives C and D would not likely result in significant changes in baseflow

over the long term. Likewise, the changes in vegetation composition under Alternative A would not likely result in significant changes in baseflow.

5.5.2.4 Conclusions

Overall, Alternative B would have the greatest potential for causing moderate adverse effects on water resources. Some of these effects could be mitigated with the use of best management practices outlined in Appendix C. However, the mitigation measures may need to be extensive and might not necessarily be successful. Alternatives C and D also have the potential for causing adverse effects, but these effects would be minor and could be easily mitigated if the best management practices outlined in Appendix C are properly implemented. Alternative A would have negligible effects on water resources. None of the alternatives would have major adverse impacts on water resources and wetlands and, therefore, would not impair these resources.

5.5.3 WILDLIFE: SPECIES OF CONCERN

5.5.3.1 Overview

Federal agencies are required by the Endangered Species Act of 1973 to consult with the U.S. Fish and Wildlife Service (USFWS) to ensure that their actions do not jeopardize the continued existence or critical habitat of any species listed as endangered or threatened. There are no federally listed threatened or endangered species known to occur within the Park. There are also no state-listed threatened or endangered species known to occur. There is, however, one species, the Jefferson salamander, on the Vermont list of Species of Special Concern. The potential impact to this species is analyzed in Section 5.5.4 below on reptile and amphibian populations. Additionally, several bird species that have been confirmed to breed in the Park are listed as a "special concern" by the Vermont Agency of Natural Resources, on the Vermont list of rare and uncommon birds, or on the Partners in Flight priority list for the northern New England region. The potential impact of the alternatives on these species is discussed in Section 5.5.5 below on bird populations.

5.5.3.2 Conclusions

None of the alternatives would have major adverse effects on, and thus will not impair, wildlife species of concern. As required by the Endangered Species Act, the Endangered Species Coordinator with the U.S. Fish & Wildlife Service was consulted, and concurred with these findings.[4]

5.5.4 WILDLIFE: REPTILES AND AMPHIBIANS

5.5.4.1 Overview

As discussed in Section 4.2.4.1, an assessment of the abundance and distribution of reptile and amphibian populations and vernal pools in the Park was conducted.

More specific information about the habitat use and migratory patterns of the Jefferson salamander, a state-listed species of concern, was developed as part of a second, more in-depth study. Considerations related to reptiles and amphibians included changes in vegetation in and adjacent to wetlands and vernal pools; retention of coarse woody debris (CWD) for habitat cover and feeding areas; soil compaction and ground disturbance from forestry activities; and habitat linkages that provide potential connections between populations in vernal pools in and adjacent to the Park.

5.5.4.2 Effects Common to all Alternatives

There would be no effects on reptile and amphibian populations common to all alternatives.

5.5.4.3 Comparison of Alternatives

Type of Forest Cover in "Life Zones": The type of forest within life zone areas (i.e., a 200-meter radius extending from the breeding pools) can influence the viability of amphibian populations. Native hardwood and mixed conifer stands provide better habitat for amphibian populations than single-species conifer plantations or open fields. Conversion of plantations and fields to native tree cover in life zone areas would enhance habitat conditions for amphibians. Changes in forest stand types were discussed in Section 5.3.2 above. Overall, in the long term, Alternatives A, C, and D would result in the eventual conversion of conifer plantations in life zone areas into native hardwood forests and therefore would enhance amphibian habitat. The intentional transition of plantations to natural communities through forest management would occur more quickly under Alternative C, creating major beneficial short-term to mid-term benefits for reptile and amphibian populations. Conversion of plantations in Alternatives A and D would occur more slowly as plantations age and hardwoods become established and mature. Under Alternative B, conifer plantations would remain within the amphibian life zones, limiting the suitability of the habitat for most reptiles and amphibians in both the short and long term.

Coarse-Woody Debris for Habitat Cover and Feeding Areas: CWD is considered important for many species of amphibians and reptiles, particularly in amphibian life zone areas. Changes in Park-wide CWD levels were analyzed in Section 5.3.4 above. Overall, Alternatives A, C, and D would increase downed CWD, with Alternative A yielding slightly higher volumes of CWD in the long term. Under Alternative B, there would be no change in CWD levels in either the short or long term.

Habitat Linkages: Open fields and single-species conifer plantations with limited understory vegetation located between breeding areas can create barriers to reptile and amphibian migration and negatively impact meta-population dynamics (i.e., limit genetic diversity). The conversion of these areas into native hardwood

or mixed forest stands would enhance opportunities for reptile and amphibian habitat connections. The eventual conversion of plantations to native hardwood and mixed forest stands in Alternatives A and C would provide the greatest opportunities for habitat connections. Alternative D would offer some increased opportunities for habitat connections, but under this alternative some plantations would be retained in areas between existing breeding vernal pool habitat. Under Alternatives C and D, a small strip of the hayfield in the north end of the Maple Lot adjacent to the Pogue Stream would be reforested to provide riparian habitat, which could be important to many species of amphibians. Alternative B would not provide any change in habitat connectivity.

Soil Compaction: Ground-disturbing activities from forestry activities could negatively impact reptile and amphibian habitat, such as soil compaction from the use of heavy equipment within life zone areas. Alternative A would have the least potential for ground disturbance and compaction of soils because no significant timber harvesting would occur. Under Alternatives B, C, and D, soil compaction and ground disturbance from forestry activities could potentially impact amphibian populations. Opportunities to minimize compaction and ground disturbance through winter logging may be restricted by ski trail easements and the desire to scarify the soil to encourage certain types of regeneration (e.g., white pine).

Water Resources and Wetland Habitat: Changes in water resources and wetlands, which were analyzed in Section 5.5.2 above, would have the potential to impact amphibian habitat. Overall, Alternative B would have the greatest potential for causing moderate adverse effects on water resources and wetlands, and thus amphibian populations, which may not be able to be mitigated successfully. Alternatives C and D could cause minor negative impacts to water resources and wetlands, but these impacts could be mitigated if best management practices in Appendix C are property implemented. Alternative A would negligibly impact water resources and wetlands.

5.5.4.4 Conclusions

Overall, Alternative A would have moderate beneficial impacts to reptile and amphibian habitat and populations in the short and long-term. Alternative C would provide beneficial impacts comparable to Alternative A; however, some soil compaction from forestry operations would occur under this alternative. Alternative D would provide less habitat enhancement compared to Alternatives A and C, but would still provide beneficial impacts to reptile and amphibian habitat. Alternative B would not enhance reptile and amphibian habitats or populations, and could have minor negative impacts to amphibian populations because of its potential effects on water quality and wetlands. None of the alternatives would have major adverse impacts on the existing reptile and amphibian populations and, therefore, would not impair these populations.

5.5.5 WILDLIFE: BIRDS

5.5.5.1 Overview

A summary of bird species found in the Park was presented in Section 4.2.4.2. More than ninety species have been identified, several of which are considered priority species by various agencies and organizations. Because species diversity is linked to habitat diversity, any changes to vegetation structure and diversity, edge habitat, hayfield management, and abundance of snags may affect bird populations.

5.5.5.2 Effects Common to All Alternatives

The timing of field mowing relative to bird life cycles is important to minimize direct impacts to grassland nesting species. As discussed in Section 3.3.2, under all alternatives grassland birds will be given adequate time to fledge their first brood before field mowing commences.

5.5.5.3 Comparison of Alternatives

Forest Type, Structure, and Diversity: Vegetation structure and species diversity are important for food and nesting habitat for birds. Changes in stand structure and species diversity were analyzed in Sections 5.3.2 and 5.3.3 above. Overall, Alternatives A and C offer the greatest amount of native hardwood and mixed forest habitat and more diverse understory conditions, which are preferred by many bird species. These conditions would develop much more quickly in Alternative C than in Alternative A because of active forest management. Alternative D would also create an increase in native hardwood and mixed forest habitat, and greater understory diversity. However, this would be to a lesser extent than in Alternatives A and C because some of the plantations will be retained and replaced, and some areas along the main carriage road corridor will be thinned or cleared to maintain views into the forest.

Additionally, as plantations age, they provide valuable habitat for diverse bird populations. Some of the older plantations have started to develop a more diverse understory and have the greatest diversity of bird species in the Park.[5] Alternatives A and C would allow existing plantations to continue to evolve, and would retain and enhance this habitat type for birds. Alternative D would also allow some plantations to develop these characteristics, but not to the same extent as Alternatives A and C.

Alternative B would provide the least favorable conditions for bird habitat because single-species, even-aged plantations would be retained and reestablished to the greatest degree and understory vegetation would be continue to be suppressed in the plantations and other portions of the Forest.

Snags and Cavity Trees: Snags and live trees with deadwood and cavities are important to many cavity-nesting bird species. Snags near the edge of fields are preferred by some species, such as American kestrels. Changes in the density of snags and legacy trees (which have the potential to become valuable cavity trees) were analyzed above in Sections 5.3.4 and 5.3.5, respectively. Overall, Alternatives A, C, and D would increase snags in the long term, but Alternative A would provide more snags in the long term as none of these trees would be culled to favor healthier trees. Alternatives C and D would also retain some large-diameter trees as legacy trees, which will eventually become cavity trees and snags as they age and die. Under Alternative B, legacy trees would be retained, but other snags would continue to be removed from areas throughout the Park; therefore there would be no significant change in snag numbers in either the short or long term.

Interior and Edge Habitat: The amount of edge habitat considered desirable varies depending on the bird species; some prefer edge and others prefer interior forest habitats. Due to the high number of forest interior species that are also considered conservation priorities in the region, forest interior may be the most important habitat to consider for the benefit of bird populations. Alternatives A and C would maximize forest interior habitat in the long term. Alternative D also would increase interior habitat, but to a lesser extent than Alternatives A and C because some plantations would be retained. Alternative B would retain existing levels of forest interior habitat; this would be the least of the four alternatives.

Alternative B would maximize the amount of edge habitat in the Park because all plantations would be retained. Alternative D would retain some of the plantations, making it the second most favorable alternative for edge habitat. Alternative C would increase edge habitat in the short and mid-term due to active forest management. Alternative A would minimize edge habitat over the long term as plantations convert to mixed hardwood forests without active forest management.

Field Management: The field management approach under Alternative C would provide the greatest benefits to bird populations that favor or require early-successional habitat. The fields would be maintained as rich herbaceous, early-succession woody vegetation by mowing every second or third year, enhancing their value as ecologically diverse communities not represented elsewhere in the Park. Field management under Alternatives A, B, and D would involve annual mowing. This would retain the habitat for grassland nesting birds. However, the fields would be maintained in their current species mix of agricultural grasses. This would provide some benefit to a few grassland bird species, but not to the same extent as the native early-successional grasses and shrubs in Alternative C would provide to other species.

5.5.5.4 Conclusions

Overall, Alternative A would provide moderate beneficial impacts to the greatest number of bird species as habitats mature. It would have the most positive impact

on cavity nesting and forest interior bird populations, no change to grassland birds, and the least amount of forest edge in the long-term. Alternatives C and D would provide minor benefits to bird species that require cavities for nesting, forest interior, and edge habitats. Alternative C would also provide some early-successional habitat that is absent from the other alternatives. Alternative B is unlikely to have any noticeable impact on bird populations over the long term because there would be the least divergence from current habitat conditions. None of the alternatives would have major adverse impacts to the existing bird populations and, therefore, would not impair these populations.

5.5.6 WILDLIFE: MAMMALS

5.5.6.1 Overview

Information on mammals known to inhabit the Park is summarized in Section 4.2.4. Considerations in analyzing the potential effects of the alternatives on mammals include levels of coarse woody debris and snags, carriage roads as bat travel corridors, vegetation cover type and structure, and mast trees.

5.5.6.2 Effects Common to All Alternatives

Carriage roads are important bat corridors, and will be managed the same under all alternatives. The primary feeding area for bats is The Pogue, which will also be managed the same under all alternatives.

5.5.6.3 Comparison of Alternatives

Coarse woody debris and snags: Dead wood provides valuable habitat to a diversity of mammal species. Cavities provide important bat nurseries and denning habitat for numerous other species (e.g., porcupine, squirrels). Large-diameter CWD on the forest floor is important for small and medium-sized mammals, providing cover, denning, and foraging areas. Levels of CWD and snags were analyzed in Section 5.3.4 above. Overall, Alternatives A, C, and D would increase the amount of deadwood in both the short term and long term. Alternative A would provide slightly more deadwood in the long term; and Alternative C has the greatest potential to increase CWD in the short term because of active forest management. Alternative B would provide the fewest snags and least amount of CWD of any of the alternatives.

Forest Type, Structure, and Diversity: Vegetation type, structure, and species diversity are important attributes of mammal habitat. While certain changes in vegetation can favor one species over another, in general a greater diversity of mammal species can be expected if there is greater structural and species diversity within a stand. Changes in forest type, stand structure, and species diversity were analyzed in Sections 5.3.2 and 5.3.3 above. Overall, Alternatives A and C offer the greatest amount of native hardwood and mixed forest habitat, more diverse understory conditions, and late-successional forest characteristics, which are

preferred by many small and medium-sized forest mammals. These conditions would develop more quickly in Alternative C because of the active forest management. Alternative D would also result in an increase of native hardwood and mixed forest habitat, greater understory diversity, and late-successional stand characteristics in some plantation and hardwood stands. However, this would be to a lesser extent than in Alternatives A and C because under Alternative D some portions of the plantations would be retained and replaced as even-aged, single-species stands.

Alternative B would maintain the existing forest cover and structural diversity, which includes large areas of single-species even-aged conifer plantations and which would provide the least overall beneficial habitat to mammal species. However, the reestablishment of even-aged stands which would provide some characteristics of early-successional habitat in the mid-term, which is preferred by some mammal species.

Mast Trees: Mast trees are trees that produce food for a variety of wildlife, especially mammals. Alternative C would retain the greatest number of mast trees intentionally through forest management. Alternatives A and D would result in an increase in mast trees, but not to the extent of C. Under Alternative B, there would be no change in the availability of mast-producing trees, as hardwood /conifer proportions would be kept largely the same as the current distribution across the landscape.

5.5.6.4 Conclusions

Alternative C would have the greatest beneficial effect on mammal populations in the short and mid-term because it would create the most diverse forest structure and plantations would be converted to natural communities. Alternative A also would provide moderate beneficial impacts to mammal populations over the long term as trees mature and die and plantations transition to natural communities. Alternative D would have similar beneficial impacts as Alternative C over time, but to a lesser extent because some portions of plantations would be retained. Alternative B would not enhance mammal habitat. None of the proposed alternatives would have major adverse impacts on existing mammal populations and, therefore, would not impair these populations.

5.5.7 WILDLIFE: FISH

5.5.7.1 Overview

As described in Section 4.2.4.6, the only fish populations in the Park are species that were introduced in The Pogue. In accordance with the deed restrictions associated with the property, recreational fishing will not be allowed under any of the alternatives. Issues considered important when examining potential impacts to fish populations included changes in water quality and habitat along the edge of The Pogue.

5.5.7.2 Effects Common to All Alternatives

There is unlikely to be a significant impact to fish populations under any of the alternatives as The Pogue's water quality will continue to be protected under all scenarios. The band of trees around The Pogue will be minimally treated as necessary for aesthetics and safety reasons. Under Alternatives A, C, and D, no forestry activities are anticipated for the steep slopes to the west of The Pogue, and most other slopes adjacent to The Pogue have moderate slopes and would remain in continuous forest cover, limiting the possibility of siltation or increased water temperature due to loss of canopy. Under Alternative B, plantations on the slopes north of The Pogue would be removed and replaced. During plantation reestablishment, erosion control measures would be applied. They would likely be extensive and, if successful, there would be negligible impacts to fish populations.

5.5.7.3 Conclusions

As long as the best management practices outlined in Section 3.3.2 and Appendix C are properly applied to protect the water quality of The Pogue, none of the alternatives would negatively impact, or impair, fish populations at the Park.

5.5.8 VEGETATION: NATURAL COMMUNITIES

5.5.8.1 Overview

As stated in Section 4.2.1.2, natural communities are interacting assemblages of species and their environment (e.g., soils, slope, aspect, and climate). The Park currently includes sixteen different natural community types. Natural community analysis provides a baseline to describe the effects of the alternatives on the development of the Forest's potential natural communities. There are also existing natural communities that have been identified in the Park as unique or ecologically sensitive (see Section 4.2.1.3). Assessing the changes to existing natural communities of special concern is also valuable in comparing the overall impacts of the alternatives on the Park's ecological resources.

5.5.8.2 Effects Common to All Alternatives

Differences in field management between alternatives would not influence natural community development in those areas as there would be no conversion to natural communities under any of the alternatives, save for a small strip adjacent to the Pogue Stream, which would be converted under Alternatives C and D.

In addition, there would be no forest management activity in the rich northern hardwood forest to the west of The Pogue under any of the alternatives due to its steep slopes and proximity to The Pogue.

