FOREST MANAGEMENT PLAN

for the Town of Stratham's

Stratham Hill Park and Town Forest

Stratham, New Hampshire

217.3± acres

Commissioned by:
The Stratham Forestry Committee and
The Town of Stratham

Prepared by:
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June 10, 2016

Charles Moreno, NH LPF #115
Consulting Forester
Report Copy # _____

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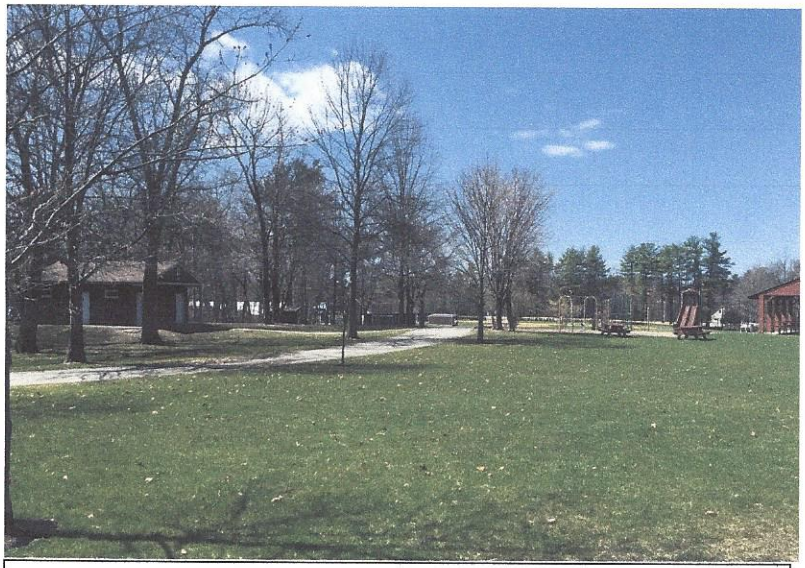

Stratham Hill Park recreation area.

Front cover photo: View of Great Bay from the Stratham Hill summit.

June 10, 2016

The author of this forest management plan, Charles A. Moreno, certifies that the contents of the plan, except where footnoted, but including all written material, maps (base information referenced), plan format and organization, are original to the author.

The purpose of this plan is to provide natural resources information and forest and wildlife management recommendations to the Stratham Forestry Committee, citizens of Stratham, and others interested in the management of the Stratham Hill Park and Town Forest in Stratham, New Hampshire. This document is a work for hire done by Moreno Forestry Associates for the Town of Stratham, New Hampshire, and may be used by the Town of Stratham, New Hampshire for any purpose. Copying of this plan by any other individual or organization, including all written material, plan content and format, requires appropriate citation and/or the written permission of Charles A. Moreno, Consulting Forester.

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TABLE OF CONTENTS

Page

I. MAPS

MAP – PROPERTY LOCUS 1
MAP – NATURAL & PHYSICAL FEATURES 2
MAP – FOREST TYPES 3
MAP – MANAGEMENT RECOMMENDATIONS 4
MAP – SOILS 5

II. INTRODUCTION

Introduction 6
Property Information
Location and Geography 6
Reference Information 7
Prominent Property Features 7

III. MANAGEMENT CONCERNS and RECOMMENDATIONS

Property Management Concerns
Viewsheds 8
Forest Recreation 10
Invasive Plants 11
Ponds 13
Fields 13
Forest 15
Other Management Considerations 17
Table – *Summary Recommendations* 17

IV. FOREST TYPES

Forest Type Descriptions and Recommendations
White Pine 18
White Pine/Hardwood 20
Upland Hardwood 22
Mixed Hardwood 24

V. APPENDICES

A. Soil Type Summary 25
B. Professional Credentials 26

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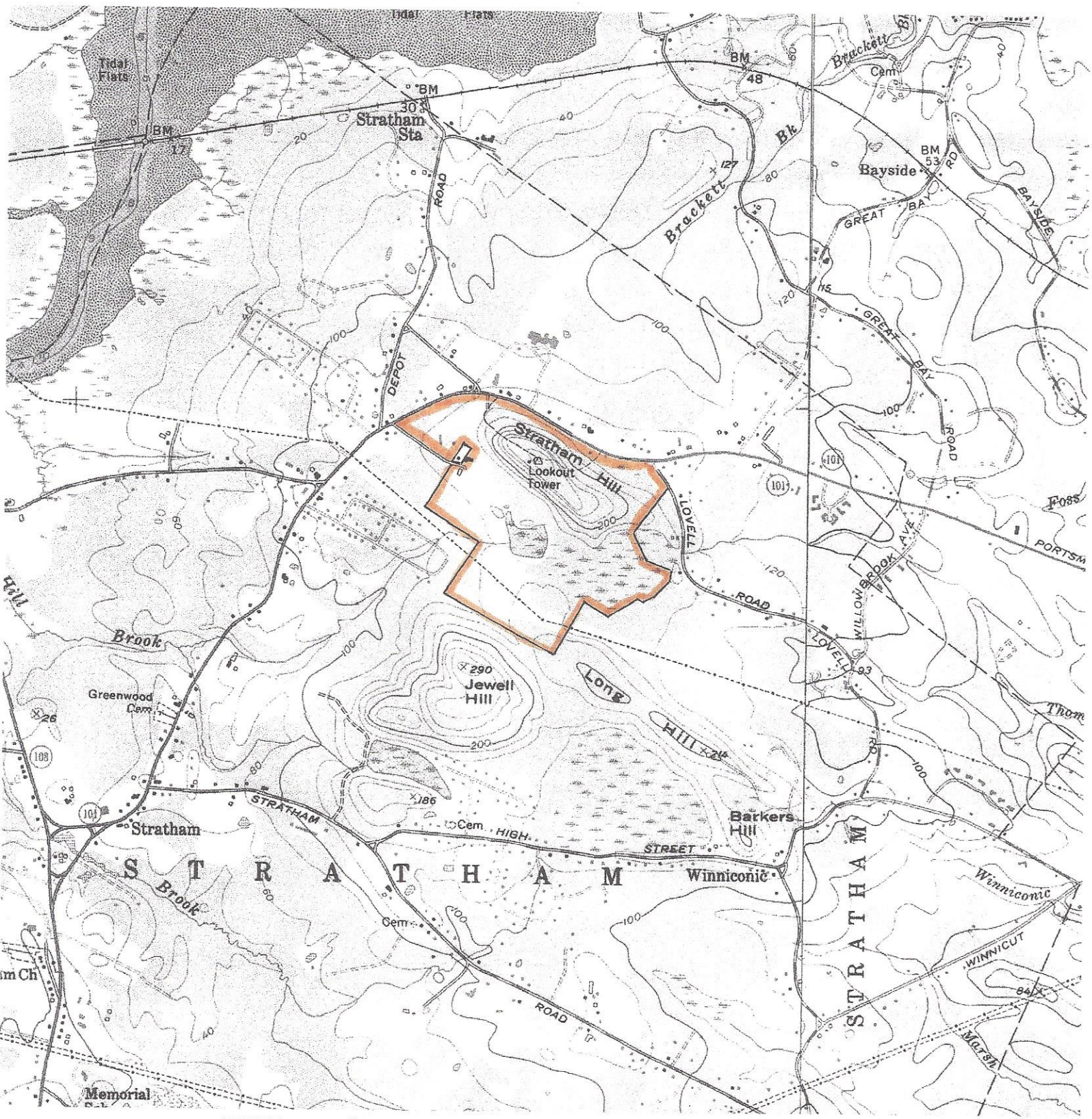
MAPS

MAP SCALE:

1 inch = 2000± feet

Locus Map *of the Town of Stratham's*
Stratham Hill Park and Town Forest
Stratham, New Hampshire
217.3± Acres



USGS Topographic Map, "Newmarket" and "Portsmouth" Quadrangles

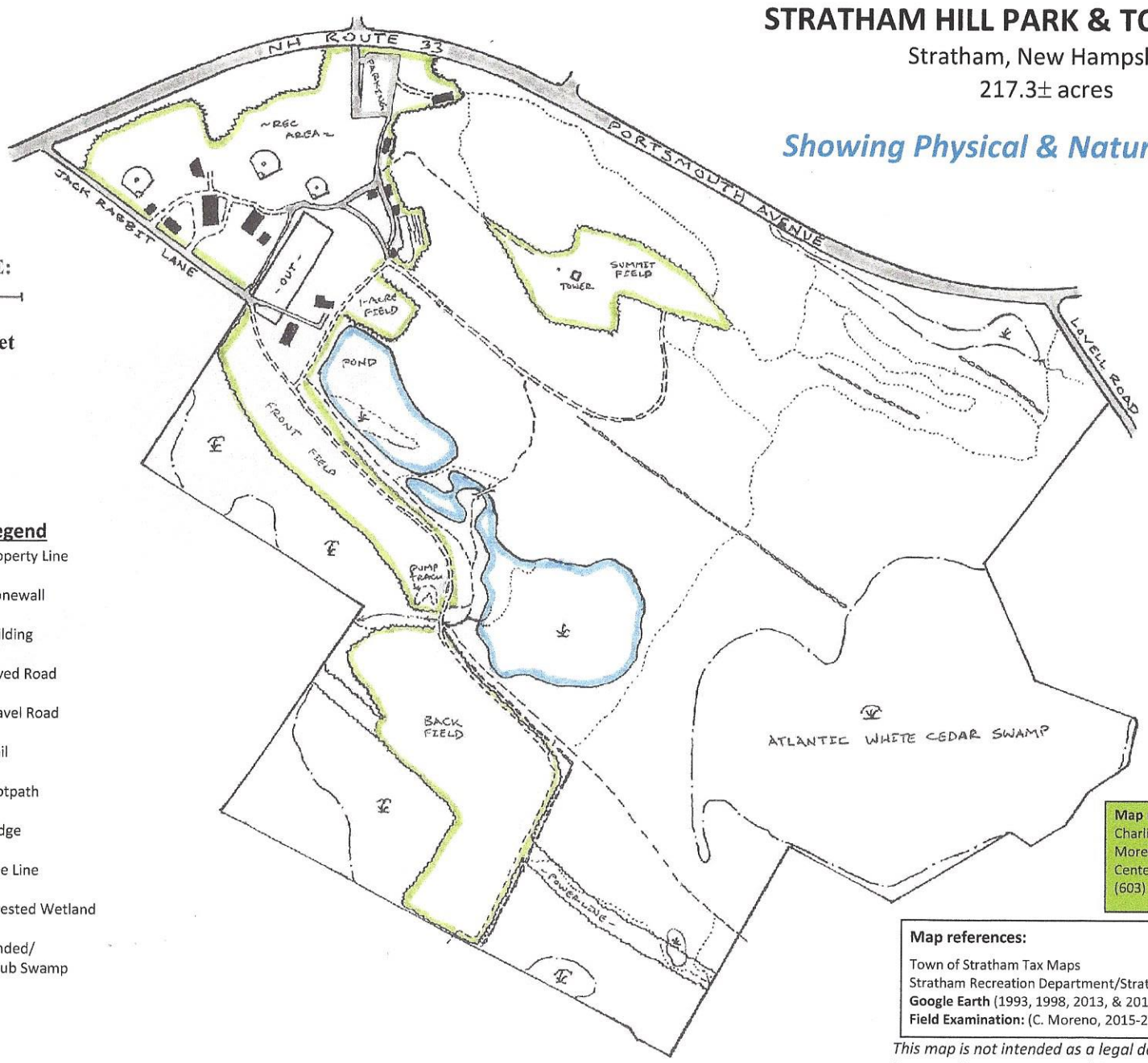
Map of the

STRATHAM HILL PARK & TOWN FOREST

Stratham, New Hampshire

217.3± acres

Showing Physical & Natural Features



MAP SCALE:

1 inch = 600± feet

Map Legend

- Property Line
- Stonewall
- Building
- Paved Road
- Gravel Road
- Trail
- Footpath
- Bridge
- Tree Line
- Forested Wetland
- Ponded/ Shrub Swamp

Map researched and drawn by:
Charlie Moreno, Consulting Forester
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Center Strafford, NH
(603) 335-1961 June 2016

Map references:

Town of Stratham Tax Maps
Stratham Recreation Department/Stratham Hill Park Association Maps
Google Earth (1993, 1998, 2013, & 2015 images)
Field Examination: (C. Moreno, 2015-2016)

This map is not intended as a legal description or for legal purposes. Property lines, acreages, and interior details are approximate.