5.5.8.3 Comparison of Alternative Impacts

Changes in forest stand types were described in Section 5.3.2 above. In general, Alternatives A, C, and D would enhance the extent and species composition of

potential natural communities at the Park. This change would happen to the greatest extent in Alternative A because there would be no active management influencing forest species composition. The forest stands would eventually evolve into the most complete representation of their potential natural communities under this alternative.

A significant transition to native plant communities would also occur in Alternative C, but at an accelerated rate. Management would encourage native species in plantation areas because this is in keeping with current thinking for best management of northeastern hardwood forests. There would be a gradual change from existing stand types to potential natural communities as native species regenerate, take hold in the understory, and eventually become dominant as existing mature trees and competing non-native trees are removed. This process would occur over the mid- to long term, as best management practices would still favor the retention of non-native species through their maturity into merchantable timber. This Alternative may not allow the natural communities to reach their full potential species composition and character as in Alternative A, because forest management may favor a greater retention of certain species because of their silvicultural value.

Alternative D would create a more gradual change in the Park's natural communities than in Alternative C, but the transition would be more rapid than under Alternative A. There would also be less area involved in the conversion of plantations to potential natural communities than in Alternatives A or C because some portions of the plantations would be retained. Additionally, the McKenzie site and orchard would be managed to retain some species associated with the homestead (e.g., black locust and apple trees).

Under Alternative B, there would be no changes to the existing natural communities, and no increased benefits to natural communities throughout the Park. Stands would be managed to retain their current species mix and even-aged character, and would not revert to their potential natural community.

5.5.8.4 Conclusions

Overall, Alternative A would have the greatest beneficial impacts on the development of natural communities at the Park. Alternative C would also expand the representation of natural communities throughout the Park, but may not allow them to develop to their full potential. Alternative D would provide the same beneficial changes as C, but to a somewhat lesser extent. Alternative B would not change the existing natural community composition, and therefore would not provide any beneficial impacts to natural community development. None of the alternatives would have major adverse impacts on existing natural communities and, therefore, would not impair these resources.

5.5.9 VEGETATION: NATIVE PLANT SPECIES OF SPECIAL CONCERN

5.5.9.1 Overview

Native plant species of special concern found at the Park are described in Section 4.2.1.4. These species could benefit or be adversely affected by changes in forest type, diversity, and structure (which were discussed in Sections 5.3.2 and 5.3.3 above), and impacts from forestry activities (e.g., ground disturbances).

5.5.9.2 Effects Common to All Alternatives

Under all of the alternatives, forest management activities would be excluded from areas with identified native plant species of special concern (see Section 3.3.2). Therefore, forest management activities (e.g., ground disturbance, changes in canopy closure) would not adversely impact identified plant species of concern.

5.5.9.3 Comparison of Alternatives

The alternatives would differ in their effect on habitat associated with native plant species of special concern. Alternative A would have the greatest beneficial impact on native species of special concern because plantations would eventually be replaced by natural communities. Alternative C also would have potential beneficial impacts to plant species of concern because the amount of habitat that would be suitable for these species would be increased by actively transitioning plantations to native hardwood and mixed forest stands. Alternative D also would have the potential for increasing suitable habitat to species of concern, but not to the same extent as Alternative C. Alternative B would have the fewest changes in habitat, and populations of plant species of special concern would remain largely unchanged.

5.5.9.4 Conclusions

Overall, Alternative A would have a moderate beneficial impacts on habitat associated with native plants of special concern. Alternatives C and D would have minor beneficial impacts to native plant species of concern, but to a lesser extent than Alternative A. There would be no direct impacts to or changes in habitat for plant species of concern under Alternative B. None of the proposed alternatives would have major adverse impacts to the existing plant species of concern and, therefore, would not impair these resources.

5.5.10 VEGETATION: INVASIVE EXOTIC PLANT SPECIES OF CONCERN

5.5.10.1 Overview

Executive Order #13112 on invasive species requires federal agencies to prevent new invasive introductions; detect, monitor, and rapidly respond to/control current infestations in a cost-effective and environmentally sound manner; and educate the public about invasive impacts and control methods. This executive order also prohibits federal agencies from authorizing, funding, or carrying out

actions that they believe are likely to cause or promote the introduction or spread of invasive species.

Non-native invasive plants have the potential to disrupt ecological systems and change the character of the forest composition. Once established in an area, non-native invasive plants can out-compete native shrubs and trees, alter the availability and type of cover and food for wildlife, and influence the historic character of a stand by changing the overall species composition and structure. As discussed in Section 4.2.1.5, non-native plants have been identified in the Park. Forest management activities proposed in this Plan can influence the potential introduction and distribution of invasive plants throughout the Park. Important considerations that influence the potential introduction, distribution, and intensity of treatment for invasive plants include ground disturbances and canopy openings created during forest treatments (i.e., thinning, harvesting, timber stand improvement).

5.5.10.2 Effects Common to All Alternatives

Under all alternatives, the potential introductions of invasive exotic plants could pose an adverse effect on Park resources and would be treated to manage or eradicate the threat. Such actions could include the use of herbicides and mechanical treatments (e.g., using hand-tools for weed removal).

5.5.10.3 Comparison of Alternatives

Alternative A proposes the least amount of forest management activities, and therefore offers the least potential opportunity for increased introduction and distribution of invasive plants.

Alternative B proposes the greatest intensity of forest treatments that would result in ground disturbances and large openings in the forest canopy, particularly as plantations are cleared and reestablished. Therefore, this alternative would create the greatest potential introduction and distribution of invasive plants. However, this alternative also recommends that the current species composition would be retained, thus encouraging the removal of any new introductions of non-native invasive plants that would result from these treatments. While there would be no net change in non-native invasive plant distribution, the treatment approach would require intensive mechanical or chemical control of invasive plants in those areas over the short and mid-term.

Alternatives C and D also would involve forest treatments that create ground disturbances and some canopy openings, but not to the extent of Alternative B. Alternative D also proposes small-scale establishment of plantations, and therefore would have some potential for the introduction of non-native invasive plants as would be the case under Alternative B. However, compared to Alternative B, these areas would be relatively small and invasive plant control could be accomplished primarily through mechanical control measures.

5.5.10.4 Conclusions

Overall, Alternative B would have the potential to create the greatest threat of invasive plant introduction and distribution. These effects would be moderate. They could be mitigated using invasive plant treatments; but the treatments would need to be extensive, would likely require the use of chemical herbicides, and might not always be successful. Alternatives C and D also would have the potential to increase invasive plant introduction and distribution, but the effects would likely be minor and could be mitigated primarily through mechanical treatments. The treatments would be less extensive than in Alternative B, and would have a greater likelihood of being successful. Alternative A would have the least potential for increasing invasive plant introduction and distribution.

5.5.11 FOREST PESTS AND PATHOGENS

5.5.11.1 Overview

Pests and pathogens are an important factor to consider in forest management because they affect the health of trees and hence the productivity and appearance of the Forest. As described in Section 4.2.6.1, assessments of forest pest and pathogens at the Park were conducted as part of a long-term forest dynamic monitoring program and site observations by professional foresters. Additionally, a risk analysis of the potential likelihood and impact of hemlock woolly adelgid was conducted in 2005.[6] Important considerations that influence the likelihood of pest and pathogen challenges include the diversity of species and age classes of forest stands (resilience) and risk of introduction of non-native invasive pests or pathogens (i.e., hemlock woolly adelgid, emerald ash borer, Asian longhorn beetle, etc.).

5.5.11.2 Effects Common to All Alternatives

Under all of the alternatives, there would continue to be a risk of introduction of non-native invasive pests and pathogens from forest management activities (i.e., hazardous tree treatments), maintenance of fields, and visitor use activities (i.e., hiking, horseback riding). As described in Section 3.3.2, the Park would treat populations of pests and pathogens that pose a risk to the Forest. Such treatments could include the use of pesticides and mechanical treatments (e.g., removal of infected trees). The Park will also implement measures to monitor and mitigate the effects of forest pests and pathogens under any of the alternatives. Additionally, a nursery will be established to cultivate replacement trees and shrubs for Park needs, which would decrease the potential of unintentional introduction of non-native invasive pests and pathogens from Park planting activities.

5.5.11.3 Comparison of Alternatives

Forest Stand Type, Diversity, and Structure: Forest stand diversity is an important consideration when assessing potential impacts of pests and pathogens because diversity reduces the portion of the forest that can be affected by any

one type of pest (for example, a forest that is completely hemlock is far more vulnerable to hemlock woolly adelgid than a mixed forest). This diversity also helps the forest as a whole respond to loss of trees or entire species groups from pests or pathogens (e.g., resilience). Analysis of changes in forest stand types and diversity was discussed in Sections 5.3.2 and 5.3.3 above. Overall, Alternative D would create the most resilient forest because it offers the greatest diversity in stand types and some increased diversity of stand age classes. Alternatives A and C would have slightly less overall resilience compared to Alternative D because there would be less diversity in forest stand types across the Park. However, these alternatives would also increase species and age-class diversity within the stands and thereby enhance the Forest's resilience. Alternative B would also offer a diversity of stand types throughout the Park, but many of these stands would be monoculture plantations which have the greatest degree of vulnerability to pests and pathogens. An introduction of a pest or pathogen that affects species in these stands would require extensive pesticide treatments in order to maintain the plantation.

Additionally, under Alternative B the reestablishment of conifer plantations in an even-aged manner (overstory removal or "clear-cutting" and planting seedlings) would also make them more susceptible to both native and non-native insects and diseases which prefer open sunlight (e.g., white pine weevil and white pine blister rust), increasing the likelihood that pesticides would be needed in order to grow healthy trees of desirable form. Under Alternative D, the approach to regenerating conifers in the understory would reduce the likelihood of weevil and blister rust damage and the corresponding potential need for chemical treatment. Additionally, under this alternative the plantations established in open areas would be small and any pest or pathogen outbreak would likely be easy to mitigate.

Risk of Pest and Pathogen Introduction: Under Alternative B, the amount of trees needed to reestablish plantations and maintain the existing composition of hardwood stands would exceed the capacity of the planned on-site nursery. Therefore, there would be a higher risk of pest and pathogen introduction from bought nursery stock purchased from off-site nurseries. Alternative D also proposes reestablishment of some plantation areas. However, the areas would be smaller and therefore sufficient numbers of seedlings could potentially be provided by the proposed nursery. No direct planting is planned in either Alternative A or C; therefore these alternatives would not pose any additional risk of pest and pathogen introduction from nursery stock.

5.5.11.4 Conclusions

Alternative B offers the least resilience and greatest risk of pest and pathogen introduction and therefore would create the greatest risk of negative effects due to pest and pathogens. Mitigation measures under this alternative would likely

require extensive use of pesticides, and might not always be successful. Alternative D would provide the greatest degree of diversity and only a minor increased potential for introduction of pest and pathogens. Mitigation measures under this alternative would likely not involve extensive use of pesticides, and would likely be successful. Alternatives A and C offer less overall stand type diversity throughout the Park but greater diversity within stands, and would not increase potential introductions of pests and pathogens.

5.5.12 NATURAL DISTURBANCE: FIRE

5.5.12.1 Overview

Wildland fires are an important consideration in forest management plans, particularly as changes in recreational use and logging activity could result in an increased potential for people or equipment to start fires.

5.5.12.2 Impacts Common to All Alternatives

As stated in Section 3.3.2, in order to protect the Park's cultural resources and reduce the potential for damage to adjacent property, the Park will take action to suppress all wildland fires within the Park's boundaries, regardless of their origin.

Fine fuels are considered to be the carrier of fire. Most of the Park's forest has a continuous cover of ground fuels in the form of leaf litter, organic materials and woody debris. Regardless of changes in cover type, these fine fuels would remain throughout the Forest.

5.5.12.3 Comparison of Alternatives

Heavier coarse woody debris (e.g., downed fuels) and standing deadwood (e.g., snags) determine the intensity of fire. The alternatives would differ in terms of the Forest's overall vulnerability to and potential magnitude of wildland fires because of different amounts of this type of ground fuels that would be created under each of the alternatives. Changes in levels of CWD and snags were analyzed in Section 5.3.4 above. Overall, Alternatives A, C, and D would increase both CWD and snags in both the short and long term. Alternative A would provide substantially more CWD and snags in the long term, and therefore create the highest risk of a more widespread, intense fire. Alternative B would provide the fewest number of snags and least amount of CWD of any of the alternatives, therefore the Forest's vulnerability to wildfire would likely be slightly less under this alternative.

5.5.12.4 Conclusions

Overall, the likelihood of significant wildland fire is small under any of the alternatives because of the suppression steps the Park will take regardless of which alternative is selected. However, Alternative A has the potential to create the greatest vulnerability of the Park's forest to wildland fires, which could have major adverse effects on Park resources. Alternatives C and D have the potential

to increase the Park's vulnerability to wildland fires, but the increases would be minor and could be mitigated by keeping fuels away from structures, carriage roads, and the Park boundary. Alternative B would have no change on the Park's vulnerability to wildland fires.

5.5.13 NATURAL DISTURBANCES: WEATHER EVENTS (WIND, ICE, AND SNOW)

5.5.13.1 Overview

The risk of impacts from damaging weather events is important to consider in forest management because weather events are a common type of disturbance that could impact cultural resources and ecological systems. The risk of impacts from weather events varies depending on the approach to forest management used and conditions of forest stands. Potential impacts from weather events were based on the overall resilience of the Forest as defined by forest stand diversity. In general, the more overall diversity there is in the Forest, the greater the likelihood that the system can respond to and recover from extreme weather events.

5.5.13.2 Effects Common to All Alternatives

There would be no effects common to all alternatives related to the Forest's vulnerability to damaging weather events.

5.5.13.3 Comparison of Alternatives

Analysis of changes in forest stand types and diversity was discussed in Sections 5.3.2 and 5.3.3 above. Alternative D offers the greatest diversity in stand types and some increased diversity of stand age classes. Alternatives A and C would have slightly less overall resilience compared to Alternative D because there would be less diversity in forest stand types across the Park. However, these alternatives would also increase species and age-class diversity within the stands and thereby enhance the Forest's resilience. Alternative B would also offer a diversity of stand types throughout the Park, but many of these stands would be even-age, monoculture plantations which have the least degree of overall resilience to extreme weather events.

5.5.13.4 Cumulative Effects and Conclusions

Alternative D offers the greatest opportunities for the Forest to resist and respond to changes from natural disturbances. Alternatives A and C would have slightly less overall resilience compared to Alternative D. Alternative B would have the least degree of overall resilience to, and greatest potential of catastrophic loss from, natural disturbances.

5.6 SUSTAINABLE MANAGEMENT PRACTICES

5.6.1 INTEGRATED PEST MANAGEMENT: HERBICIDE USE

5.6.1.1 Overview

As stated in Section 4.3.2, the Park practices an Integrated Pest Management approach to address unacceptable levels of pests. In an IPM approach, chemical and biological controls are only used when other available options are either not acceptable or not feasible. Sections 5.5.10 and 5.5.11 above discussed the degree to which pesticide use would be required under each of the alternatives to address populations of invasive exotic plants and forest pests and pathogens. In addition to treating invasive exotic plants and forest pest and pathogens, pesticides might also be used to manage native vegetation to create the desired forest composition and character. The alternatives would differ in the degree to which chemical control measures would be necessary to achieve the desired forest character.

5.6.1.2 Effects Common to All Alternatives

There would be no effects common to all alternatives.

5.6.1.3 Comparison of Alternatives

Under Alternative B, a concerted effort would be made to maintain the existing forest stands in their current species composition and character, including even-aged monoculture conifer plantations and early-successional forest. However, as discussed in Sections 2.3 and 5.3.2, these forested areas are naturally changing to include a greater component of native late-successional species. In order to control native regeneration and allow conifer seedlings to become reestablished, herbicide use and/or mechanical treatment (e.g., hand lopping) would be necessary. Given the large size of some of the areas that would require treatment (plantation sizes range up to 22 acres), use of substantial amounts of herbicides would be likely. Additionally, herbicide treatment might also be required to maintain current species composition in the naturally regenerated stands.

Alternative D also proposes to manage some conifer stands to perpetuate a dominant conifer composition or, in a few cases, establish new small-scale plantations. However, under this alternative a strategy of encouraging existing conifer regeneration would be pursued, and mechanical treatment (e.g., hand lopping) would be a feasible option for managing the competing hardwoods because of the small areas being considered for initiating new plantations.

Under Alternatives A and C, there would be greater flexibility to allow the species composition of the Forest to change in response to native plant regeneration. Except for treating non-native invasive populations of plants, insects, and disease, as discussed under Sections 5.5.10 and 5.5.11, these alternatives would not require herbicide use.