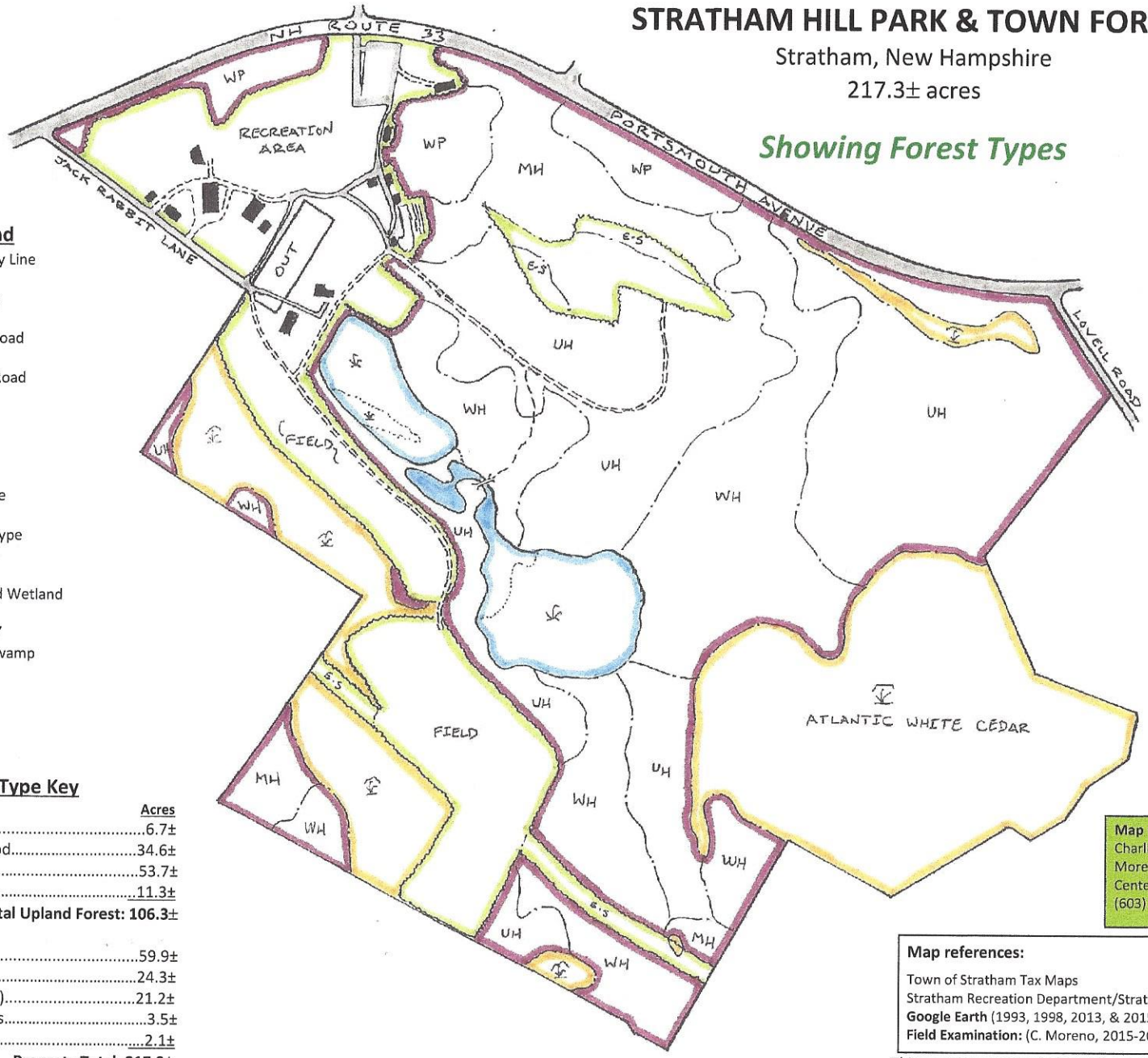
Map of the

STRATHAM HILL PARK & TOWN FOREST

Stratham, New Hampshire

217.3± acres

Showing Forest Types



MAP SCALE:

1 inch = 600± feet

Map Legend

- Property Line
- Building
- Paved Road
- Gravel Road
- Trail
- Bridge
- Tree Line
- Forest Type Change
- Forested Wetland
- Ponded/ Shrub Swamp

Forest Type Key

	Acres
A. White Pine	6.7±
B. White Pine/Hardwood	34.6±
C. Upland Hardwood	53.7±
D. Mixed Hardwood	11.3±
Total Upland Forest:	**106.3±**
Wetlands	59.9±
Fields	24.3±
Recreational Area (Park)	21.2±
Early-successional Areas	3.5±
House Site	2.1±
Property Total:	**217.3±**

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Map of the

STRATHAM HILL PARK & TOWN FOREST

Stratham, New Hampshire

217.3± acres

Showing Management Recommendations

MAP SCALE:

1 inch = 600± feet

Management Areas

- Clear Viewshed
- Early-successional Management
- Hazard Tree Removal
- Recreation and Field Management Areas
- Primary Silvicultural Management Areas
- Secondary Silvicultural Management Areas
- Reserve

Recommendations Key

1. Property Line – Blaze & Paint
2. Improve Cross-Trail Drainage
3. High Density Trail Area

⊗ Landing Site

Invasive Plant Concentration

Map Legend

- Property Line
- Building
- Paved Road
- Gravel Road
- Trail
- Footpath
- Bridge
- Tree Line
- Forested Wetland
- Ponded/ Shrub Swamp

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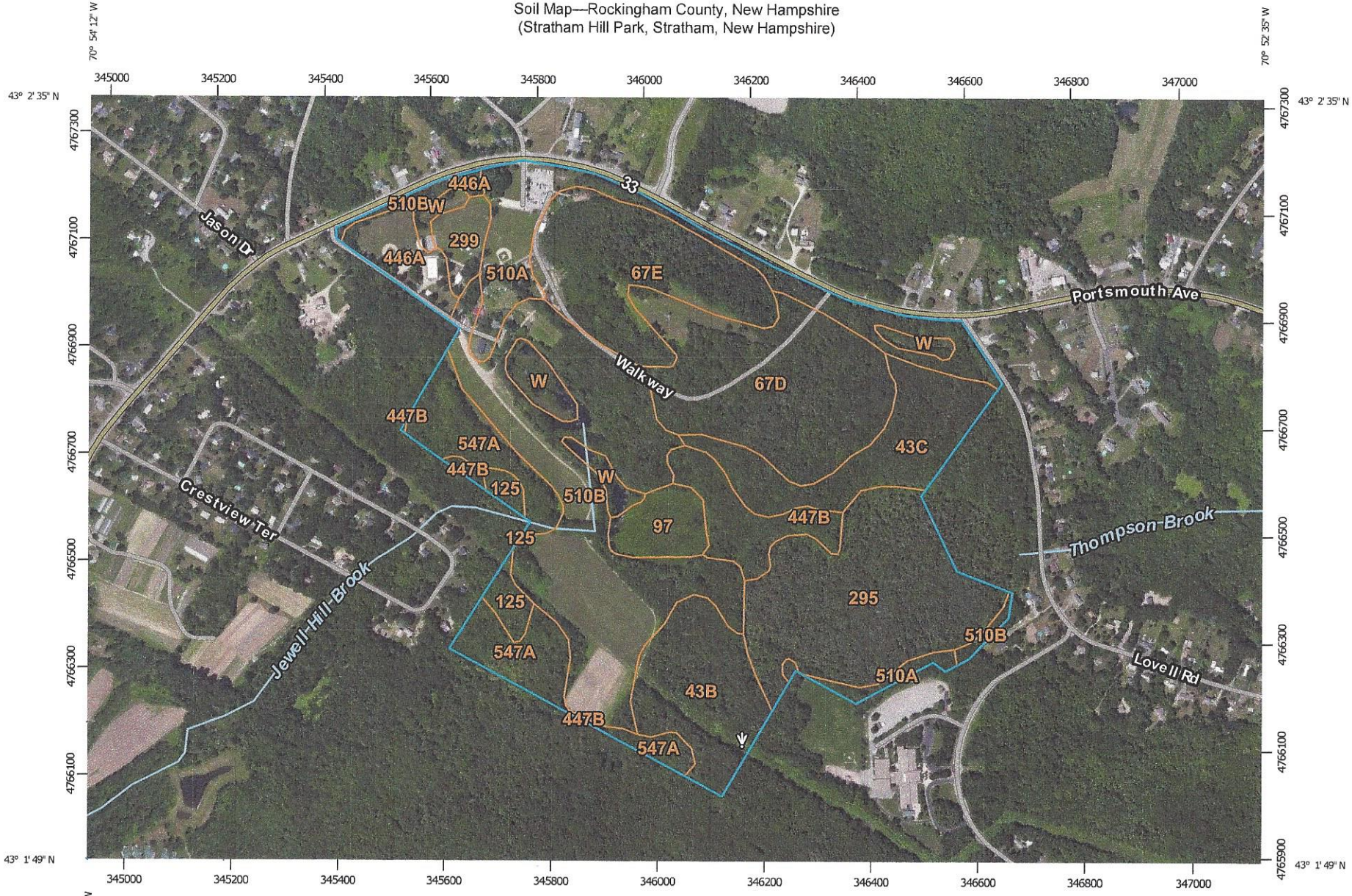
Soil Map—Rockingham County, New Hampshire
(Stratham Hill Park, Stratham, New Hampshire)



INTRODUCTION

Stratham Hill Park and Town Forest
Stratham, New Hampshire

INTRODUCTION

The community of Stratham, New Hampshire is owner of two premier properties, Stratham Hill Park and the Stratham Town Forest, which lie adjacent to one another and collectively cover 217.3± acres. The variety of recreational activities hosted at the park are unparalleled, from ice skating to ballgames, and concerts to an annual agricultural fair. Additionally, scenic views of the Seacoast area are attained from the field and fire tower atop Stratham Hill. The Town Forest contains outstanding forest, field, and wetland environments, including a unique Atlantic white cedar swamp. An extensive trail network that weaves through the properties provides a popular destination for recreationists.

With increasing recreational use and evolving forest conditions, the community, through its Forestry Committee, has identified a series of management needs and concerns. Based on a detailed study of the property and its forest, this plan provides recommendations and an action plan to address these concerns.

PROPERTY INFORMATION

LOCATION and GEOGRAPHY

The Stratham Hill Park and Town Forest property is located along Portsmouth Avenue (aka NH Route 33) between Jack Rabbit Lane and Lovell Road, northeast of the town center.

The property is located in the Gulf of Maine Coastal Lowland ecoregion subsection[1]. Near Great Bay and approximately 7 miles from the Atlantic Ocean, the sea moderates the area's climate. Though near the northerly extent of the Appalachian oak-pine forest[2], the property hosts a number of southerly species including pignut hickory and swamp white oak.

Soils on the property are formed from marine clays and glacial tills with near-surface compaction. Stratham Hill is a steep-sided, glacially-formed drumlin on the property. Topography ranges from level in the extensive wetlands, fields, and recreational areas, to steeply sloping on the sides of Stratham Hill. Elevations range from 280± feet above sea level at the hilltop to about 140± feet in the park's recreational area. Seasonal streams flow towards the Squamscott or Winnicut Rivers.

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[1]Keys, J.E. and C.A. Carpenter. 1995. Ecological Units of the Eastern United States: First Approximation. U.S. Department of Agriculture, Forest Service.
[2] Sperduto, D. D. and W.F. Nichols. 2004. Natural Communities of New Hampshire. New Hampshire Natural Heritage Bureau and The Nature Conservancy.

REFERENCE INFORMATION

Surveys: Not available

Aerial Photos: Google Earth images 1993, 1998, 2013, and 2015.

Tax Maps: Stratham Tax **Map 22, Lots 83** (86.15 acres), **85** (125.15 acres), and **79** (5.2 acres).

Acreage: TOTAL – 217.3± Acres

Recreational Area (park)	**– 21.2± acres**
House site	**-- 2.1± acres**
Wetlands	**-- 59.9± acres**
Ponds (11.9 ac)	
Cedar Swamp (32.0 ac)	
Forested Wetlands (16.0 ac)	
Fields	**-- 24.3± acres**
Early-successional Areas	**-- 3.5± acres**
Powerlines (2.5 ac)	
Hilltop young growth (1 ac)	
Upland Forest	**--106.3± acres**

PROMINENT PROPERTY FEATURES

- Stratham Hill Park, a 21± acre recreation area offering a great variety of activities and events including playgrounds, ball fields, basketball court, soccer field, ice skating area, animal barns, picnic pavilion, concession stands, and concert stage.
- The location of the annual Stratham Agricultural Fair.

- Stratham Hill, elev. 280± feet. A field and fire tower atop this steep-sided, glacially-created drumlin provides scenic views of the seacoast area.
- 106± acres of well-established upland forest.
- An extensive Atlantic white cedar-yellow birch-pepperbush swamp, a rare natural community in New Hampshire.
- Nearly 4 miles of recreational trails and roads, including BMX riding mounds.
- Extensive fields with management opportunities for field-using birds.
- Two ponds which provide fine wildlife habitat.

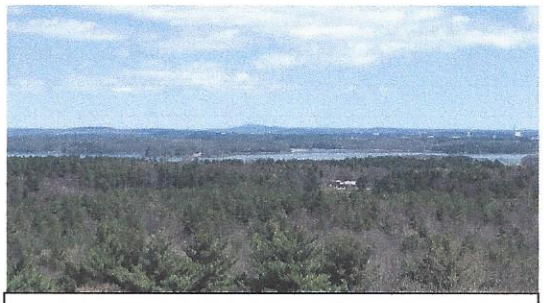
MANAGEMENT CONCERNS & RECOMMENDATIONS

MANAGEMENT CONCERNS
with Summary Discussion and Recommendations

The Forestry Committee identified the following challenges and concerns in the management of Stratham Hill Park and the Town Forest. The Committee gathered ideas and feedback from the community, user groups, and other town stakeholders. In concert with the Forester's property study, recommendations were vetted via Forestry Committee meetings and field walks.

VIEWSHEDS: Craft long-term plan to retain scenic views from Stratham Hill's summit.

Background: A century ago, Stratham Hill was mostly pastured with unimpeded 360° views from the summit. A compass rose structure was installed in 1881 to celebrate this panoramic view, with lines pointing to major landmarks in all directions, including Mt. Washington. Through the 20th century, tall forest returned to the slopes, with only a small field area retained at the top. While occasional clearing has occurred over the years, view corridors are now significantly reduced.



View of Great Bay and Mt. Washington from the Stratham Hill summit.

Concerns: Efforts to regain/retain views from the hilltop will incur ongoing expense. Furthermore, there is concern that over-removal of the hillside forest will increase noise and visibility from Route 33, potentially cause erosion, and look poorly. Finally, the logistics of tree removal is challenging due to steep slopes and limited equipment accessibility.

Recommendations: Forestry Committee consensus is that view clearings should be limited to three viewsheds, with the forest retained in all other directions. These are:

- **North towards Great Bay –** Retention of panoramic Great Bay views (and northern mountains) is paramount. Due to the hill's steep northern downslope, this view can be maintained relatively easily, especially from the fire tower, by retaining the strip of low vegetation ("early-successional" growth including sumac and aspen). *Clear this strip once every 10± years, not allowing vegetation to exceed 25 feet in height.* The early-successional (e-s) strip also provides excellent bird habitat.

  Eventual removal of the tier of tall trees behind the early-successional strip may also be necessary, however, this might be timed for when the strip has densely grown back to screen this hillside tree removal.

  Great Bay views may also be expanded to the northwest by removing a group of tall pines and hardwoods next to the small utility building near the top of the slope. The powerline corridor down the slope may also need minor widening, though widening should be minimized close to Route 33.

- **West southwest (WSW) towards Newfields and Pawtuckaway –** This viewshed has also been maintained in the past. It requires relatively minimal tree removal on the steep hillside slope, including mostly small diameter hardwoods that will soon overtake the view. Two larger oaks and one pine near the hill crest may also be removed to

provide a full vista. A patch of early-successional (e-s) vegetation on the edge of the hilltop field provides some screening for tree removal activity below.

Long-term, clearing of additional trees should be re-visited every 10± years, in conjunction with e-s re-clearing for the north view. A 3-year maintenance cycle for e-s vegetation in the WSW viewshed using a bushhog is suggested after initial clearing.