5.6.1.4 Conclusions

In general, Alternative B may require intensive use of herbicides in order to suppress native species regeneration to achieve the desired forest character, which would negatively impact Park IPM strategies for reducing pesticide use. Alternative D could require limited applications of chemical treatments in some small-scale areas, but this could likely be avoided by using mechanical treatments. In any case, herbicide use under Alternative D would be to a much lesser extent than Alternative B. Alternatives A and C would likely require the least intensive chemical treatment to achieve the desired forest character.

5.6.2 RELATIONSHIPS WITH THE LOCAL FOREST ECONOMY AND OPPORTUNITIES FOR VALUE-ADDED FOREST PRODUCTS

5.6.2.1 Overview

As discussed in Section 4.2, the role of the productive forest in the local economy was an important factor driving Billings to begin his reforestation efforts on Mount Tom. The Forest has continued to contribute to the local economy since that time, and the Park's forest management will sustain that relationship (see Section 3.3.3). In assessing the effects of the alternatives on this topic, important considerations include the relative amounts of wood products harvested from forestry operations that could contribute to value-added markets, and the relative amounts of labor by forestry professionals that would be needed to accomplish the forest management program envisioned for each of the alternatives.

5.6.2.2 Effects Common to All Alternatives

There would be no effects common to all alternatives.

5.6.2.3 Comparison of Alternatives

Value-Added Products: The alternatives will differ in terms of the amount of wood they could contribute to local value-added markets. Alternative A would offer the least opportunity for contributing value-added products to local markets because of the limited timber harvesting that would occur under this alternative. Over the long term, Alternative C would favor growing late-successional native hardwood species, which are most suited for local value-added markets. Alternative D would have the potential to contribute the greatest diversity of wood products for value-added markets. Like Alternative C, it would offer a greater production of hardwoods and could also provide unique large-dimensional wood to specialty markets (e.g., large timbers for repairing historic bridges) because some portions of the conifer plantation would be maintained and the trees would be allowed to grow to large-diameter sizes. Alternative B would have a greater emphasis on growing softwoods, which would have less opportunity to contribute to local value-added markets.

Professional Forestry Services: Under all alternatives, local forestry professionals would be involved to some degree; however, the extent of their involvement

and range of skills required would differ between Alternatives. Alternative A would require the least involvement of local forestry professionals because active forest management would be limited. Alternatives B, C, and D would all require a diversity of skilled professionals and laborers to implement the forestry work proposed under each alternative. Alternative B would require the highest amount of labor in order to maintain plantations and the species composition of hardwood and mixed forest stands, remove competing hardwood regeneration, and control invasive plants.

5.6.2.4 Conclusions

Alternatives B, C, and D all offer potential benefits to the local forest products economy. Alternative C would offer the greatest overall opportunity to provide hardwood products to value-added markets, and would require a diversity of skilled forestry professionals and laborers to implement. Alternative B would have a greater emphasis on non-value-added softwood markets and would require extensive labor investment from local forestry professionals. Alternative D would contribute to the greatest diversity of value-added markets of any of the alternatives, and require a diversity of skilled forestry professionals and laborers to implement. Alternative A would offer limited opportunities to contribute to value-added product markets, and minimal involvement of skilled forestry professionals and laborers to implement.

5.6.3 FINANCIAL SUSTAINABILITY OF FORESTRY OPERATIONS

5.6.3.1 Overview

The Marsh-Billings-Rockefeller Fund of the Woodstock Foundation was created by Mary and Laurance S. Rockefeller, and is dedicated to preservation and conservation work, including forestry, in the Park. It is anticipated that revenue generated from forest management activities will be returned to the endowment to support the ongoing forestry work.

As discussed in Section 5.6.2 above, the alternatives would differ in the amount of labor needed to implement them successfully. The associated costs of labor, as well as supplies (e.g., herbicides), are important considerations for assessing the overall financial sustainability of the forestry operations of each of the alternatives.

5.6.3.2 Effects Common to All Alternatives

There would be no effects common to all alternatives for this topic.

5.6.3.3 Comparison of Alternatives

Alternative A proposes a forest management program that would be the least costly to implement. Expenses would be limited to hazardous tree management and occasional responses to forest damage from weather events or pests. Alternative B proposes a forestry program that would be the most costly to implement. Under Alternative B, the effort to retain, reestablish, and maintain

the plantations would require intensive mechanical and/or chemical intervention with corresponding costs in supplies, labor, harvesting equipment, and personnel. Forest management costs under Alternatives C and D would be substantially less than Alternative B because these alternatives would work with the natural processes of stand development and therefore would not be dependent on, or have associated cost related to, extensive chemical or mechanical intervention. Alternative D would have some additional costs associated with the reestablishment of small-scale plantations, but these would be substantially less than Alternative B.

5.6.3.4 Conclusions

Overall, Alternative B would be the most costly of the alternatives to implement and would be unsustainable under the Park's current budgets. Alternatives C and D would be significantly less costly to implement than Alternative B; and Alternative A would have minimal implementation costs. The forest management programs under Alternatives A, C, and D could all be sustained with the Park's current budgets.

5.7 Effects on Education and Interpretation

5.7.1 EDUCATION AND INTERPRETATION OPPORTUNITIES

5.7.1.1 Overview

As described in Section 4.4, the Park seeks to strengthen the human commitment to stewardship by engaging in educational initiatives and resource management activities that tell the evolving story of conservation; demonstrate sustainable forest management; and encourage reflection, dialogue, and lifelong learning. The type of forest management activities proposed under each of the alternatives would have the potential to influence the range of educational and interpretive opportunities that could be conducted at the Park. In particular, the degree to which contemporary forest stewardship would be practiced under the different alternatives would impact the Park's overall ability to demonstrate sustainable forest management and to invite the public to participate in hands-on learning opportunities that encourage exploration and discussion of contemporary stewardship. Likewise, the degree to which examples of early forest management practices would be retained by the different alternatives would influence the Park's ability to interpret the evolving story of conservation.

5.7.1.2 Effects Common to All Alternatives

As stated in Section 3.3.4, under all of the alternatives the Park will continue to offer a diversity of programs for teachers, students, professionals, landowners, and the general public on topics of conservation and stewardship.

5.7.1.3 Comparison of Alternatives

Alternative A would provide the fewest opportunities to demonstrate sustainable forest management, provide hands-on learning activities that explore contemporary stewardship practices, or demonstrate the evolving nature of forest conservation. This alternative would provide opportunities for exploring the processes of natural forest evolution, although this is not a primary focus of the Park's interpretive mission.

Alternative B would also provide limited opportunities to demonstrate sustainable forest management or provide hands-on learning activities that explore contemporary stewardship practices. However, this alternative would offer the greatest opportunities for visitors to experience examples of reforestation and forest management techniques that were prevalent from the late nineteenth-century to the end of the twentieth century.

Alternative C would offer a greater diversity of opportunities to demonstrate sustainable forest management and provide hands-on learning opportunities about contemporary stewardship practices. However, as with Alternative A, over the long term there would be fewer opportunities to demonstrate and interpret examples of early reforestation and forest management practices that illustrate the evolution of forest conservation.

Alternative D would offer the greatest range of interpretive and educational opportunities. Representative plantations would be maintained or created to illustrate the evolution of forest management practices. Elsewhere, best current thinking and practices in forest management would be applied to create demonstrations and opportunities for the public to learn about contemporary sustainable forest management practices.

5.7.1.4 Conclusions

Overall, Alternative D would create the greatest diversity of learning opportunities related to the Park's mission. Alternative B would favor interpretation of the history of forest stewardship from Billings' initial plantations to the end of the Rockefeller period, and offer few opportunities to demonstrate contemporary forest practices. Alternative C would favor the demonstration of contemporary forest practices, and offer limited opportunities to interpret the history of forest stewardship. Alternative A would offer the fewest opportunities to offer interpretive and education programs related to the Park's mission.

5.8 Effects on Visitor Use and Community Considerations

5.8.1 PUBLIC ACCESS AND RECREATION

5.8.1.1 Overview

As discussed in Section 4.5, recreation has always been an important part of the Park's history. The Park's 20 miles of carriage roads and trails provide extensive opportunities for hiking, snowshoeing, cross-country skiing, horseback riding, and orienteering. Forest management activities proposed in the alternatives could impact opportunities for, and quality of, recreational activities in the Park. In particular, access to certain areas of the Park could be limited during forest management activities because of concerns for visitor safety and some recreational uses may conflict with forestry activities (e.g., maintaining groomed trails for skiing while conducting winter harvesting).

5.8.1.2 Effects Common to All Alternatives

As discussed in Section 3.3.5, under all alternatives the current permissible recreational activities will continue. The carriage roads and trails will be maintained at their current extent and level of care, and potentially hazardous trees will be managed along these corridors. Some former skid trails may be revegetated in the long-term, but this would minimally alter the road and trail network or existing recreational uses. Additionally, as outlined in the conditions of the property's deed and easement held by the Woodstock Resort Corporation, any winter forest management activities would be conducted in a manner that would not impact the Woodstock Resort Corporation's operation and maintenance of the cross-country ski trail system. Also, the Park will establish a notification system to inform visitors about any active forestry operations, temporarily closed areas, and recommended alternative areas in the Park for recreational activities.

5.8.1.3 Comparison of Alternatives

Alternative A would entail limited forestry activities, and therefore would have minimal impact on recreational uses. Alternatives B, C, and D have the potential to impact recreational use in small areas of the Park on a short-term basis when forestry activities are in progress. It is anticipated that most forest treatment activities would require between one to thirty working days to complete. Operating equipment and felling activities could pose hazards to visitors or conflicts with some recreational uses (e.g., startle horses, create noise impacts during hiking experiences). However, the notification system described above should eliminate potential hazards and minimize conflicts.

5.8.1.4 Conclusions

There would be no impacts on recreational uses under Alternative A. In Alternatives B, C, and D, forest management activities would have minor impacts

on recreational activities. However, these impacts would be short-term, would only impact small areas in the Park at any one time, and would not restrict the overall use of the Park for any of the permissible recreational activities.

5.8.2 VISUAL EXPERIENCE

5.8.2.1 Overview

As described in Section 4.6.3, the Park is a unique visual resource for the Woodstock area. Additionally, as discussed in Section 4.1.2, the diversity of visual qualities of forest stands, fields, and open water is one of the Forest's most striking historic characteristics and a source of visitor enjoyment. The forestry activities proposed in the alternatives would alter the forest composition in the long term. Additionally, during and immediately following forestry activities, the visual qualities of forest stands could potentially be altered by increased amounts of slash (e.g., coarse woody debris) and ground disturbance. Forest treatments also could enhance the visual quality of the Forest in the short and long term (e.g., maintaining vistas, thinning understory vegetation to create views into the forest, etc.).

5.8.2.2 Effects Common to All Alternatives

There would be no effects common to all alternatives for this topic.

5.8.2.3 Comparison of Alternatives

Alternative A would have the greatest effect on the existing visual resources in the Park. Under this alternative, as the forest matures there would be increased crowding, limited views into the forest, and a change in the Park's overall forest composition to predominantly native hardwoods in both the short and long term. This would limit the diversity of views and scenic experience from the carriage roads and trails, and diminish the characteristics that distinguish the Park from surrounding forests when viewed from different locations in Woodstock. Additionally, with the limited amount of forestry activity, over the long term there would be substantial quantities of coarse woody debris in the Forest.

Alternative C would have similar impacts on visual resources as Alternative A in terms of changes in forest composition. Under this alternative, vistas along the carriage road to adjacent lands would be maintained, but the practice of thinning and removing the understory to create views into the forest along the carriage road would not be continued.

Alternative B would most closely replicate the visual qualities of the Forest that exist today over the long term. It would maintain the current composition and character of forest stands, internal and external views, and would remove slash from forest management activities to maintain the existing aesthetic appearance along the carriage roads and trails. However, this alternative also recommends

replacement of plantations as they age and decline. The process of replacing plantations would require removal of trees over large areas (in some cases, more than 20 acres). The clear-cutting and soil disturbance created during these treatments would extensively alter the visual experience of the Park and views of the Park from Woodstock. These visual impacts would persist until the replanted trees become established (i.e., approximately twenty-five to fifty years after they are planted).

Alternative D would retain the diversity of the existing visual qualities along the primary carriage road corridors. Elsewhere, plantations would transition to native hardwood and mixed forest stands, offering less visual contrast with the surrounding hardwood forest. However, these stands would be managed to retain remnant plantation trees and legacy trees over the long term, thus creating a forest with a strong sense of history and overall diversity. The approach may diminish some of the characteristics that distinguish the Park from the surrounding landscapes. However, key views of the Park from Woodstock (e.g., from along the eastern part of Route 12, and from Route 4 looking up to the larch and spruce plantations) would retain their unique character. Under this alternative, vistas along the carriage roads to the surrounding landscape and selective views from the carriage roads into the Forest would be maintained. Slash from forestry activities would be minimized along the primary carriage road corridors, but not removed from elsewhere in the Forest. The reestablishment of plantations under this alternative would not be extensive and would not require large-scale clearing as in Alternative B; therefore, the visual qualities of the Forest would not be extensively impacted.

5.8.2.4 Conclusions

Overall, Alternative D would retain the greatest visual diversity and offer the fewest visual impacts of the alternatives. Alternative B would maintain the existing visual diversity, but would have major negative visual impacts when plantations are cleared and replanted. Alternatives A and C would reduce the overall visual diversity of the Forest and would result in higher levels of slash throughout the Forest, which could be considered a negative visual impact.

5.8.3 SOUNDSCAPES

5.8.3.1 Overview

Director's Order #47 requires the NPS to protect, maintain, or restore natural soundscape resources in a condition unimpaired by inappropriate or excessive noise sources, to the fullest extent practicable. Although ambient noise levels have not been measured in the Forest, the existing soundscape can be inferred based on noise levels typically associated with similar land uses (e.g., associated with residential, agriculture, and natural areas). For the land uses in and around the Park, noise levels of 60 to 75 dB are generally considered normal and acceptable.[7]

Impacts from noise production are generally assessed with respect to changes in noise levels experienced at sensitive receptors (e.g., adjacent residents, schools, churches, and areas with threatened and endangered wildlife). Changes in sound levels in the Park, particularly extensive increases in the time and intensity of sound from forestry equipment, could adversely affect visitor experiences, nearby residences, and the use of the area by wildlife.

5.8.3.2 Effects Common to All Alternatives

There would be no effects related to soundscapes that would be the same under all alternatives.

5.8.3.3 Comparison of Alternatives

Under Alternative A, there would be limited use of chainsaws and other forestry equipment for hazardous tree management, mowing fields, and repairing roads.

Alternatives B, C, and D would have the same sources of noise as Alternative A, but the amount of noise from forestry equipment (e.g., chainsaws, tractors, forwarders, skidders, and logging trucks) would increase relative to current conditions. Forest management activities would occur occasionally throughout the year under all three of these alternatives. It is estimated that forestry equipment and vehicles would operate for no more than eight hours per day and most treatment activities would last between one to thirty days. Sound levels from forestry equipment would range from 60 decibels to 103 decibels; the noise would not be continuous.[8]

There are several nearby residences that border the Park. The majority of those closest to the Park are on the southeastern border near the Mansion Grounds and within the village of Woodstock. This area of the Park also has sensitive wetland habitat, and would not likely receive any extensive forest management treatments under any of the alternatives. In most instances, forestry activities would be removed both in distance and in topography from nearby residences, and the noise levels would be reduced by the terrain, foliage, or other site variables.

In addition to these potential effects on adjacent residents, visitors and wildlife also could be disturbed during forestry operations. Visitors would be informed of where forestry activities were occurring and could select alternative routes to avoid noise disturbances during the short times that forestry work is underway. Since this disturbance would be only occasional and short-term, any displaced wildlife would likely move back into suitable habitat in the same general area after treatments.

5.8.3.4 Conclusions

Under all of the alternatives, forestry operations would contribute to an increase in noise. Under Alternative A, the increase would be negligible. Under Alternatives

B, C, and D, the increase in noise would be occasional, intermittent, and last for relatively short periods of time. This would result in a minor impact on the soundscapes of the Forest and adjacent areas, but would not impair soundscape resources of the Park.

5.9 Other Topics Considered, But Dismissed from Further Analysis

NEPA emphasizes the importance of adjusting the scope of each environmental assessment (EA) to the particulars of the project and its setting, and focusing on the specific potential impacts of that project. There is no need to assess potential impacts on resources that are either not present or would not be affected by the alternatives in any measureable way. For this EA, topics that were identified as not requiring detailed analysis included geological resources, floodplains, air quality, Indian Trust resources, ethnographic resources, and environmental justice in minority and low-income populations. Each is discussed briefly below.

5.9.1 GEOLOGICAL RESOURCES

The Park's geological resources were assessed by consulting existing state-wide surficial and sub-surface geological maps (see Section 4.2.2). Locations of rock outcrops that were historically altered as part of the road-building activities were recorded and mapped in the Cultural Landscape Report for the Forest. Activities in this Plan primarily address vegetation management and preservation of existing features related to the carriage roads, including rock outcrops. It is not anticipated that activities proposed by any of the alternatives would affect geological resources. Therefore, this topic was dismissed from further analysis.

5.9.2 FLOODPLAINS

Executive Order 11988 requires federal agencies to examine potential risks and impacts of management activities on floodplains. The project area is not within a 100- or 500-year floodplain.[9] Therefore, this topic was dismissed from further analysis.

5.9.3 AIR QUALITY

The 1963 Clean Air Act, as amended (CAA) (42 USC 7401 et seq.), provides for the protection of air quality–related values (including visibility, plants, animals, soils, water quality, cultural and historic objects, and visitor health) on federal lands from adverse air pollution impacts. Under all of the alternatives, the Park will work with the NPS Northeast Temperate Inventory and Monitoring Program and other agencies to assess changes in air quality and its related effects on Park resources. (See Section 3.3.6 for further discussion.)

The Clean Air Act and the NPS 2001 Management Policies also recognize the need to analyze impacts to air quality during park planning. Section 118 of the CAA requires the Park to meet all federal, state, and local air pollution standards. Section 176(c) of the CAA requires all federal activities and projects to conform to state air quality implementation plans to attain and maintain National Ambient Air Quality Standards. The Park is located in a mandatory Class II clean air area.[10] Under the CCA, maximum allowable increases of sulfur dioxide, particulate matter, and nitrogen oxide beyond baseline concentrations established for Class II areas cannot be exceeded. Under any of the alternatives, emissions from forestry activities (e.g., from the operations of forestry equipment) would be short-term, localized, and would have a negligible effect on regional or local pollutant levels. Therefore, this topic was dismissed from further analysis.

5.9.4 INDIAN TRUST RESOURCES

Secretarial Order 3175 requires that any anticipated impacts to Indian Trust resources from a proposed project or action by U.S. Department of Interior agencies be explicitly addressed in environmental documents. The Federal Indian Trust responsibility is a legally enforceable fiduciary obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights, and it represents a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes. There are no Indian Trust resources in the Park. The lands comprising the Park are not held in trust by the Secretary of the Interior for the benefit of Indians due to their status as Indians. Therefore, Indian Trust Resources was dismissed from further analysis.

5.9.5 ETHNOGRAPHIC RESOURCES

As described in Section 4.1.4, an ethnographic resource is any "site, structure, object, landscape, or natural resource feature assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it." The relationship between the Mount Tom Forest and the local community has been an important part of the property's history. As outlined in the General Management Plan and established in the deed that conveyed the property to the NPS, some long-standing uses of the property by local residents (e.g., hunting, fishing, camping, campfires, motor vehicles, mountain biking, and swimming) are prohibited. These restrictions will be adhered to under any of the alternatives. Views to and of the Park from Woodstock village and other surrounding locations are also part of the local community's connection with the property. Potential effects of the alternatives on visual resources were analyzed in Section 5.8.2 above. Aside from those considerations, there would be no effect on ethnographic resources under any of the alternatives. Therefore ethnographic resources were dismissed from further analysis.

5.9.6 ENVIRONMENTAL JUSTICE IN MINORITY AND LOW-INCOME POPULATIONS

Executive Order 12898 requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects on minority and low-income populations. None of the alternatives would have health or environmental effects on minorities or low-income populations or communities. Therefore, this topic was dismissed from further analysis.

5.10 Cumulative Effects

The term "cumulative effects" is a NEPA term that relates to overall effects on the environment that could result from a potential federal action when added to the effects of other past, present, and reasonably foreseeable future actions regardless of who may initiate such action or where they may occur. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.[11]

In the context of this Plan, the consideration of actions that could contribute to cumulative effects on the resources of the Forest can be reasonably divided into two primary geographic contexts: on-site actions (i.e., within the Park and Forest itself) and broader actions (i.e., regional and global actions and trends that may be beyond the control of the Park).

With respect to the effects of on-site actions, prior actions within the Forest from Frederick Billings' time through the Rockefellers' tenure are directly responsible for creating the diversity of significant resources for which the Park was established. Since the Park's establishment, NPS management actions in the Forest have been limited and conservative because of the recognized need for a thoughtfully developed plan that would identify an overall management direction and specific guidelines and actions that would protect and enhance the Park's significant values. Future on-site actions will be consistent with this Plan and any subsequent revisions or amendments, which will ensure that the cumulative effect of on-site actions will not impair Park resources.

There are many broader actions and external changes that may affect the Forest, but that cannot be fully assessed when comparing the different alternatives. For example, these broader changes could include changes in atmospheric deposition and climate, alternations in adjacent land use, or new introductions of invasive exotic plants, pests, or pathogens. The complexity and magnitude of these changes are difficult to predict, assess, and control. However, the Park recognizes that the long-term viability of the Forest and its significant resources could be influenced by changes in external conditions. To address these unknowns, the Park is committed to an adaptive management approach that will include an ongoing

program to monitor these trends and adjustments to management activities in response to external change (see Sections 3.3.6 and 4.7).

5.11 IMPAIRMENT

Impairment is an impact so severe that, in the professional judgment of a responsible NPS manager, it would harm the integrity of Park resources or values and violate the 1916 NPS Organic Act.[12] Based on the analysis of impacts presented in Sections 5.4 to 5.10 above, Alternatives B and D would not impair any Park resources. However, Alternatives A and C would diminish the Forest's historic character related to the property's association with Frederick Billings, pioneering nineteenth-century forestry, continuous forest management, and landscape design. These changes would result in a major or moderate adverse impact on cultural landscape resources. Under the provisions of the National Historic Preservation Act and associated regulations, the impacts of these alternatives on the integrity of the cultural landscape would be considered adverse effects, and therefore could be considered an impairment of cultural landscape resources.

5.12 ENVIRONMENTALLY-PREFERRED ALTERNATIVE

In accordance with the National Environmental Policy Act and agency policies, the National Park Service is required to identify the "environmentally preferred alternative(s)" for any of its proposed projects. In essence, the environmentally preferred alternative would be the one(s) that "causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources."[13]

More specifically, the environmentally preferred alternative is determined by applying criteria established in the National Environmental Policy Act and promulgated by the Council on Environmental Quality (CEQ). The CEQ directs that "[t]he environmentally preferable alternative is the alternative that will promote the national environmental policy as expressed in NEPA's Section 101. This includes alternatives that:

1) Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

2) Ensure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings;

3) Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;

4) Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;

5) Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and

6) Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources."

Of the four alternatives presented in this Plan, Alternative D is the environmentally preferred alternative because it addresses these NEPA goals most completely. It would provide the greatest simultaneous retention of the Forest's historic landscape character and enhancement of the Park's ecological values, educational opportunities, and sustainable operations.

Over the long term, Alternative A would create a greater degree of ecological diversity, but it would have major adverse effects on some of the Park's historic cultural landscape resources. Alternative C would have moderate adverse effects on some cultural landscape resources, although it would maintain the traditions of sustainable forest management and foster greater ecological diversity. Alternative B would preserve the Park's historic characteristics to the greatest degree, but in so doing would have numerous adverse effects on natural resources, aesthetics, and sustainable operations.

5.13 NPS-Preferred Alternative

Alternative D is the NPS-preferred alternative because it offers a strategy for holding on to many of the historic characteristics of the Forest by maintaining broad landscape patterns and representative features, while also recognizing the challenges of ecological change in managing a dynamic cultural landscape. Alternative A takes no long-term proactive steps to address this fundamental challenge. Alternative C defines the "essential character," rather narrowly by focusing only on continuing the tradition of applying the best current thinking and practices in forest management, and thus failing to preserve some of the historic landscape features that illustrate the unique legacy of forest management that gives the Forest its national significance and enduring sense of history. Applying Alternative B to re-create the historic softwood plantations would be in direct conflict with the ecological conditions faced today. To attempt to turn back the clock on forest growth and change under this alternative would require intensive clear-cutting and removal of competing regeneration, either through labor-intensive manual treatments or herbicide applications. This would be inconsistent with the conservation mission of the National Park Service and outside the norms of contemporary ecosystem and sustainable forest management, and would undermine the financial sustainability of the Park's operating budgets.

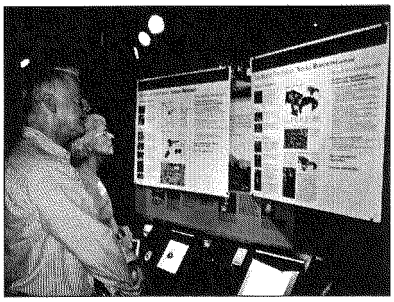
By emphasizing the integration of natural and cultural values, Alternative D reflects a promising direction in conservation philosophy and practice. Alternative D combines an historic preservation perspective that incorporates the role and influence of natural succession and ecological processes, and a natural resource conservation perspective that is informed and shaped by a sense of history and stewardship.

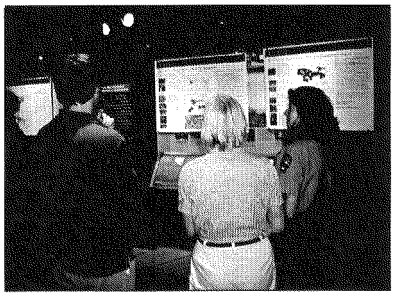
ENDNOTES TO PART 5

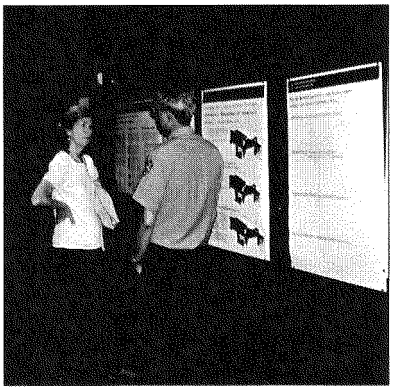
[1] NPS 2001.
[2] Keeton 2005.
[3] NPS 2001.
[4] VanOttigen July 10, 2005.
[5] Keeton 2005.
[6] Machin et al. 2005.
[7] HUD 1991.
[8] Measurements of noise generation during forest management activities at the Park are not available. Data are from the Occupational Safety and Health Administration (OSHA) and Louisiana Forest Products Development Center, Louisiana State University Agricultural Center (2003). Measurements for forestry equipment are based on average readings taken 10 feet from equipment operating at full throttle.
[9] ESRI/FEMA 2002.
[10] NPS 1999.
[11] CEQ NEPA Regulations, 40 C.F.R Part 1508.7
[12] NPS 2001.
[13] NPS 2001.

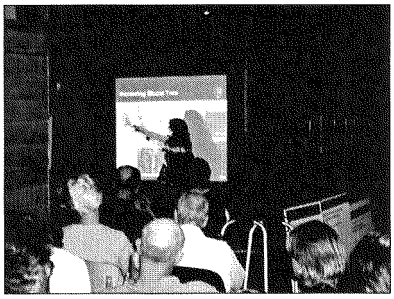
(OCLP 2003)

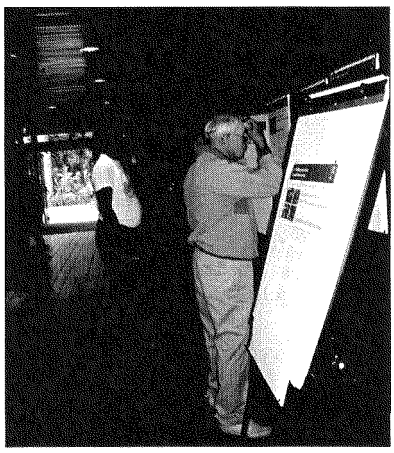
PART 6: PREPARERS, PUBLIC INVOLVEMENT, AND AGENCY CONSULTATION











Part 6: Preparers, Public Involvement, and Agency Consultation

Photographs from the Forest Management Plan open house. (MABI 2004)

6.1 PREPARERS

6.1.1 PLANNING TEAM

The team responsible for developing this Forest Management Plan and Environmental Assessment for Marsh-Billings-Rockefeller National Historical Park was established in 2003 and includes:

Marsh-Billings-Rockefeller National Historical Park
- Rolf Diamant, Superintendent
- John Gilbert, Facility Manager
- Janet Houghton, Curator
- Kyle Jones, Ecologist
- Christina Marts, Resource Manager
- Joanna Bould, SCA Unilever Intern (2004)
- Justin Bangs, SCA Unilever Intern (2005)

NPS Conservation Study Institute
- Nora Mitchell, Director
- Delia Clark, Director for Community Engagement
- Daniel Laven, Outdoor Recreation Planner

Olmsted Center for Landscape Preservation
- Bob Page, Director
- Margie Coffin Brown, Historical Landscape Architect
- Jeff Killion, Historical Landscape Architect
- John Auwaerter, Historical Landscape Architect

Phil Huffman, Planning Consultant

Redstart Forestry, Inc.
- Virginia Barlow, Consulting Forester
- Markus Bradley, Consulting Forester
- Ben Machin, Consulting Forester and GIS Consultant

Woodstock Foundation, Inc.
- David Donath, President
- Marian Koetsier, Administrative Officer

Carolyn Bennett, ThinkGIS

Jane Crosen, Crackerjack Editorial Services

6.1.2 ADVISORS

6.1.2.1 National Park Service, Northeast Region

Dave Clark, Program Manager, Environmental Protection
Alan Ellsworth, Hydrologist
Mary Foley, Chief Scientist
Betsy Lyman, Coordinator, Exotic Plant Management Team
Greg Shriver, Coordinator, Northeast Temperate Inventory and Monitoring Network
Chuck Smythe, Ethnographer and Park 106 Advisor
Jennifer Waite, Director of Vermont Projects, Rivers and Trails
Paul Weinbaum, Program Manager, History and Park 106 Advisor

6.1.2.2 Town/Village of Woodstock, Vermont

Michael Brands, Town Planner
Steve Clark, former chair, Woodstock Conservation Commission
Lea Kachadorian, Woodstock Conservation Commission
Byron Quinn, Chair, Woodstock Conservation Commission

6.1.2.3 Other Agencies, Organizations, and Individuals

Nancy Bell, The Conservation Fund
Dale Bergdahl, Rubenstein School of Environment and Natural Resources, University of Vermont
Jon Bouton, Windsor County Forester
Dave Capen, Rubenstein School of Environment and Natural Resources, University of Vermont
MaryBeth McCubbin, Department of Landscape Architecture, Pennsylvania State University (formerly)
Janis Chiappetta, Woodstock Union Middle School
Bob Cooke, USDA Forest Service State and Private Forestry
Doug Cross, Woodstock Union High School
John Dumville, Vermont State Historic Preservation Office
Judith Ehrlich, Vermont State Historic Preservation Office
John Elder, Department of English, Middlebury College
Steve Faccio, Vermont Institute of Natural Sciences
James Finley, School of Forest Resources, Pennsylvania State University
Elsa Gilbertson, Vermont State Historic Preservation Office
Eric Gilbertson, Vermont State Historic Preservation Office
Forrest Hammond, Department of Fish and Wildlife, Vermont Agency of Natural Resources
Rob Hanson, Pomfret School
John Heirs, Woodstock Union High School
William Jenney, Vermont State Historic Preservation Office
William Keeton, Rubenstein School of Environment and Natural Resources, University of Vermont

Dave Lacy, Archeologist, USDA Forest Service and Park 106 Advisor
Anne Lassard, Woodstock Union Middle School
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Kathy Sennall, Woodstock Elementary School
John Souter, Woodstock Elementary School
Ken Tamminga, Department of Landscape Architecture, Pennsylvania State University
Geri Tierney, Department of Environmental and Forest Biology, State University of New York
Laurel Tobiason, Woodstock Union High School
Grace Wang, School of Forest Resources, Pennsylvania State University (formerly)
Sarah Woodhead, Pomfret School
Tom Yahner, Department of Landscape Architecture, Pennsylvania State University

6.1.2.4 Special Thanks

Pete Fellows, Two-Rivers Ottauquechee Regional Planning Commission
Greg Sharrow, Vermont Folklife Center
John Wiggin, Consulting Forester
Chuck Wise, Two-Rivers Ottauquechee Regional Planning Commission

6.2 PUBLIC INVOLVEMENT AND AGENCY CONSULTATION

6.2.1 PUBLIC INVOLVEMENT

The National Park Service has taken a comprehensive approach to public involvement. To date, the Park has prepared or held the following events to encourage broad public discussion about the Forest Management Plan:

- A letter announcing the initiation of the Plan and encouraging public involvement was published in the *Vermont Standard* in August 2003. The *Standard* is distributed to 4800 residents, primarily within the ten towns of Windsor County, Vermont.