- **East southeast (ESE) towards the ocean** – This viewshed does not presently exist. It would be created due to the improved performance needs of emergency communications equipment that is mounted on the hilltop fire tower, with transmission aimed in this particular direction. A 50± foot wide corridor would be cleared starting near the junction of the fire road and the hilltop field. Due to the mild gradient in this direction, the corridor must extend 1200+ feet downslope to provide sufficient tree clearance for communications, and to create a view towards the ocean.

  Long-term maintenance for this corridor requires 10-year re-clearing for the top 250± feet, and less frequent re-clearings further downslope.

Logistics:

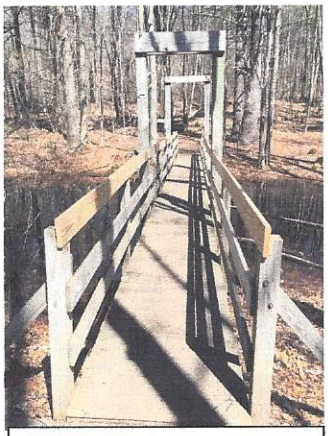
1) If a 10-year cutting cycle is used, early-successional areas (totaling 1± acre) likely need re-clearing with a Brontosaurus or similar sapling-mulching equipment. Presently, the estimated total cost is $1500±. Alternately, maintenance can be done in-house using a tractor and bushhog (the areas are not steeply sloped), but on a more frequent mowing basis, not exceeding 3± years.
2) Removal of larger trees in the north viewshed should be done in concert with the creation of the ESE corridor, using biomass harvesting equipment. This work should occur on frozen ground or very dry conditions to avoid overly disturbing the hilltop field. As long as there is a substantial enough project to stage a biomass operation, this tree removal will not incur expense, but rather, likely generate modest income.
3) The harvest of polewood (trees 4 to 10 inches diameter) in the WSW viewshed can be done in-house, with trained personnel felling the trees and neatly lopping brush to ground level. Since there are relatively few tree to harvest, they should be left on the ground, and not removed, as this action may unnecessarily disturb the steep ground and initiate erosion. The few large trees for removal can either be cut, lopped and left (with firewood perhaps carried out and salvaged), or removed in conjunction with the biomass operation.

Schedule/Finances:

Project/Viewshed	When	Method/Equipment	Projected Cost
E-s vegetation removal (N & WSW)	2016	Brontosaurus	$1500±
WSW polewood harvest	2016	In-house, chainsaw	n/a
ESE corridor clearing & larger tree removal in N	2017 or 2018	Biomass harvest	Modest income
E-s maintenance (3-year)	2019	In-house, tractor & bushhog	n/a

FOREST RECREATION: Manage the changing and increasing nature of forest recreation.

Background: The vastly increased use of Stratham Hill Park and Town Forest over the last 25 years has been a challenge for the town to manage. During certain events and seasons, the park may host over 1200 cars in its parking areas. The park's recreation area offers a diverse set of activities in a concentrated space, which the town manages exceptionally well with talented staffing and adequate funding. Over the past quarter century, use of the forest and field acreage has greatly increased and evolved. There is a considerably expanded trail network that is now heavily used for dog walking and mountain-biking. Town recreation personnel has engaged in comprehensive mapping, signage installation, and trail marking. Planning is needed to adequately handle increased trail-based usage, forestall conflicts, and minimize adverse environmental consequences.



Footbridge fords a wetland on a Stratham Town Forest trail.

Concerns: Though nearly 4 miles of roads and trails now cover the town lands, the use capacity of these trails may eventually be reached. Use dispersal is dependent on trails with significant networking on adjacent private properties. Biker-walker trail conflicts sometimes arise. Environmental degradation including trail erosion, wetland impacts, and wildlife disruption may occur due to over-usage. Long-term trail maintenance requires ongoing expense.

Recommendations: The current road and trail network is very well maintained, needing little upgrading. Significant expansion of the network *is not recommended* due to maintenance costs and the increased potential for environmental impacts. Minor expansion is underway with the layout of single-track side trails for bikers to avoid conflicts with walkers on heavily used trail segments. These side trails should remain relatively close to existing trails to avoid trail "sprawl"—the situation where few extensive *trail-less* areas are left for wildlife.

Good communications, partnering, and maintenance assistance with/for the adjacent landowners who share the trail network is important, as modification or loss of these trails will likely displace and concentrate usage onto the town's properties.

Suggested trail improvements/modifications: A) Improve drainage into a culvert on the trail which traverses between the fire road (to hill summit) and the footbridge. Re-establish a dry trail surface. B) Eliminate, if possible, the new trail(s) that cross through the middle of the back field, allowing improved conditions for wildlife.

Park staff should conduct periodic trail usage inventories (number and type of users), while monitoring and recording corresponding trail conditions. Devise a set of condition parameters that can be tracked in order to maintain consistent inventorying. Tracking usage and condition over time will help planning and budgeting for maintenance needs, and will provide a firm basis for limiting usage, when needed, if over-use eventually occurs.

Logistics: All new trails, including single-track side trails, should be approved, and preferably, laid-out by the park recreation director or other personnel. Dissuade rogue trail building. Color coding, perhaps with a stenciled bike symbol on trees, can be used to designate single-track trails intended for mountain biking.

Single-track side trails can be laid-out and designated at no cost besides town personnel time, unless there is a wetland crossing involved. Wetland and stream crossing should be avoided.

In addition to usual town staffing and budgeting to cover the cost of grading, water diversion, erosion control, and signage/marking on existing roads and trails, town personnel can help organize volunteer trail maintenance efforts for targeted projects such as installing waterbars in steep trail sections. Mountain bike groups, Scouts, and community helpers are potential sources of volunteer work.

Schedule/Finances:

Project	When	Method/Equipment	Projected Cost
Trail culvert installation	2016	In-house, backhoe	$500±
Complete single-track side trails	2016	In-house and supervised volunteer	$ 0
Road/trail maintenance	Ongoing	In-house, town equipment	n/a
Periodic use inventory	Annual?	Park staff	n/a
Adjacent landowner contact	Annual?	Park director	n/a
Volunteer projects	Occasional	Supervised by park staff	n/a

INVASIVE PLANTS: Exotic, invasive plants threaten forest degradation.

Background: Several species of non-native, invasive plants are present in Stratham Hill Park and the Town Forest. These include: multiflora rose, Japanese barberry, European barberry, Oriental bittersweet, glossy buckthorn, Norway maple, autumn olive, and Japanese knotweed. Most are concentrated or in relatively low numbers, though rapid spread is readily possible likely with glossy buckthorn and Norway maple.

Exotic invasives cover the interface of fields and forested wetlands.

The most severely infested sites include the recreation area and the homestead, as well as field edges, the powerline, and forested wetlands in the Town Forest's southerly area. While there is incipient infestation of upland forest areas, much of the forest remains invasive-free. In 2015, park staff and volunteers initiated a concerted effort to control invasives around the recreation area and at the top of Stratham Hill.

Concerns: Severe invasive plant infestations alter microenvironments, as well as the forest as a whole. Biodiversity is diminished, wildlife habitat affected, and perhaps most alarming of all, the forest's ability to successfully regenerate is compromised.

The task of controlling and possibly eliminating invasive plants from Stratham Hill Park and the Town Forest is formidable, possibly cost-intensive, and ongoing. However, *inaction leads to ever-increasing numbers of exotic plants*, posing a real threat to this forest's long-term integrity and existence.

Recommendations: Immediately fund and implement an organized strategy to treat all areas where invasive plants are present. Plan annual follow-up treatments, including the areas covered in 2015. Practice continuous, long-term monitoring for invasive plant presence, and immediate control response. Strive to maintain the entire property free of invasive plants.

Work to educate the public about the major environmental threat posed by alien invasive plants, and the need and methodology to control them as a community-wide effort. Every year of inaction escalates control costs and exacerbates the problem.

Logistics: Divide the property into management *sectors* (2 to 20± acres in size). For example, the recreation area and its edges can be a sector, the homestead site another. Areas contained within a field edge, a trail, and/or a stream, for example can be designated as sectors. Sectors should be readily defined by surrounding physical features. Once sectors are defined and mapped, determine the location of invasive plants within the sector, and a treatment strategy. The following control strategies are available:

- In field-forest edges, or forest areas where favorable young growth is not intermixed with invasives—apply mechanical mowing and uprooting method. *Do not use this method if Japanese knotweed is present.*
- If favorable native shrubs or young growth is intermixed, or in forested wetlands where equipment travel is limited—use a trained rotary-brushsaw crew to find and cut invasives, then wait for the growth of low re-sprout and herbicide treat the re-sprout.
- For Japanese knotweed or Oriental bittersweet, use herbicide treatment, foliar and stem application, respectively. These must be applied by a licensed applicator, possibly in-house, who is experienced with invasive plant control.
- Volunteer teams work well, after brief training, in pockets of seedling-sized invasives using hand pulling. Sapling or shrub-sized invasives, if not overwhelming in number, can be uprooted using a weed wrench.

Schedule/Finances:

Project	When	Method/Equipment	Projected Cost
Develop sector map	Aug 2016	Park director	n/a
Fall invasive control effort: follow-up treatment of 2015 areas, and begin treatment of back field edges.	Sept 2016	In-house and supervised volunteers	n/a
Ascertain the presence of invasives in each sector. Develop a treatment strategy.	Oct-Nov 2016	Forester	$500-1000±
Contract treatment of severe areas under powerlines and in forested wetlands.	Mar-Sept 2017	Contractor—brush remover equipment. Possible trim and follow-up herbicide.	$8,000±
Fall invasive control effort: follow-up treatment of all 2016 areas, while adding any remaining areas.	Aug-Sept 2017	In-house and supervised volunteers	n/a
Ongoing treatment—all sectors	Annual	In-house, contractor, and supervised volunteers	n/a

PONDS: Is maintenance necessary?

Background: The Town Forest contains two substantial ponds, 4.1± acres and 7.7± acres respectively, with interconnecting smaller impoundments. In the past, these readily-accessible ponds contained open water, but dense shrub vegetation has filled most of the larger pond. The vegetation is primarily winterberry holly, but includes buttonbush. Swamp white oaks are found on the edges.

Beaver lodge in front of dense shrub growth in the larger pond.

Concerns: Removing the vegetation from the larger pond is desired by some community members. This will allow attendant recreational uses, including small craft boating and fishing. Other community members prefer allowing the pond to evolve naturally, primarily for the beneficial wildlife habitat it provides. Should something be done?

Recommendations: Pond vegetation removal is unfeasible from both permitting and cost standpoints. NHDES is not likely to allow this project: detrimental impacts outweigh perceived benefits. Moreover, the cost of permitting and site work is prohibitive. In addition to vegetation removal, dredging is needed to insure that the vegetation does not return.

The existing shallow shrub swamp conditions provides habitat to amphibians, turtles, birds (yellowthroat, yellow warbler, wood duck), and mammals (beaver, raccoon, mink). It is recommended that no intervention be made. Furthermore, to protect habitat, a loop trail surrounding the ponds *is not recommended*.

FIELDS: How to manage?

Background: In addition to the recreation area, the town properties contain four fields totaling 24.3± acres, or over 10% of the area. A 1± acre field near the homestead is regularly mowed. The 4.1± acre field at the summit of Stratham Hill is regularly mowed and considered essential to the park's scenic beauty and accessing the hill's panoramic views. In the Town Forest, the 6.7± acre "front" field, is periodically mowed, formerly for hay. It provides scenic beauty, hayfield habitat, and overflow parking for certain recreational events such as the Great Bay 5K road race. The recreation department established a "pump" track, or BMX course, on the eastern end of the field. The 12.4± acre "back" field was recently abandoned for hay production, but now has good potential to be managed for tall grass or wildflower field habitat.

This pump track course is located in the eastern end of the "front" field, and is used by bikers of all ages.

Concerns: There are no pressing concerns with the fields, other than the cost of maintaining them open. Recommendations will address potential uses and management options.

Recommendations:

- **The 1± acre field** – continue light use for picnicking or lounging. It may also be used for events (and possibly as rented event space). It may also provide an easily accessible site for a community garden, with nearby water (the pond). A small orchard may also be considered. Exotic, invasive plants along this field's perimeter need to be eliminated.
- **The 4.1± acre summit field** is a signature feature of the park. Continued meticulous maintenance is planned. In 2015, a volunteer group was organized to remove patches of autumn olive and other invasives along the field edges. This work must continue annually to insure the elimination of the noxious shrubs. Additionally, periodic cutting of early-successional growth—sumac, aspen, gray birch, and brambles—along this field's edges is needed to maintain viewsheds and for habitat management.
- **The 6.7± acre Town Forest "front" field** should remain as a rough hayfield, even if mowing occurs at town expense (formerly maintained by a local farmer). Hay should be removed if possible to prevent the formation of a deep thatch layer. This field has become essential to recreational uses of the park.
- **The 12.4± acre Town Forest "back" field** is no longer maintained by a local farmer. Due to its extensive size, the back field could be managed for grassland birds by practicing late-season mowing (after mid-August, with the crop of mulch hay removed). Birds which may nest in the field under undisturbed conditions include savannah sparrow and bobolink. The latter species has sharply reduced numbers and is now imperiled in New Hampshire. Nesting is unlikely unless recreational use of the field is carefully managed, with dog walking confined to one field edge, or the forest beyond. Nesting boxes for eastern bluebird, tree swallows, and possibly American kestrel, can also be established. A bat box on the south facing edge of the field may also be utilized. Finally, field edges can be managed for pollinators. The remaining abandoned hay bales may provide a haven for bees and other insect pollinators. Wildflower patches can be established and managed.

The "back" field has good habitat management potential. Remove this central trail, however, to improve habitat.

Logistics: Management of the four fields requires maintenance scheduling for a wide variety of uses, and adequate budgeting to cover the cost of field maintenance. Grant funding for the maintenance of the "back" field for wildlife purposes may be available through NH Fish & Game.

Schedule/Summary:

Field	Mowing Frequency	Present or Potential Uses
1-acre field	Weekly	Possibly a community garden.
4.1 acre summit field	Weekly	Aesthetics, summit access.
6.7 acre "front" field	2 to 5 times a summer, prior to large events	Recreation, scenery, event parking.
12.4 acre "back" field	Once per year, late summer only	Wildlife habitat, scenery.

FOREST: Should it be managed? Are there priority projects?

Background: Upland forest covers 106± acres, with an additional 16± acres of wetland forest. The base age (the oldest set of trees) in much of the forest interior is mid-aged, ranging from 80 to 100± years of age. A variety of species are common including red oak, red maple, white pine, black birch, shagbark hickory, and sugar maple. Overstory trees generally range from 6 to 22 inches in diameter.