- An announcement letter and a copy of "Trees and Ideas" by Tom Slayton (published in *Vermont Sunday Magazine*, November 16, 2003) was distributed

in February 2004 to the Forest Management Plan mailing list, composed of approximately 800 organizations, local, state, and federal agencies, Woodstock residents, and other interested stakeholders. The mailing solicited approximately ten responses.

- A display introducing the Forest Management Plan and topics of potential interest was exhibited at the Park's visitor center from September 27, 2003 to the end of December 2003. The exhibition of the display was announced in the Forest Celebration Weekend event publication that was distributed to over 1000 individuals and organizations on the Park's public event mailing list. Over fifty comments were written on the interactive visitor response boards of the display.

- Several focus group meetings were conducted as part of the scoping process. These included meetings with local teachers (October 7, 2003), staff of the Vermont Institute of Natural Sciences (April 29 2004), several Park cooperators (May 20, 2004), and researchers from the University of Vermont (June 4, 2004).

- A public scoping workshop was held on June 15, 2004 at the Park. An announcement for the workshop was distributed to the 800 individuals on the Forest Management Plan mailing list; posted in public buildings around Woodstock, Quechee, Windsor, and other local towns; printed in the *Vermont Standard*, *Rutland Herald*, and *Valley News*; and submitted to a number of environmental and forestry email list-serves.

- A correspondent from the *Vermont Standard* attended the scoping workshop on June 15, 2004, and wrote an article that discussed the Plan, draft alternatives, and opportunities for public input. The article was distributed in the paper on June 17, 2004.

- Several staff-led hikes on the "Future of the Forest" were offered during the summer of 2003 and 2004, and advertised in Park brochures and local papers.

- Individual meetings were held with local officials including the Woodstock Town Planner, Woodstock Conservation Commission, and Billings Park Commission throughout the planning process.

- Park staff met and discussed the Plan with the boards and representatives from various local forestry organizations, including Vermont Woodlands Association, Vermont Coverts, and Forest Stewards Guild.

- A memory workshop with local foresters, loggers, tree farm managers, and conservationists was held as part of the Forest Festival Weekend in September 2004. The workshop was facilitated by the Vermont Folklife Center, and

the public was invited to participate in listening to the personal accounts of the panel and contribute their own thoughts about the stewardship of local forests and Mount Tom. A total of approximately twenty people participated in the workshop.

- A workshop lead by William Cronon and Edward Linenthal on "Contested Landscapes: Humans and Nature in National Parks" was held September 23–24, 2004 at the Park. During the workshop, the Forest Management Plan was presented and discussed as a case study in a public evening program to an audience of over 100 participants. The workshop was part of the NPS Northeast Region civic engagement initiative to expand the relevance of parks through meaningful public engagement.

- During the George Wright Society "People, Places, and Parks: Preservation for Future Generations" meeting on March 14, 2005 the draft Plan and alternatives were presented to a group of thirty NPS colleagues and other interested professionals. The GWS is a non-profit association whose goal is to foster the protection, preservation, and management of cultural and natural parks and resources through research and education.

- A newsletter that contained overviews of the need for the Plan, proposed management goals, draft alternatives, and information for public involvement was sent to the 800 individuals and organizations on the Forest Management Plan mailing list in March 2005. The newsletter solicited two email responses.

- An article about the Plan and planning process was published in "Forest Matters," the stewardship newsletter of the USDA Forest Service Northeast Area State and Private Forestry. The newsletter is distributed to approximately 1500 natural resource professionals, consulting foresters, and private forest landowners throughout the Northeast and Midwest.

- Consultation as part of Section 106 of the National Historic Preservation Act was conducted with the Vermont State Historic Preservation Officer and staff. Meetings were held on March 19, 2004 and October 21, 2004 to review the need for the Plan, discuss management approaches, potential issues, and Section 106 compliance review. After reviewing a draft of the Plan, in a letter dated August 30, 2005, the SHPO concurred with the Park's assessment that Alternative D, Recognize and Work with Ecological Change in Preserving the Historic Character of the Forest, is the most appropriate treatment approach of the four alternatives.

- Consultation as part of Section 404, wetlands, was conducted through a site visit with Mike Adams, Army Corps of Engineers, Section 404 coordinator on May 6th, 2004.

- Consultation as part of the Endangered Species Act (ESA) (16 USC 1531-1544) was conducted through U.S. Fish and Wildlife Service review of the draft Forest Management Plan. In a letter dated July 10, 2005, Susi VanOttigen, USFWS Endangered Species Coordinator, determined that none of the actions proposed within the Plan will impact known federally listed Rare, Threatened or Endangered species.

6.3 List of Agencies and Organizations to Which Copies of the Draft Plan/EA Will Be Distributed

An announcement publicizing the availability of the Draft Plan and Environmental Assessment will be distributed widely through the Park's Forest Management Plan mailing list (composed of approximately 800 organizations, local, state, and federal agencies, local residents, and other interested stakeholders), the Park's website, and local papers. In addition, the agencies and organizations below will be sent a copy of the Draft Plan and EA.

6.3.1 LOCAL

Chateauguay No Town Conservation Committee
Office of the Town and Village Manager, Woodstock, Vermont
Office of the Town and Village Planner, Woodstock, Vermont
Two-Rivers Ottauquechee Regional Planning Commission
Woodstock's Billings Park Commission
Woodstock Conservation Commission

6.3.2 STATE

Vermont Agency of Natural Resources
    Department of Fish and Wildlife
    Department of Forest, Parks, and Recreation
    Non-game and Natural Heritage Program
Vermont Division of Historic Preservation, State Historic Preservation Office

6.3.3 FEDERAL

Natural Resource Conservation Service
USDA Forest Service
Gray Towers National Historic Site
Green Mountain National Forest
State and Private Forestry
U.S. Fish and Wildlife Service
Office of Senator Jeffords

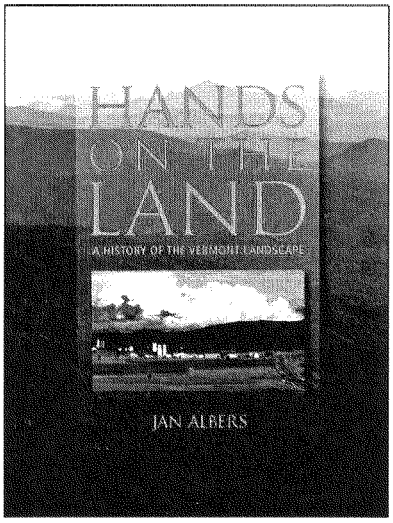
Office of Senator Leahy
Office of Representative Sanders

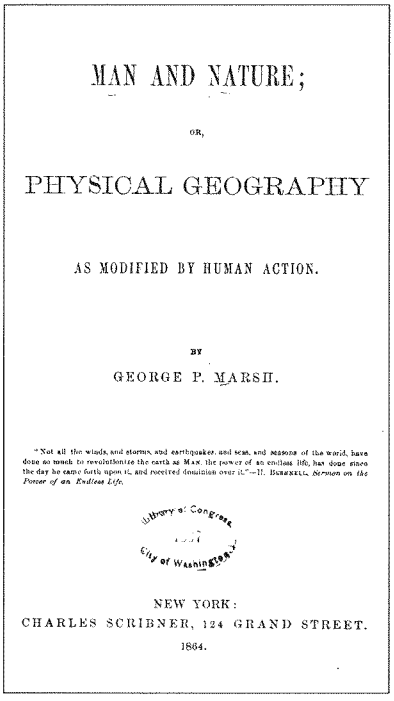
6.3.4 OTHERS

Billings Farm & Museum
Clemson University, Department of Planning and Landscape Architecture
The Conservation Fund
Forest History Society
Forest Stewards Guild
Green Mountain College
Harvard Forest
Middlebury College
National Wildlife Federation
New England Forestry Foundation
Norman Williams Public Library
Paul Smiths College
Pinchot Institute for Conservation
Presidio Trust
University of Vermont, Sustainable Forestry Program
University of Vermont, Rubenstein School of Environment and Natural Resources
Vermont Coverts, Inc.
Vermont Institute of Natural Science
Vermont Woodlands Association
Woodstock Foundation, Inc.
Woodstock Resort Corporation

(OCLP 2003)

PART 7: REFERENCES




MAN AND NATURE;

OR,

PHYSICAL GEOGRAPHY

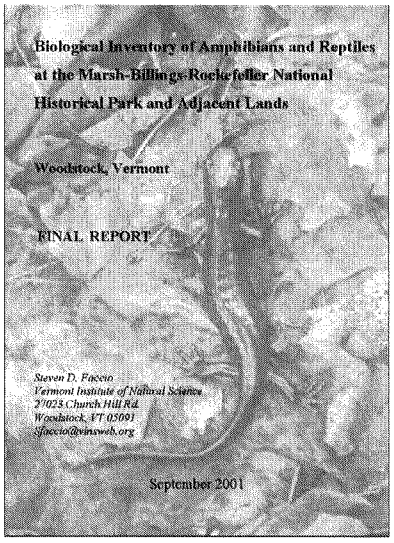
AS MODIFIED BY HUMAN ACTION.

BY

GEORGE P. MARSH.

"Not all the winds, and storms, and earthquakes, and seas, and seasons of the world, have done so much to revolutionize the earth as MAN, the power of an endless life, has done since the day he came forth upon it, and received dominion over it."—H. BUSHNELL, *Sermon on the Power of an Endless Life.*

NEW YORK:
CHARLES SCRIBNER, 124 GRAND STREET.
1864.



Covers from a few of the works cited in this report. (MABI)

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7.2 Description of Guiding Laws and Policies

All activities at Marsh-Billings-Rockefeller National Historical Park are governed by the 1916 Organic Act that created the National Park Service and established the Park Service's mission:

> "...to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

The Park's legislative mandate is further articulated in its enabling legislation of 1992 (Public Law 102-350).

National Environmental Policy Act (NEPA) (42 USC 4321-4370): As a federal property, the Park is subject to the provisions of the NEPA, which require an evaluation of the impacts associated with federal actions. This requirement was initially met through the preparation of a Final Environmental Impact Statement (FEIS) for the Marsh-Billings-Rockefeller NHP. No major changes are proposed in this Forest Management Plan. The description of alternatives will address alternative forest management options that are within the framework of the guidance set by the General Management Plan. Impacts on natural and cultural resources are evaluated in greater detail in this document. Any future modifications to this Plan would be reviewed through the NEPA process, and where relevant to cultural resources, reviewed in accordance with Section 106 of the National Historic Preservation Act.

Council on Environmental Quality (CEQ) Regulations for Implementing NEPA (40 CFR 1500-1508): These regulations provide specific direction to federal agencies in achieving the goals of the NEPA Act. The environmental information must be available to the public and must concentrate on the issues that are truly significant to the action in question.

National Historic Preservation Act (NHPA) (16 USC 470 et seq.): In accordance with NHPA, federal agencies are required to take into account the effects of their actions on properties listed or eligible for listing on the National Register of Historic Places. The Marsh-Billings-Rockefeller NHP is listed on the National Register. Historic buildings, historic landscapes, historic circulation systems, and archeological resources all contribute to this significant designation. All undertakings with the potential to affect the historic character or potential archeological resources of the Park property require Section 106 compliance review (as mandated by the National Historic Preservation Act) to ensure protection of cultural resources. Review and consultation with the Vermont Historic Preservation Officer will be undertaken through the development of a programmatic agreement to assure compliance with Section 106 of the National

Historic Preservation Act. All actions and projects that involve ground disturbance in sensitive areas and changes to the cultural landscape implemented under the Plan will be assessed for conformance with the Secretary of the Interior's Standards for the Treatment of Historic Properties.

The Secretary of the Interior's Standards also provide professional standards on the preservation and protection of all cultural resources listed on or eligible for listing on the National Register of Historic Places. These standards are codified in 36 Code of Federal Regulations, Part 68, and apply to the treatment of the Park's cultural resources, including the historic Mount Tom Forest. The standards prescribe four distinct, but interrelated approaches to treatment of historic properties—preservation, rehabilitation, restoration, and reconstruction. As specified in the Park's General Management Plan, the Park will focus on rehabilitation as the general treatment approach. Rehabilitation acknowledges the need to alter or add to a historic property to meet continuing or changing uses while retaining the property's historic character.

Endangered Species Act (ESA) (16 USC 1531-1544): The Endangered Species Act is addressed as part of the NEPA compliance process. Potential impacts to endangered and other special-status species are assessed. Federal agencies are required by the Endangered Species Act of 1973 to consult with the U.S. Fish and Wildlife Service (USFWS) to ensure that their actions do not jeopardize the continued existence of any species listed as an endangered or threatened species or its critical habitat.

Clean Water Act (CWA) (33 USC 1251 et seq.): Section 404 regulates the discharge of pollutants, including dredged or fill material, into navigable waters of the U.S. through a permit system jointly administered by the U.S. Environmental Protection Agency (USEPA) and the U.S. Army Corps of Engineers (USACE). Non-point sources requirements control pesticide runoff, forestry operations, and parking lots/motor pools. Point sources require individual or group permits and must be monitored at the point at which they enter public waters, storm sewers, or natural waterways.

Clean Air Act (CAA) (42 USC 7401 et seq.): Among its varied provisions, the CAA establishes standards for air quality in regard to the pollutants generated by internal-combustion engines. These standards, known as the National Ambient Air Quality Standards (NAAQS), define the concentrations of these pollutants that are allowable in air to which the general public is exposed ("ambient air").

Archaeological Resources Protection Act (ARPA) 16 USC 470a et seq.): Ensures the protection and preservation of archeological resources on federal lands.

E.O. 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations: Requires federal actions to achieve

Environmental Justice by identifying and addressing disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.

E.O. 11990: Protection of Wetlands: An overall wetlands policy for all agencies managing federal lands, sponsoring federal projects, or providing federal funds to state or local projects. It requires federal agencies to follow avoidance/mitigation/preservation procedures with public input before proposing new construction projects.

E.O. 11988 Floodplain Management: Requires all federal agencies to take action to reduce the risk of flood loss, to restore and preserve the natural and beneficial values served by floodplains, and to minimize the impact of floods on human safety, health, and welfare. Because many wetlands are located in floodplains, E.O. 11988 has the secondary effect of protecting wetlands.

E.O. 13112 Invasive Species: Requires federal agencies to prevent new invasive introductions; detect, monitor, and rapidly respond to/control current infestations in a cost-effective and environmentally sound manner; and educate the public about invasive impacts and control methods. Prohibits federal agencies from authorizing, funding, or carrying out actions that they believe are likely to cause or promote the introduction or spread of invasive species.

National Park Service Management Policies (NPS 2001): A management policy document that sets the framework and provides direction for all decisions within NPS. This document establishes the NPS policies for natural and cultural resource management.

National Park Service-77, Natural Resource Management Guidelines (NPS 1991) and DO-28, Cultural Resource Management Guidelines (NPS 1998): These service-wide guidelines establish the basic principles and objectives for natural and cultural resource management by the NPS and define the steps for developing an ecologically sound and historically sensitive vegetation management program. They provide general guidance for NPS actions under this Plan as well as program guidance for future action plans that will address site-specific vegetation management activities.

State Permitting Requirements: Federal agencies are not subject to state or local regulations unless specified by Congress. Although forest management activities on federal lands do not fall under the jurisdiction of Vermont's comprehensive land use regulations (Act 250), the NEPA requirements (impact analysis and public involvement) being conducted through this planning process accomplish similar purposes. In addition, the forest-wide best management practices proposed in this Plan were developed to meet or exceed Vermont Acceptable Management Practices (see Appendix C).

7.3 GLOSSARY

Acceptable management practices (AMPs) – A term that is often used interchangeably with "Best Management Practices" or "BMPs" to describe state-designated guidelines developed to minimize soil erosion and other adverse impacts on water quality from forest management activities.

Adaptive management – Adaptive management has been defined as a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs (Boremann et al. 1996).

Age class – The interval into which the age range of trees or forest stands are divided for classification, commonly grouped into 20-year increments.

Allowable cut – The volume of timber that may be harvested during a given period that is specified in a sustainable–yield forest plan (Helms 1998).

Archeological resource – Any material remains or physical evidence of past human life or activities of archeological interest, including record of effects of human activities on the environment that are capable of revealing scientific or humanistic information through archeological research (NPS 1998).

Aspect – The direction toward which a slope faces; exposure.

Basal area – The cross-sectional area of a single stem, including the bark, measured at breast height (4.5 feet). Basal area is often computed on a per acre basis for use in determining forest stand stocking (Helms, 1998).

Basal scar – A wound at the base of a tree's trunk where the bark has been removed by fire or some form of collision.

Best current thinking and practices – A term used in this Plan to describe the ethic of management that has informed forestry work on Mount Tom since Frederick Billings' time. Over the ensuing 135 years, each of the property's stewards drew upon current research and the expertise of forestry professionals to guide their management activities.

Best management practices – A term that is often used interchangeably with "Acceptable Management Practices" or "AMPs" to describe state-designated guidelines developed to minimize soil erosion and other adverse impacts on water quality from forest management activities.