As the interior forest matures, beech and hemlock will increasingly dominate the understory to the exclusion of other tree species. Silvicultural management of established forest areas can attenuate the trend towards shade-tolerant species exclusivity. In addition to providing growing space for healthy trees and enhancing habitat, judicious forest harvesting allows sunlight to penetrate to the forest floor. This encourages new generations of diverse tree species.

The following table summarizes the prevalence of various pathogens and insects affecting local forests, and Stratham Hill Park/Town Forest's susceptibility. Over time, silvicultural management may improve the forest's resilience to pathogens, insects, storm events, and climate change.

Pathogen or Insect	Species *Most* Affected	Prevalence	Vulnerability
Beech bark disease	Beech	Moderate	High
Nectria canker	Black birch, yellow birch	Moderate	Moderate
Strumella canker	Red oak	Low	Low
Pine blister rust	White pine	Low	Moderate
Hemlock wooly adelgid	Hemlock	Moderate	Moderate
Gypsy moth	Oaks, birches, hemlock	None	Moderate
Emerald ash borer	White ash, black ash	None	Low
Red pine scale	Red pine	None	Low

Young forest is found in a 15± acre area on the westerly slopes of Stratham Hill where a 1991 thunderstorm microburst levelled an old pine grove. Incipient, early-successional forest covers about 4½ acres including a powerline corridor in the Town Forest and two young patches along the Stratham Hill summit field. Though the early-successional areas are periodically cleared for maintenance reasons, clearing also serves to perpetuate this important young habitat type.

Other than the microburst and a gypsy moth outbreak in 1980-82, extensive natural or human-caused disturbances have not occurred in the Stratham forest since it grew up from pasture.

Concerns: As the forest matures, species diversity will decrease unless some form of acute disturbance occurs. Natural disturbances include storms, fire, flooding, and insect or disease infestations. Silvicultural management (employing carefully planned logging) can be used as a natural disturbance substitute.

The altered visual condition of the forest, post-harvest, is often perceived as a great drawback of silvicultural management when logging is involved. While important forest health and habitat benefits result from a thoughtfully planned harvest, forest appearance is changed, especially in the first few years. This will be noticeable from the extensive trails that traverse the forest.

While it is recognized that forest harvesting may be controversial, there are at least two urgent upcoming projects. The first is the need to remove hazard trees along trails, especially the perimeter trail north of the hill. Second is the pending project to clear a corridor for emergency communications. Methods to mitigate the aesthetic impact of these projects are discussed under logistics below.

Recommendations: While the forest may benefit from silvicultural management, there are few pressing concerns involving forest health. Therefore, management should *at first* occur only in conjunction with the urgent projects—hazard tree removal and communications corridor—previously described. Light thinning may be planned in the forest surrounding the corridor and to remove larger trees in the summit viewsheds. Economy of scale comes into play: If the project is too small, it will be a cost operation. A larger project, covering 20 or more acres, will be breakeven or provide positive cashflow.

Over time, if the projects are reasonably well-received and/or the habitat and tree growth benefits are recognized, silvicultural management may be initiated in additional forest areas. Specifications for this work are presented in the *Forest Types* section.

Brambles and staghorn sumac are found in the summit field early-successional area.

Salvage and restoration harvesting may be needed in the future in response to an unpredicted large-scale natural disturbance.

Management of early-successional areas should continue as specified in the viewshed management section.

Logistics: There are techniques to mitigate scenic impacts, including thorough preparation (tree marking and logging trail layout), the use of top contractors, application of Best Management Practices (BMP's), avoiding sensitive areas, and working during favorable conditions (dry summer or frozen ground). To ensure that silviculture is applied for any harvest, the exact set of trees to be harvested should be selected and marked by a professional forester, after review of the management plan.

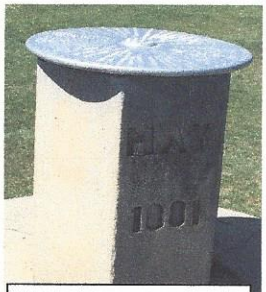
A staging area for the corridor harvest and thinning is needed. This can be either at the northeast corner of the back field, or possibly, the summit field. While the latter option provides close access, the summit field is an especially sensitive site and the fire road leading to the field is steep. For these reasons, the back field area may be best alternative.

Removal of hazard trees in the pine stand along the perimeter trail north of the hill is challenging with logging equipment due to steep grades and tall trees. Tree removal will be highly noticeable from the trail. Employment of a tree service to remove the trees is an expensive option, but will have more favorable scenic results.

OTHER MANAGEMENT CONSIDERATIONS

Property Lines: Property lines along adjacent private parcels should be located, followed by straight-line layout. Long-lasting demarcation is done by axe-blazing boundary line trees (according to surveying protocol) and then brush painting the blazes with surveying paint. Follow-up maintenance painting of the blazes should occur every 10 years.

Historic Features: A thorough survey of the property's historic features is beyond the scope of this report. Old cellar holes, dug wells, farm dumps, and primitive cemeteries, for example, were not observed. A series of more or less parallel interior stonewalls was noted on the east side of Stratham Hill. Stonewalls are also found along the edges of the fields. The compass rose at the top of Stratham Hill is a unique historic feature.



Compass rose atop Stratham Hill.

Educational Opportunities:

- Interpretive signs can be located along trails with information about the natural environment or management activities.
- Educational tours of the forest can be staged, perhaps in conjunction with UNH Cooperative Extension.
- Stratham Memorial Elementary School lies adjacent to the Town Forest, east of the Atlantic white cedar swamp. Programs to connect students with the park's natural environment may be explored. If permitting allows, the construction of a boardwalk through a small portion of the swamp may provide educational access to the school community.

Summary Recommendations – Priority Level			
High	**Medium**	**Low**	**Not Recommended**
Management of Stratham Hill's viewsheds.	Early-successional habitat management.	Recreational trail network expansion.	Pond maintenance
Recreational trail maintenance and modifications.	Back field management for wildlife.	Silvicultural management for forest health, species diversity, and habitat enhancement.	
Invasive plant control.	Property line maintenance.		
Hazard tree removal.	Communications corridor clearing.		
Ongoing field maintenance.			

FOREST TYPES

A. White Pine – 6.7± acres

Description – White pine dominates (>75%) the canopy of this forest type, which is found in two small pockets on the north side of Stratham Hill, as well as along the park's Route 33 road frontage. The main stand (variant A1, described below) is about 100 years of age and is the remaining portion of the pine stand that once covered a considerable area of Stratham Hill. In 1991, a severe thunderstorm microburst levelled most of the stand. After the storm, thousands of pine seedlings were planted on the hill's northeast slope; this area, 25 years hence, now constitutes a new pine stand, variant A2, where pine dominates but is only 25 to 30± years of age.

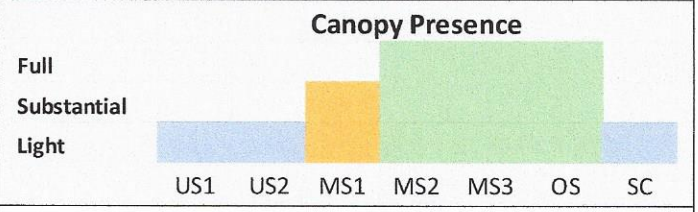
Northface Trail through older (A1) white pine stand.