Biodiversity – The variety of plants and animals, their interrelationships, and the biological and physical systems or ecosystems, landscapes, communities, and region in which they exist.

B-Line – In silviculture, the minimum stocking that allows for full utilization of the site (Lancaster and Leak 1978).

Blowdown – The topping of living trees by strong winds.

Board foot (bf) – A volume of wood with outside dimensions of 12 X 12 X 1 in.

Buffer strip – Vegetation bordering a special area, such as a road or stream, that often is managed differently than the surrounding landscape.

Canopy – The continuous cover of tree crowns in a forest.

Canopy decline – The thinning of a forest's canopy due to leaf loss from pathogens or stress.

Certification, third-party – A means to achieve sustainable forestry through a voluntary third party audit that meets defined standards to ensure environmentally, socially, and economically responsible management.

Character–defining feature – See defining landscape characteristics.

Citizen science – Projects in which trained volunteers or students work with researchers to answer real-world questions.

Civic engagement – Civic engagement is a continuous, dynamic conversation with the public on many levels that reinforces public commitment to the preservation of heritage resources, both cultural and natural, and strengthens public understanding of the full meaning and contemporary relevance of these resources.

Clearcut – A harvest that removes all merchantable timber in an area. Clearcuts are sometimes used as a forestry technique to encourage regeneration of species whose seedlings require full sunlight to grow well.

Cover crop – A crop whose main purpose is to benefit the soil or other crops by improving soil quality and fertility, controlling erosion, suppressing weeds, and/or controlling insects.

Cover type – A descriptive term used to group stands of similar characteristics and species composition (due to given ecological factors) by which they may be differentiated from other groups of stands (BC Ministry of Forestry 2001).

Crop trees – Trees that are designated for future harvest and managed to promote their growth.

Cultural Landscape Inventory(CLI) – The CLI is a computerized, evaluated inventory of all cultural landscapes in which NPS has or plans to acquire any legal interest. Its purpose is to identify cultural landscapes in the system and provide information on their location, historical development, character defining features, and management.

Cultural Landscape Report(CLR) – A comprehensive report used for long-term management of a cultural landscape. The overriding purpose of a CLR is to establish a preservation philosophy based on research, inventory, documentation, analysis, and evaluation which provides the foundation for making sound management decisions.

Cultural landscape – A geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values (NPS 1994).

Decay class – Qualitative assessment of stage of decay of coarse woody debris based on visual assessments of color of wood, presence/absence of twigs and branches, texture of rotten portions, and structural integrity (USDA Forest Service FIA 2004).

Decibels (dB) – The unit of measurement of sound level calculated by taking tem times the common logarithm of the ratio of the magnitude of the particular sound pressure to the standard reference sound pressure of 20 micropascals and its derivatives.

Defining landscape characteristics– Those prominent or distinctive aspects, qualities, or characteristics of the Forest that contribute significantly to its historic character. Such characteristics may include landscape patterns, vegetation, materials, and designed elements (NPS 1996).

Density, crown – The compactness of the crown cover of the forest, dependent upon (1) the distance apart and (2) the compactness of the individual crowns.

Deposition, dry – Delivery of air pollutants in the gaseous or particle phase to surfaces (NPS 2005).

Deposition, wet – Air pollution produced when acid chemicals are incorporated into rain, snow, fog, or mist (NPS 2005).

Disturbance – Any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment (Helms, 1998).

Dominant trees – Those trees in the forest that out-compete others in the canopy and are above them in vertical structure.

Ecological processes – The relationships between living organisms and their environment. Among these processes are natural disturbances such as periodic fire, flooding, or beaver activity; natural stresses such as disease or insects; catastrophic weather-related events such as severe storms or lightning strikes; or more subtle ongoing processes such as succession, hydrology, and nutrient cycling.

Ecosystem – A complex array of organisms, their natural environment, the interactions between them, the home of all living things, including humans, and the ecological processes that sustain the system.

Ecosystem health – A state of an ecosystem in which structure and functions allow the maintenance of the desired conditions of biological diversity, biotic integrity, and ecological processes over time.

Ecosystem management – The careful and skillful use of ecological, economic, social, and managerial principles in managing ecosystems to produce, restore, or sustain ecosystem integrity, uses, products, and services over the long term.

Endangered species – A species listed on the state or Federal endangered species list (VSA Title 10, chapter 123). Endangered species are those which are in danger of becoming extinct within the foreseeable future throughout all or a significant portion of their range.

Ethnographic Landscape – A landscape containing a variety of natural and cultural resources that associated people define as heritage resources.

Even-aged – A term applied to a stand in which relatively small age differences exist between individual trees. The maximum difference in age permitted in an even-aged stand is usually 10 to 20 years, although where the stand will not be harvested until it is 100 to 200 years old, larger differences, up to 25 percent of the rotation age, may be allowed.

Exotic – Not native; foreign. Those trees and plants introduced from other climates or countries.

Feature – The smallest element(s) of a landscape that contributes to its significance and can be the subject of a treatment intervention. Examples include a woodlot, hedge, lawn, specimen plant, meadow or open field, orchard, fence, wall, pond, earthwork, or house (NPS 1996).

Forest composition – The species of trees and other plants present in a forest.

Forest decline – The death of trees in a forest due to pathogens or stress.

Forest health – A condition in which damage and death from insects, diseases, and abiotic factors is within normal and expected limits.

Forest inventory – A set of objective sampling methods designed to quantify the spatial distribution, composition, and rates of change of forest parameters within specified levels of precision for the purposes of management.

Forest structure – The sizes and spatial distribution of a forest's trees.

Forwarder – A self-propelled (harvesting) machine, usually self-loading, that transports trees or logs by carrying them completely off the ground (Helms 1998).

Fragmentation – Division of a large forested area into smaller patches separated by areas converted to a different land use. Fragmentation is associated with the interruption of continuous natural habitat due to human and/or natural occurrences and can impact biodiversity.

Growth – Increase in diameter, basal area, height, and volume of individual trees or stands during a given period of time. Also known as increment.

Habitat – The environment in which an organism interacts and from which it gains its resources. Often variable in size and content, changing with the phases of an organism's life cycle.

Hardwood – Generally, one of the botanical group of trees that have broad leaves, in contrast to the needle-bearing conifers; also wood produced by broadleaved trees, regardless of texture or density. They are generally deciduous and include oak, alder, or maple (Stoddard and Stoddard, 1978).

Harvest – (1) The practice of felling and removing trees or the removal of dead or damaged trees from an area; (2) the products resulting from the harvesting activities. (BC Ministry of Forestry 2001).

Harvest, average annual – Volume of wood harvested over a given number of years divided by the number of years.

Herbivory – The state or condition of feeding on plants.

Historical integrity – The authenticity of a property's historic identity, evidenced by the survival of physical characteristics that existed during its historic or prehistoric period; the extent to which a property retains its historic appearance. According National Register of Historic Places criteria, there are seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association.

Historical significance – The meaning or value ascribed to a structure, landscape, object, or site based on the National Register of Historic Places criteria for evaluation. The quality of significance is present in resources that possess integrity and A) are associated with events that have made a significant contribution to the broad patterns of our history; B) are associated with the lives of persons significant in our past; C) embody the distinctive characteristics of a type, period, or method of construction or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or D) have yielded, or may be likely to yield, information important in prehistory or history.

Integrated Pest Management – The maintenance of destructive agents, such as insects, at tolerable levels by the planned use of a variety of preventative, suppressive, or regulatory tactics and strategies that are ecologically and economically efficient and socially acceptable.

Interior dependent species – Those wildlife species that depend on large, unbroken tracts of forest land for breeding and long-term survival. The term is also often used in conjunction with neotropical migratory bird species requiring large patches of fairly homogeneous habitat for population viability.

Intolerance – The incapacity of a tree to develop and grow in the shade of and in competition with other trees.

Invasive species – A species that is non-native (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

Mast – The fruit of trees considered as food for livestock and wildlife. Hard mast is the fruit or nuts of trees such as oaks and beeches, soft mast include fruits and berries such as hawthorn, cherry, and serviceberry (Helms 1998).

Maturity – For a given species or stand, the approximate age beyond which growth declines or decay begins to increase at a rate likely to assume economic importance.

Merchantable – Trees or stands of a size and quality suitable marketing and utilization.

Meta-population – Partially isolated populations of the same species, which are able to exchange individuals

Mosaic – A landscape ecology term that describes a holistic landscape, including its biological, environmental, and cultural characteristics, and how it can be segregated into distinct components of patch, corridor, and matrix types, such as ponds, streams, forest stands, crop fields, roads, and meadows. Components of a landscape mosaic can be defined as a patch, corridor, or matrix.

National Register of Historic Places (NRHP) – The comprehensive list of districts, sites, buildings, structures, and objects of national, regional, state, and local significance in American history, architecture, archeology, engineering and culture kept by NPS under authority of the National Historic Preservation Act of 1966.

Native – A plant or animal indigenous to a particular locality.

Natural community – An assemblage of plants and animals that is found recurring across the landscape under similar environmental conditions, where natural processes, rather than human disturbances, prevail.

Net growth, average annual – The average annual net increase in the volume of trees during the period between inventories (Helms 1998).

Non-native – Not inherent or original to an area.

Overstory – (1) The crown canopy of a forest; (2) the trees that make up the crown canopy.

Patch – A landscape ecology term that describes an area of vegetation that is relatively homogeneous internally and differs from surrounding elements.

Partial overstory removal – A silvicultural technique that partial removes trees constituting the upper canopy layer of a stand to encourage the growth of trees or other vegetation in the understory.

Pathogen – Any disease-producing organism.

Period of significance – the span of time in which a property attained the significance for which it meets National Register of Historic Places criteria.

Plantation – A stand comprised primarily of trees established by planting or artificial seeding (Helms 1998).

Plantation, naturalized – A planted stand that over time has become more diverse in species composition and vertical structure because of natural regeneration.

Plantation, single-species – A planted stand of one tree species, often all of the same age.

Preservation – The act or process of applying measures to sustain the existing form, integrity, and material of a historic structure, landscape or object.

Programmatic agreement(PA) – A special type of memorandum of agreement typically developed for a large or complex project or a class of undertakings that would otherwise require numerous individual §106 actions. Procedures for developing a programmatic agreement are outlined in 3 CFR Part800. 14(b).

Pulpwood – Wood cut or prepared primarily for manufacture into wood pulp for subsequent manufacture into paper, fiber, board, or other products, depending largely on the species cut and the pulping process (Stoddard and Stoddard 1978).

Reforestation – The natural or artificial restocking of an area with forest trees (Stoddard and Stoddard 1978).

Regeneration – The process by which a forest or range is renewed by self-sown seeds, sprouts, or rhizomes; by seeds from adjacent stands; or by seeds deposited by wind, birds, or animals (Stoddard and Stoddard 1978).

Rehabilitation – The act or process of making possible an efficient compatible use for a historic structure or landscape through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural and architectural values.

Release cut – A cutting of larger individual trees that are overtopping young trees, for the purpose of freeing the young trees to permit them to make good growth.

Resilience, forest stand – The ability of an ecosystem to maintain diversity, integrity and ecological processes following disturbance (BC Ministry of Forestry 2001).

Riparian – An area of land adjacent to a stream, river, lake or wetland that contains vegetation that, due to the presence of water, is distinctly different from the vegetation of adjacent upland areas (BC Ministry of Forestry 2001).

Rotation – In even-aged silvicultural systems, the period between regeneration establishment and final harvesting.

Runoff – surface water discharging from a drainage area.

Salvage – Logging operations specifically designed to remove damaged timber (dead or in poor condition) and yield a wood product. Often carried out following fire, insect attack or windthrow (BC Ministry of Forestry 2001).

Sapling – A usually young tree larger than a seedling but smaller than a pole (sizes vary by region and species).

Saw timber – (1)Timber stands in which trees of sawlog size make up most of the volume; (2) live trees of commercial species containing merchantable sawlogs.

Sediment – Mineral or organic matter deposited by water, ice, or air.

Seed tree – A tree that produces seed; usually trees reserved during a harvesting operation to supply seed following the harvest.

Seedling – A tree grown from seed. The term is restricted to trees smaller than saplings.

Selection, group – A silvicultural system designed to support or create an uneven-aged forest condition by removing trees in small groups to establish new age classes (Helms 1998).

Selection, single-tree – A silvicultural system designed to support or create an uneven-aged forest condition by removing individual trees of all age classes more or less uniformly throughout the stand (Helms 1998).

Silviculture – The art and science of managing the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis.

Site index – A measure of site quality; expressed as height in feet of dominant trees at least 50 years of age.

Skid – To pull logs along the ground, from the stump to the skidway or landing.

Skidder – A vehicle used to transport logs to a landing.

Slash – Branches, bark, tops, chunks, cull logs, uprooted stumps broken or uprooted trees left on the ground after logging; also large accumulation of debris after wind or fire.

Snag – A standing, dead tree from which the leaves and most of the branches have fallen, or a standing section of the stem of a tree broken off at a height of 20 ft or more. If less than 20 ft high, it is properly termed a stub.

Softwood – Cone-bearing trees with needle or scale-like leaves such as fir, spruce, and pine species (BC Ministry of Forestry 2001).

Spatial organization – A type of landscape characteristic. The three-dimensional organization of the forms and visual associations in the landscape, including the articulation of the ground, vertical, and overhead planes that define and create spaces. Examples include circulation systems, views and vistas, divisions of property, and topography (NPS 1998).

Species composition – The percentage of each recognized tree species comprising the forest type based upon the gross volume, the relative number of stems per hectare or basal area (BC Ministry of Forestry 2001).

Stand – In silviculture, a contiguous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit (Helms 1998).

Stand, northern hardwood – A stand that is dominated by an association of hardwood species; in Vermont these include sugar maple, white ash, beech, and basswood.

Stand, mixedwood or mixed forest – A stand that includes a component of coniferous species that falls between 25-65% of the total species composition.

Standing deadwood – See snags.

Stand age – The age of a community of trees that contribute to its distinction as a feature distinguishable from the forest or other growth on adjoining areas (Stoddard and Stoddard 1978).

Stewardship – (1) an expression of a deeply held personal belief associated with a commitment to future generations; (2) an approach to conservation practice that values both nature and culture, including the imprint of people on the land.

Stock, growing – All the trees growing in a forest or in a specified part of it, usually commercial species, meeting specified standards of size, quality, and vigor, and generally expressed in terms of number or volume.

Succession – The gradual supplanting of one community of plants by another based on ecological factors (Helms 1998).

Succession, early – The state of succession shortly following the beginning of re-forestation; often includes "pioneer" species such as aspen, paper birch, and white pine.

Succession, late – The state of succession which occurs after a long period of continuous forest cover in an area; often includes species such hemlock, beech, and sugar maple.

Sustainable forest management – Management regimes applied to forest land which maintain the productive and renewal capacities as well as the genetic, species and ecological diversity of forest ecosystems (BC Ministry of Forestry 2001).

Sustained yield – As applied to a policy, method, or plan of forest management, the term implies continuous production, with the aim of achieving, at the earliest practicable time, an approximate balance between net growth and harvest.

Thinning – Cutting in an immature stand to increase its rate of growth, to foster quality growth, to improve composition, to promote sanitation, to aid in litter decomposition, to obtain greater total yield, and to recover and use material that would be otherwise lost.

Threatened species – A species listed on the state or Federal threatened species list. Threatened species are those likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

Tolerance – The capacity trees to grow satisfactorily in the shade of, and in competition with, other trees (Helms 1998).

Traditional uses – Those uses of the forest that have characterized the general area in the recent past and present, including an integrated mix of timber and forest products harvesting, outdoor recreation, and recreation camps or residences.

Tree, den – A tree that contains cavities that provide cover for wildlife.

Tree, legacy – A tree that is retained on site or cultivated for its historical association or to provide biological richness.

Timber stand improvement (TSI) – An intermediate treatment made to improve the composition, structure, condition, health, and growth of even or uneven-aged stands.

Type, forest – A descriptive term used to group stands of similar character as regards composition and development due to certain ecological factors, by which they may be differentiated from other groups of stands.

Understory – That portion of the trees in a forest stand below the overstory.

Uneven-aged – A stand in which there are three or more age classes, either intimately mixed or in small groups. See also all aged.

Value-added products – Those products that have an added value due to an association with place, sustainable management, and craftsmanship.

Vernal pool – An ephemeral body of water that fills in the spring, holds water for at least 10 days, and dries up by fall some or all years and that does not contain fish; important habitat for amphibians and reptiles (Maine Forest Service 2003).

Vertical diversity – Amount of variation in canopy heights (see also vertical stand structure)

Vertical stand structure – Canopy layering as determined by an analysis of foliage height distribution (Keeton 2005).

Vigor, stand – The capacity for natural growth and survival, sometimes measured by rate of growth and health.

Vista – A type of landscape characteristic that describes a controlled prospect of a discrete, linear range of vision, which is deliberately contrived.

Watershed – The geographic area within which water drains into a particular river, stream, or body of water. A watershed includes both the land and the body of water into which the water drains.

Woodlot – The forested portion of a private property upon which small-scale forestry operations are carried out (BC Ministry of Forestry 2001).

Woody debris, coarse – Any piece(s) of dead woody material (e.g. boles, limbs, large root masses) on the ground in forest stands or in streams (Helms 1998).

Year, seed – A year in which a given species produces (over a considerable area) a seed crop greatly in excess of the normal; usually applied to trees of irregular or infrequent seed production.

Yield – Estimate in forest mensuration of the amount of wood that may be harvested from a particular type of forest stand by species, site, stocking, and management regime at various ages (Helms 1998).

(OCLP 2004)

APPENDICES

Appendix A: **Summary of Comments Provided During Scoping Activities**

Appendix B: **Proposed Northeast Temperate Network Vital Signs and Measures**

Appendix C: **System-wide Management Guidelines**

Appendix D: **Description of Forest Stands**

APPENDIX A: SUMMARY OF COMMENTS PROVIDED DURING SCOPING ACTIVITIES

The following is a summary of suggestions offered and concerns raised by members of the public during the scoping activities conducting for the Forest Management Plan:

Related to Cultural Resources

- What effect will forestry activities have on the remnant stone walls and fences throughout the Park?
- The overall diversity of the Park's forest is an important part of its history; provides excellent opportunities for interpreting the history of land practices; and offers unique ecological benefits. How will the diversity of the Forest be continued if large-scale reforestation and forest succession (changes from agricultural fields to forest) are no longer occurring?
- What effect will forestry activities have on the condition of the carriage roads and trails as well as their associated culverts, causeways, and retaining walls?
- If the understory is suppressed in stands alongside the carriage roads, will this affect the overall health of the Forest?
- How can viewsheds be managed when forest openings extend to adjacent properties?
- Archeological resources should be identified and protected: The Park should complete the Level I archeological survey for which it was funded for FY04.
- Management of legacy trees will be a challenge as the forest canopy continues to grow. Consider identifying and cultivating replacements; consider a version of "crop tree release" to promote new legacy trees.
- Plantations:
  - Which plantations are integral to the cultural landscape?
  - Will some of the plantations be converted/ let go to native hardwoods?
  - How will plantations be managed to preserve historic characteristics, especially considering the competition of native hardwoods and the natural lifespan of the plantation trees?
  - Will plantations be managed as even- or uneven-aged?
  - Will native or non-native species be used for replanting?
  - Will new plantations be created to keep this type of forest management represented on the property?
  - Manage for big, well-spaced plantation trees (i.e., like in Mansion Grounds area); this also creates late-successional forest characteristics that benefit wildlife.
  - How will plantation management be balanced with ecological objectives?
- Will the McKenzie orchard be retained?
- Hardwood and mixed forest stands: Manage the Forest for a diversity of hardwood and mixed forest stands throughout the Park and for large trees within stands.

Related to Natural Resources and Ecological Health

- Follow Vermont Acceptable Management Practices; Examine Maine and other state Best Management Practices.
- Buffer vernal pools, particularly those with Jefferson salamanders, using Maine BMPs or other more extensive standards; follow silvicultural guidelines established by Maine BMPs for Vernal Pools for forestry activities within those areas.
- Convert plantations that are within "Jefferson salamander life zones" of vernal pools to hardwood forests.
- For treatments in vernal pool buffer areas: Schedule forest treatments for winter when the ground is frozen; and if that is not possible, times from July onward would be better.
- Re-forest the northern edge of the Maple Lot to increase the stream buffer.
- Keep coarse woody debris in stream areas.
- Observance of good watershed management practices (i.e., mitigating measures to reduce soil loss, compaction, and nutrient loss) will result in more vigorous forest health.
- Increase coarse woody debris (CWD) and snags throughout the Park; favor larger logs that decay more slowly; develop a tiered approach to removal of CWD next to roads and trails; manage for a diversity of decay classes.
- Low-intensity silviculture may have increased rates of successional development in hardwood and mixed forest stands; forest management could continue to be used to promote old-growth characteristics.
- Managing for "big trees" will increase forest structural diversity and wildlife habitat, and fits nicely with cultural landscape objectives.
- How can aesthetic management considerations be met while still addressing ecological considerations? (i.e., road corridor management)?
- Maintain and increase diversity of all kinds; landscape, forest stands, species.
- Is the impact of deer browse reducing the structural and species diversity of forest stands?
- Develop an approach to deal with invasive plants and the possible impacts of forestry on their distribution.
- Will some of the natural communities have different management approaches or protection status based on unusual attributes or landscape-level considerations?
- How and when would the Park use pesticides or biological controls to treat forest pests?
- Beech bark disease is prevalent throughout the Forest: Loss of beech could impact the late-successional forest structure, and reduce the availability of beech nuts, an important food source for wildlife.
- Promote herbaceous growth of fields, especially in the Maple Lot, by only cutting every two to three years; on the other hand, mowing once a year is best for insects.

- Consider putting up bat boxes for habitat enhancement and educational potential.
- Favor the retention of mast trees.
- Can a mowing schedule be developed that considers the nesting times of grassland birds and results in quality hay production?
- Develop a hazard tree program so that trees that would provide excellent wildlife habitat aren't being removed needlessly.
- Develop forest health inventory and monitoring program, and an early detection system.
- How will hemlock woolly adelgid, emerald ash borer, sudden oak death, etc. be addressed if they were to be found at the Park?
- What will be the Park's response to catastrophic loss of an area due to wind, fire, etc.?
- Develop a wildland fire response strategy.
- Develop an alternative to consider the effects of global warming and include greater representation of southern species (e.g., oaks, hickories, etc.).

Related to Sustainable Management Practices

- The long-term management has resulted in a healthy forest that exhibits sound conservation and considerable human manipulation; the Park should continue this record of stewardship.
- Develop approaches for demonstrating the full cycle of forestry: i.e., milling on-site, create solar kiln for wood-drying, work with local producers to develop value-added products.
- Forest management has always been an important part of the property and needs to continue.
- Meet and exceed Vermont Current Use standards
- Beech bark disease is a major issue, and eradicating it will be an arduous endeavor. A strategy will be needed in areas such as Stands 39 and 44 along the Mountain Road.
- Use a variety of harvesting techniques depending on the situation, and to increase educational value of forestry operations at the Park.
- Plantations are seen as both unhealthy forest management (i.e., not ecologically diverse, subject to catastrophic loss, etc.) and a method of high-production forestry (growth of large volume of wood on a small acreage) that allows other areas to be preserved.
- If deer browse pressure is high, it could affect the health and quality of any regeneration.
- Make wood available to historic preservation projects: The quality of trees at the Park is very unique and replicates wood qualities that can no longer be found for historic rehabilitation projects.
- Harvesting should be conducted at sustainable levels; the Park should assess growth and yield.

- Historical practices that conflict with contemporary conservation should be modified to represent good stewardship.
- Reintroduce sugaring.

Related to Education and Interpretation

- Visitors tend to notice distinct remnant features related to the property's land use history, such as rock walls, open-grown trees, stone markers.
- The Pogue is an important interpretive spot for discussing ecological and cultural history.
- Keep examples of earlier forestry practices, even if they are no longer considered "best management," because they illustrate changes in thinking and can serve as examples of what is not good forestry now (i.e., keep portions of the 1952 red pine plantation).
- Reintroduce a "nature trail" - i.e., the Wildflower Walk near the Woodbarn, or Elizabeth Billings' woodland gardens.
- Have a place to see succession in action.
- Develop trail maps/ wayside exhibits on historic land use changes.
- Use "tensions" in resource management to explore the theme of conservation.
- Show by example: The Park's management work should be a model of good forestry and stewardship.
- The Park offers a unique opportunity to educate the public about the complexities of forest management (recreation, wood use, forest health, ecological considerations, etc.).
- Establish an outreach program that would take the message beyond Park boundaries.
- Build the educational relationship with local schools through the Forest for Every Classroom program. Perhaps establish plots in the Forest that they can monitor for changes in the forest, and revisit throughout their time in school (i.e., K-12 experiences).
- Create opportunities for students to get involved in monitoring, research, planting, forest management, trails, etc.
- Initiate an "adopt-a-tree" program that encourages students to observe changes in their tree through the seasons.
- Develop programs that create linkages between Park staff and teachers; resource professionals, community members, teachers, and students; high school and elementary students.
- Enhance opportunities for year-round exploration of the Forest (e.g., an education classroom for students to come in out of the cold, winter interpretive hikes).
- Create service-learning opportunities through after-school and weekend programs.
- Provide access to facilities for school groups - restrooms, a place to get out of the rain.

- Hold an annual gathering of teachers at the Park to discuss opportunities for educational programs and send announcements to teachers about upcoming forest management activities that their classes can get involved in.
- Continue to offer professional training opportunities to teachers to increase their skill in using the Park as an outdoor classroom.
- Ranger-led tours typically begin at Prosper Road and head to The Pogue before looping back. Public workshops and ranger tours are a key interpretive tool.
- Forest management actions (i.e., leaving downed logs along the roads, vernal pool management, plantation retention) could be important from an educational point of view.

Related to Visitor Use and Recreation

- The Park has two main entrances that change seasonally in degree of use. The Pogue and the South Peak are the main destinations. Predictably, local visitors tend to use the Prosper Road entrance while out-of-towners gravitate to the Mansion entrance.
- It will be important to articulate the balance between providing recreation opportunities and practicing good forestry.
- Road and trail maintenance is an important part of the Forest's management and should continue with its current high level of care.
- Are there maintenance differences between winter ski needs and summer trail uses?
- Wayfinding would be improved by better and more trail signs
- Getting far into the Forest can be physically challenging for some visitors.
- What effect will forestry activities have on equestrian users?
- With increased pressures on public lands, examples are needed for how forestry and recreation can co-mingle.
- What impact will forest management activities have on recreationists if segments of trails need to be closed while forestry work is occurring?
- A message board announcing when forestry activities are planned or are occurring will be helpful so that hikers and horseback riders can choose alternative routes to use.
- How will increased vehicle use in the Park for management needs (i.e., logging trucks) impact recreational experiences?
- The Park should try to retain the diversity of trail experiences that exist and the year-round use of trails.
- Can winter harvesting be accommodated with recreational skiing?

Related to Watershed and Community Connections

- Work with adjacent landowners to continue to foster common goals such as: habitat improvement for Jefferson salamanders, invasive plant management, diverse regional recreational opportunities, etc.
- How will changes in land-use patterns in the area affect the Forest?

- Value that the Park is the community's "backyard."
- Work with the Woodstock Conservation Commission for plan review and community forums.
- Create a successful model of cooperation and engagement with the community.
- Work with state and community organizations on common interpretive programs and management activities.

Related to Adaptive Management

- Work with NPS Inventory and Monitoring Program.
- Evaluate the impacts of various management practices and determine if actions are meeting the goals of sustainability and other objectives (i.e., effects on hydrology and biogeochemistry, erosion, growth rates and forest health, yield of forest products, etc.)/
- Tie inventory and monitoring data to GIS.
- Make monitoring interdisciplinary: Include monitoring of trends related to ecology, recreation, silviculture, interpretation, cultural landscape preservation.
- Reassess silvicultural inventories about every five years
- Continue with forest dynamic monitoring program, with resampling every three to five years.
- Develop and demonstrate a model that can be used by other managers and landowners.
- Engage other staff, community members, school groups, and local universities in the implementation of an adaptive management program.
- Develop a bulletin to share information about monitoring trends and management activities.
- Develop an activity reporting and harvesting form to track management actions.
- Potential research studies:
  - Coarse woody debris management
  - Impacts of compaction
  - Effects of plantation conversion on wildlife
  - Vernal pool management
  - Dendrochronology
  - Additional oral histories

APPENDIX B: PROPOSED NORTHEAST TEMPERATE NETWORK VITAL SIGNS AND MEASURES

The following are proposed Northeast Temperate Network vital signs and measures likely to be implemented at Marsh-Billings-Rockefeller National Historical Park. Bold and numbered indicates core vital signs the network should include in the initial phase of protocol development. Non-bold vital signs are a high priority and will be included over time as the cost of program development and implantation are realized. Potential Measures in italics will be investigated for inclusion in the Program as part of the development of the monitoring implementation plans, currently underway.[1]

TABLE B-1
PROPOSED NORTHEAST TEMPERATE NETWORK VITAL SIGNS AND MEASURES LIKELY TO BE IMPLEMENTED AT THE PARK

Level 1	Level 2	Network Vital Sign	Potential Measures
Air and Climate	Air Quality	**Ozone**	Atmospheric ozone concentration (synthesize existing data) (*foliar injury to indicator species*)
		Acidic deposition & stress	Wet and dry deposition rates (synthesize existing data), soil nitrification, soil base cation availability, soil Ca:Al ratio, streamwater ANC, streamwater nitrate concentration (*total deposition rates including occult*)
		Contaminants	Heavy metal deposition (synthesize existing data)
	Weather and Climate	**Climate**	Air temperature, precipitation by type, relative humidity, total solar radiation, wind speed, wind direction, snow water equivalent, snow depth
		Phenology	First flowering of sensitive plant species, first amphibian call dates, length of growing season, ice-out/in dates for lakes and ponds
Water	Hydrology	**Water quantity**	Water depth, water duration, lake levels, streamflow, groundwater levels/inputs, spring/seep volume, sea level rise
	Water Quality	**Water chemistry**	Stream water nitrate, stream alkalinity/ANC, water temperature, percent dissolved oxygen, specific conductance, pH, turbidity, color, salinity, chlorophyll a, photosynthetically active radiation (PAR)
		Nutrient Enrichment	Turbidity, number of septic systems in and near park, algal biomass, total and dissolved phosphorus, amount of fertilizer used within park, residential density near park
		Streams – macro-invertebrates	Diversity of selected communities and subcommunities
		Contamination	Concentrations of relevant EPA priority pollutant metals

Table B-1
Proposed Northeast Temperate Network Vital Signs and Measures Likely to be Implemented at the Park

Level 1	Level 2	Network Vital Sign	Potential Measures
Biological Integrity	Invasive Species	Exotic plants: early detection	Presence/absence
		Exotic animals: early detection	Presence/absence
	Focal Species or Communities	Wetland: vegetation	Diversity of community and subcommunities, exotic species extent, beaver activity
		Forest: vegetation	Community diversity (all layers), tree species, rates of mortality and regeneration, stand structural dynamics, tree basal area by species, canopy condition, snag density, coarse woody debris volume; percent exotic species
		Fish: lakes and streams	Diversity of community and subcommunities; percent exotic species.
		Breeding birds	Diversity of forest, high elevation, grassland/scrub, old-field, and coastal communities and subcommunities
		Amphibians and Reptiles	Diversity of wetland/vernal pool communities and subcommunities (*red-backed salamander abundance in forests*)
		White-tailed Deer herbivory	Browse intensity in forests
		Insects	Selected indicator groups: *Pollinators (bees), decomposers (burying beetles), carabids, ants, odonates, butterflies and skippers*
Human use	Visitor and Recreation Pressure	21) Visitor Usage	Number of visitors by location and activity, trampling impacts, soil erosion
	Consumptive Use	Harvesting: Forestry	(*Board feet removed by species, cords removed by species*)
Ecosystem Pattern and Processes	Land Cover Land Use	22) Land Cover / Ecosystem Cover	Change in area and distribution of ecological systems (including intertidal communities) within park and adjacent landscape, patch size distribution, patch connectivity, patch fragmentation, extent of major disturbance, ecological integrity index by ecological system
		23) Land Use	Road network extent, nearby housing development permits, proportion of nearby lands in various categories of human uses, percent impervious surface in watershed, nearby human population density, landscape buffers
	Extreme Disturbance Events	Extreme Disturbance Events	Extent and duration of large-scale natural and anthropogenic disturbances

APPENDIX C: SYSTEM-WIDE MANAGEMENT GUIDELINES

BEST MANAGEMENT PRACTICES FOR STREAMS, SEEPS, VERNAL POOLS, AND THE POGUE SHORELINE[2]

Streams, Seeps, and the Pogue

In most cases, state Acceptable Management Practices (AMPs) and Best Management Practices (BMPs) recommend a streamside buffer zone of a varying distance depending on the slope of the adjacent area. This zone of vegetation, also known as a buffer or protective strip, prevents sedimentation from reaching streams, and maintains shade and streambank stability.[3] The following buffer distances will be observed during any harvesting activities at the Park that are near streams or other water bodies, including The Pogue.

Forestry Practices within the Buffer Zone:

- There will be no new roads or landings
- Only light thinning or selection harvesting will take place, so that breaks in the canopy are infrequent.
- Exposure of mineral soil (especially by equipment) will be minimized.
- Coarse woody debris and snags will be maintained throughout the buffer zone, unless this conflicts with public safety or historical objectives.

TABLE C-1
MANAGEMENT GUIDELINES FOR STREAMS, SEEPS, AND THE POGUE DURING HARVESTS

Slope of Land Between Roads or Landings and Streambanks or Lake Shores (in Percent)	Width of Strip Between Roads or Landings and Stream or Water Body (Feet Along Surface of Ground)
0-10	50[4]
11-20	70[5]
21-30	90[6]
31-40	110[7]
Pogue Stream (variable slope)	200[8]
Note: For slopes above 40 percent, an additional 20-foot buffer width will be used for each additional 10 percent slope.	

Vernal Pools

Several vernal pools at MABI host amphibian populations, including Jefferson salamander, a species listed as being a regional conservation concern by the Northeast Endangered Species Technical Committee.[9] The Park will protect vernal pool habitat when performing forestry activities.

The Park will follow best management practices developed jointly by the University of Maine, Maine Audubon, Maine Department of Inland Fisheries

and Wildlife, Maine Department of Conservation, and the Wildlife Conservation Society, and published by the Metropolitan Conservation alliance.[10] These guidelines will be augmented with site-specific life zone buffer distance recommendations developed through an in-depth Jefferson salamander study conducted by the Vermont Institute of Natural Science.[11]

Based on a combination of the Maine guidelines and the site-specific data, a tiered approach to the vernal pool management zone will be employed:

Table C-2
Management Guidelines forVernal Pools during Harvests

Vernal Pool Management Zone	Width	Best Management Practices [12]
Depression	Site-specific	No disturbance
Protection Zone	100' (30.5m) from pool's edge[13]	Limited harvesting Maintain at least 75 percent canopy cover Harvest during frozen or dry soil conditions Maintain abundant coarse woody debris Minimize use of heavy machinery
Life Zone	656' (200m) from pool's edge[14]	Partial harvesting Maintain 50 percent canopy cover, or more Openings no larger than 1 acre Harvest during frozen or dry conditions Maintain abundant coarse woody debris

COARSE WOODY DEBRIS AND SNAGS

Under all of the alternatives, specific management actions that could be used to maintain or increase the amount and diversity of downed CWD and snags include:

- Retain live trees of various sizes and types beyond their normal "maturity age."[15] As these trees age, decay, die, and fall to the forest floor, they will be contributing to an increase in both standing and downed material.
- Leave treetops and sections of bole that result from harvesting and natural mortality on the forest floor.

When a clear understory appearance is desirable to achieve cultural landscape management objectives, the Park will integrate CWD management using the following guidelines:

- Downed trees will be removed in the immediate vicinity of carriage roads (where visible within 50 feet). However, large-diameter logs may be retained. Logs will be limbed so that only the trunk remains visible on the ground.
- Snags will be retained as long as they do not pose a risk to visitor safety, following the Park's Hazardous Tree Management Plan. In some cases, hazardous trees may be treated by removing the upper part of the tree

that poses the hazard and leaving a standing bole. This technique is also useful for retaining declining legacy trees that might otherwise be completely removed because they are hazardous.

- Logs removed from the carriage road corridor may be relocated to other areas of the Forest, especially within the 200m vernal pool buffers, to aid in restoring more desirable CWD levels in those areas.
- Slash within 15–30 feet of the ski and hiking trails will be lopped to 3 feet or lower in height.

HARVESTING PROCEDURES

Harvesting Equipment

In deciding what harvesting equipment to use for forest management activities, the Park will consider the following variables, including but not limited to:

- Slope and soil type: e.g., steepness and susceptibility to erosion and compaction.
- Access to and within the treatment area: e.g., width of skid trails, distance to the landing, and room to maneuver between trees within the stand.
- Forest products: e.g., type, quality, and quantity of wood to be removed and status of wood markets.
- Timing: e.g., season of harvest, and ability to complete the job within any given time constraints.
- Availability of equipment and skilled operators.
- Silvicultural objectives for treatment: e.g., scarification (soil disturbance often accomplished by skidding logs across the surface) contributes to the establishment of certain tree species including white pine (*Pinus strobus*). Where the establishment of a new generation of white pine is desired, a conventional skidding system is more desirable than a forwarding system, in which the wood is carried on the bed of a wheeled vehicle instead of being dragged across the surface.

There are many types of harvesting equipment including horse, four-wheel-drive tractor, crawler/bulldozer, skidder (both cable and grapple types), forwarder, cutter, de-limber, feller-buncher, and mechanical harvester. For many of these types of equipment, there are also various sizes, and many timber harvesting operations use several pieces in conjunction (e.g., a skidder and a crawler or a cutter and delimber). Each type of equipment has advantages and disadvantages, and each is best suited to certain site conditions and treatment activities. Flexibility in equipment choice is important to ensure that Park management objectives are met. It is also important to note that technologies are always changing and the Park will embrace new harvesting systems if they are deemed more appropriate for addressing management objectives than existing methods.

Access and Erosion Control (skid trails)

Skid trails allow movement of wood from the stand to the log landing. There are many skid trails already in place throughout the Park because of the long history of active forest management. Many of the existing skid trails are adequate for the Park's forest management activities, but in some situations it will be necessary to develop new trails or segments of trails. Construction of any new skid trails would avoid steep slopes and would proceed across the slope and not exceed grades above 20 percent whenever possible. However if higher grades are necessary, the length of the road above 20 percent will not exceed 300 feet.[16]

To control surface water runoff and soil erosion on new and existing skid trails, drainage structures would be spaced at varying distances depending on slope. See Recommended Spacing of Drainage Structures below.

Table C-3
Recommended Spacing of Drainage Structures

Slope (percent)	Spacing (feet)
1	400
2	250
5	135
10	80
15	60
20	45
25	40
30	35
40	30

Depending on the site conditions, drainage structures could include traditional culverts, pole culverts, broad-based dips, water bars, and temporary or permanent bridges. Traditional culverts are best used for diverting significant amounts of water under a skid trail, especially when the water source (e.g., seep or stream) is perpendicular to the skid trail. Pole culverts (constructed from sections of poles or logs and covered with planks) also allow water to pass under or through a skid trail but are easier to install and to remove if deemed unnecessary following the harvesting activities. Broad-based dips are gradually sloped declines in the road that allow water to be gently dispersed across the road surface and off the sides. They are best used on sections of trail where there is little slope and no streams or seeps are threatening to cross.

Because the well-developed network of carriage roads already crosses many streams and seeps that would otherwise need drainage structures, new culverts and broad-based dips will rarely be needed to control erosion during treatment activities. Along the typical skid trails throughout the Park, water bars will likely be the best drainage structure. They would be constructed during treatment activities

when necessary, finalized directly following completion of the treatment activities, and monitored and maintained until the scarified soil becomes revegetated. Additional erosion control techniques that can be used include "brushing in," which involves scattering brush across skid trails to limit erosion and discourage pedestrian use, and seeding. If seeding is necessary, the Park will use native plant seed mixes that are suitable to the site conditions (i.e., sun exposure, season of planting).

Access and Erosion Control

The carriage road system provides excellent access for logging trucks throughout the parcel, and it has been historically used for this purpose from Billings' time forward. The roads are capable of supporting a fully loaded ten-wheel log trucks, but not tractor-trailers. In a situation where wood markets dictate the use of a tractor-trailer (e.g., long distance to the mill), wood will have to be transported out of the Park using a ten-wheel truck and subsequently loaded onto a tractor-trailer for shipment to its destination.

The carriage road system has been well maintained. General maintenance activities will be developed in a separate plan for carriage road and trail maintenance, currently funded for 2005.

Winter Harvesting

Winter harvesting is sometimes desirable because it can reduce soil compaction and erosion, avoid potential impacts to sensitive habitat areas such as vernal pool buffer zones, and result in less abrasion damage to trees. For the New England area, winter harvesting periods are typically from December 1 through March 31 when soils are frozen and have adequate snow cover that can minimize compaction and rutting.

The Woodstock Resort Corporation retains an easement on most of the Park roads and trails for use as groomed cross-country ski and snowshoe trails. The ability for the Park to conduct winter harvests is limited to those activities that will not adversely affect the winter operations of the Woodstock Ski Touring Center.

The Park will work with the Woodstock Resort Corporation to identify opportunities to conduct winter forestry activities that will not hinder ski touring operations. At minimum, the Park may consider stockpiling cut logs in the vicinity of the treatment area during winter and removing them at the end of the ski season.

Temporary Road and Trail Closures

There are a number of situations in which the carriage roads and trails on Mount Tom would be temporarily closed to public use, such as:

- During periods when wet conditions exacerbate trail wear from pedestrians and equestrians.
- When maintenance and repair activities make the roads or trails impassable to foot or horse traffic.
- While forest management operations are underway to prevent potential conflicts between pedestrians, equestrians, and forestry equipment.
- After natural events (e.g. wind and ice storms) that cause trees to fall across roads or trails.

Prior and during roads and trails closures, the Park will announce details about the closure (e.g., the area closed, duration that the closure is expected) to visitors through announcements posted at Park visitor centers and trailhead kiosks. Extended closures from forestry operations or seasonal trail conditions will also be provided through the Park's automated voicemail system (802.457.3368) and on the web (www.nps.gov/mabi).

APPENDIX D: DESCRIPTION OF FOREST STANDS

TABLE D-1
DESCRIPTION OF FOREST STANDS

Cover Type	Stand Number	Forest Type	Acres	Date Initiated	Stand Structure	Stocking
Natural Stands	5	Mixed pioneer	57.4	1950s	even	well
	6	White pine	5.2	1940s	even	well
	7	Eastern hemlock	2.6	1900 - 1930s	even	well
	8	White pine	9.7	1930s - 1940s	even	well
	9	Sugar maple/white ash	2.6	1940s	even	well
	10	Sugar maple	6.7	1940s - 1960s	even	over
	11	Sugar maple	3.9	1800s - 1940s/1950s	even	over
	14	Mixed pioneer	3.4	1920s	even	over
	15	White pine/black cherry	2.1	1930s	even	well
	19	Mixed hardwood	4.2	1900	even	over
	20	Sugar maple/mixed hardwood	14.8	1900	even	over
	21	Eastern hemlock/mixed hardwood	31.1	late 1800s - 1920s	even/uneven	over
	23	Big-toothed aspen/sugar maple	0.5	1930	even	over
	24	Sugar maple/mixed hardwood	24.4	1920	even	over
	29	Eastern hemlock/mixed hardwood	13.1	1890	natural	no data
	30	Mixed hardwood	15.7	1900 and before	even	over
	31	Mixed hardwood	16.2	late 1800s - early 1900s	even	over
	32	Sugar maple	3.5	before 1900	even	well
	33	American beech/sugar maple	14.8	late 1800s	even	well
	34	Mixed hardwood/eastern hemlock	30.0	late 1800s	even	well
	36a	Red maple/black ash swamp	0.4	no data - late 1800s	n/a	n/a
	36b	Red maple/black ash swamp	1.8	no data - late 1800s	n/a	n/a
	36c	Red maple/black ash swamp	2.0	no data - late 1800s	n/a	n/a
	36d	Red maple/black ash swamp	0.9	no data - late 1800s	n/a	n/a
	36e	Red maple/black ash swamp	0.4	no data - late 1800s	n/a	n/a
	37a	Mixed hardwood/eastern hemlock	2.2	before 1900	uneven	over
	37b	Mixed hardwood/eastern hemlock	6.8	before 1900	uneven	over
	38a	Eastern hemlock	7.6	before 1900	uneven	over
	38b	Eastern hemlock	1.2	before 1900	uneven	over
	39	Mixed hardwood	83.4	1920s	even	over
	44	Mixed hardwood	28.9	before 1900	even	over
	51	Sugar maple	1.8	1890s	even	no data

Table D-1
Description of Forest Stands

Cover Type	Stand Number	Forest Type	Acres	Date Initiated	Stand Structure	Stocking
Plantations	1	European larch/mixed hardwood	6.8	1887	even	over
	2	White pine/Norway spruce	10.2	1887 - 1910/1911	uneven	well
	3a	Norway spruce	3.1	1887	even	almost over
	3b	Norway spruce	1.2	1887	even	almost over
	4	Red pine	16.3	1952	even	over
	12	Mixedwood/apple	1.6	1890s - 1940s	even	n/a
	13	Norway spruce	4.4	1950	even	well
	16	Scots pine	1.6	1917	even	well
	17	Red pine	21.0	1917	even	over
	18	White pine	22.2	1905	even	adequately
	22	Scots pine	2.1	1930	even	well
	25	Scots pine/mixedwood	1.9	1917	even	well
	26	Red pine	6.5	1917	even	well
	27	Norway spruce/mixedwood	4.0	1896	even	well
	28	Norway spruce	1.4	1913	even	well
	35a	White pine	0.7	1911	even	adequately
	35b	White pine	4.1	1911	even	adequately
	40	Mixedwood	5.4	1897	uneven	well
	41	White pine/Norway spruce	3.8	1911	even	well
	42a	Norway spruce	2.6	1882	even	well
	42b	Norway spruce	1.0	1882	even	well
	43	Mixedwood	2.0	1880s	uneven	well
	45	White pine/mixedwood	15.9	1880s	uneven	well
	46a	White pine/Norway spruce	1.6	1880s and various	uneven	well
	46b	White pine/Norway spruce	5.9	1880s and various	uneven	well
Grounds and Garden	0	--	9.9	before 1900	n/a	n/a
Hayfields	49a	Hayfield	16.6	before 1900	n/a	n/a
	49b	Hayfield	3.3	before 1900	n/a	n/a
	49c	Hayfield	5.1	before 1900	n/a	n/a
	49d	Hayfield	1.9	before 1900	n/a	n/a
Open fields	50a	Open field	1.0	before 1900	n/a	n/a
	50b	Open field	3.3	before 1900	n/a	n/a
Upland Pasture	48	Pasture	11.2	before 1900	n/a	n/a
Open water	47	Open water	14.2	before 1900	n/a	n/a

*

ENDNOTES FOR APPENDICES

[1] Shiver et al. 2004.
[2] These recommendations were developed through a review of Acceptable Management Practices (AMPs) and Best Management Practices (BMPs) of the northern New England states, and recommendations developed through site-specific studies. New Hampshire (New Hampshire Division of Forest and Lands 1991), Vermont (Vermont Department of Forests, Parks, and Recreation 1987), and Maine (Maine Forest Service 2004) all recommend similar buffer zones distances. Vermont and New Hampshire use the same guidelines for buffer distances; and these were used to set the baseline guidelines for the park. The following sources were reviewed in the development of the management specifications for the park: Calhoun and deMaynadier 2004; Faccio 2001; Faccio 2003; Maine Forest Service (Maine Department of Conservation) 2004; New Hampshire Division of Forests and Lands 1991; Semlitsch 1998; Vermont Department of Forests, Parks, and Recreation 1987; Kittredge and Parker 2000; Hunter, Calhoun, and McCullough(eds). 1997; Bryan 2003; New Hampshire Division of Forests and Lands 1997.
[3] Vermont Department of Forests, Parks, and Recreation 1987.
[4] Vermont Department of Forests, Parks, and Recreation 1987.
[5] Vermont Department of Forests, Parks, and Recreation 1987.
[6] Vermont Department of Forests, Parks, and Recreation 1987.
[7] Vermont Department of Forests, Parks, and Recreation 1987.
[8] Recommendations do not specifically address the needs of the amphibians that dwell in the main, year-round Pogue Stream, particularly populations of two-lined and northern dusky salamanders (Faccio 2001). Hence, the additional recommendations made by Faccio in his 2001 report were incorporated into MABI forest management policy.
[9] Based on both the biological inventory (Faccio 2001) and more recent research regarding postbreeding emigration and habitat use (Faccio 2003).
[10] Calhoun and deMaynadier 2004.
[11] Faccio 2003: Radio telemetry was used to track mole salamanders during the summer months. Postbreeding emigration varied greatly, from 30m/98 feet to 219m/719 feet. Based on the data gathered at MABI, 95 percent of the population was calculated to remain within a zone that extends 157m (515 feet) from the edge of a vernal pool. When data from MABI was combined with that from other studies (Semlitch 1998), a somewhat larger zone, 175m(575 feet) was found to encompass 95 percent of mole salamanders in summer. Based on these data, Faccio recommends a buffer of 200m (656 feet) around each vernal pool. This is more than the 100- to 400-foot life zone recommended in the amphibian habitat management guidelines (Calhoun and deMaynadier 2004).
[12] Calhoun and deMaynadier 2004.
[13] Calhoun and deMaynadier 2004.
[14] Faccio 2003.
[15] Defined as the age at which the culmination of mean annual increment has occurred.
[16] VT AMPs, p.19.

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