A2 white pine stand, planted after 1991 storm.

Species Composition	
Primary[1]	White pine.
Secondary[2]	Black birch, sugar maple, white ash, shagbark hickory.
Tertiary[3]	
Regeneration (saplings)	White ash, shagbark hickory, black birch, sugar maple.

Forest Structure	**Description of Older White Pine Stand (A1 variant)**		
Composition			
Stand Structure	Two-aged		
Successional Stage	Late-intermediate		
Stand Age	50±//80-100± years		
Tree Size			
DBH range	6 – 24± inches		
Mean DBH	14± inches		
Avg. Max. Height	90± feet (white pine)		
Stand Density			
Relative Stocking	Considerable	**Trees/Acre**	170± trees
Basal Area/Acre	180± sq. ft./acre	**Canopy Closure**	90± %

[1] Dominant tree species in main canopy layer.
[2] Fairly common to less common tree species.
[3] Less common, or a unique tree species with only one or a few specimens in the forest type.

Wildlife/Ecological	
Habitat Features	Large diameter cavity trees, snags, and dead stubs. Older white pine provide potential nest sites to hawks and ravens. Substantial forest floor woody debris.
Canopy Stratification	
Woody Deadfall	Substantial accumulation, including large trunks.
Invasive Plants	Moderate to severe, especially Oriental bittersweet.

Management Recommendations

White Pine Forest Type

Considerations/Discussion

Stand A1 -- An important concern is the immediate need to remove the growing invasion of exotic plants. Hazard trees are another concern. A major trail, connecting the pavilion area to the top of Stratham Hill, traverses through Stand A1. A number of large pines are unstable and may fall across the trail. Large scale removal of potential hazard trees, however, may expose the remaining trees to wind damage. Hazard tree removal must be light, staged over time, and meticulously done to minimize the visual impact. A tree service approach is perhaps best, providing scenic results but at relatively high cost. Felling *and leaving* the hazard trees lying in the forest is an option to minimize cost. A second option for minimizing cost involves prolonged closing of the trail while logging and project mitigation is applied.

Stand A2 is densely stocked with young pine. Ideally, thinning (hand felling) would be applied to improve tree growth. A 100± foot wide band of un-thinned growth would be left at the base of the hill adjacent to the recreation area as a shaded barrier that prevents the spread of invasive plants into the forest.

Recommendations:

Stand A1 – 1) Remove all exotic invasive plants.
2) Fell, and possibly remove, hazard trees along trail. Explore both tree service and logging options.

Stand A2 – 1) Thin young pine, retaining the healthiest, best-formed pines.
2) Retain a 100' undisturbed buffer along the recreation area edge. Remove invasive plants from this edge.

B. White Pine/Hardwood – 34.6± acres

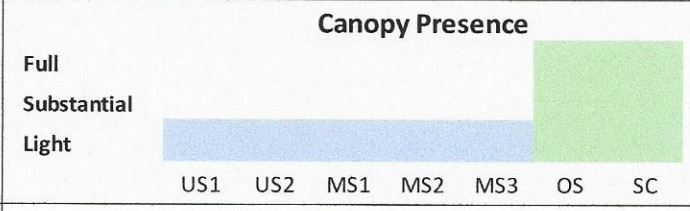
Description – This forest type is characterized by mixed hardwoods with substantial presence of white pine. Pines are found scattered or in small pockets referred to as "inclusions". The forest type is found in several areas ("stands"), and is generally well-established. Natural regeneration under the fairly full canopy is not abundant.

Cavity trees valuable to wildlife are abundant in the white pine/hardwood forest type.

A white pine inclusion is visible in the background, with mixed hardwoods in the foreground.

Species Composition	
Primary	White pine, red oak, red maple, black birch.
Secondary	Sugar maple, white ash, white oak, shagbark hickory
Tertiary	Black cherry, beech, pignut hickory, black oak, white birch, hemlock.
Regeneration (saplings)	Black birch, white ash, beech, white pine.

Forest Structure	
Composition	
Stand Structure	Three-aged with white pine inclusions
Successional Stage	Late-intermediate
Stand Age	50±//80 to 100+ years
Tree Size	
DBH range	4 – 24± inches
Mean DBH	12± inches
Avg. Max. Height	90± feet
Stand Density	
Relative Stocking	Dense
Basal Area/Acre	185± sq. ft./acre
Trees/Acre	225± trees
Canopy Closure	90-100± %

Wildlife/Ecological	
Habitat Features	Oak and hickory mast sources. Substantial cavity trees and snags.
Canopy Stratification	
Woody Deadfall	Good accumulation, including large trunks.
Invasive Plants	Incipient presence.

Management Recommendations

White Pine/Hardwood Forest Type

Considerations/Discussion

Management Option 1: Minimal intervention

This forest type may be largely left to the course of nature, with the exception of continued monitoring and removal of exotic invasive plants, including a patch of highly invasive Norway maple. A benefit of non-intervention in the management of the forest is the day-by-day unaltered appearance of the forest to recreational users. However, inevitably, an acute natural disturbance such as a damaging windstorm or hurricane will occur. At that time, a well-planned response may include salvage removal of uprooted or damaged trees. In the aftermath, reforestation should largely occur through natural regeneration.

A potential long-term disadvantage with non-intervention is the forest's natural trend towards shade tolerant species, especially beech and hemlock. In the absence of a large natural disturbance, the forest's species diversity will likely diminish.

Management Option 2: Silvicultural management

Light harvesting may be applied for two major purposes: 1) Thinning to improve the growth of a diverse species mix of healthy trees; and 2) Selection, using micro canopy gaps, to create small forest openings for young growth.

The advantages of this approach are improved forest health and growth, and the continued natural regeneration of the forest. Wildlife habitat also benefits. A mixed age forest develops over time.

The disadvantage of silvicultural management is largely aesthetic. Harvests alter the forest's appearance, no matter how carefully planned and implemented.

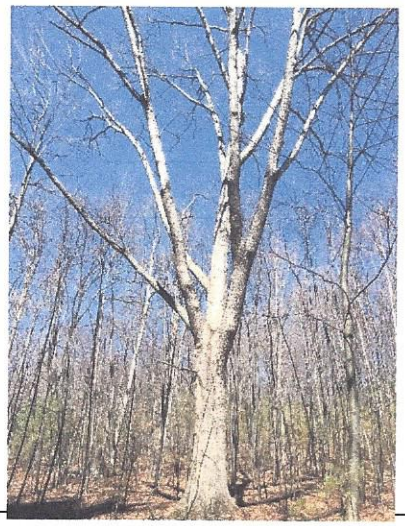
Recommendations:

1) Remove all exotic invasive plants, especially Norway maple.
2) If non-intervention approach is taken, do nothing further except maintain trails. If a large natural disturbance occurs in the future, consider a salvage operation.
3) If silvicultural management is selected, carefully plan, prepare and implement harvests. Post-harvest, apply visual mitigation. Over time, work to release natural regeneration from shade.

C. Upland Hardwood – 53.7± acres

Description – Generally dominated by red oak, this forest type covers several areas, including an outstanding hardwood stand in the northeast section of the property. White pine and hemlock (softwoods) are noticeably sparse or absent in the overstory of the upland hardwood stands. Variant C1 is widespread; it is characterized as mostly even-aged with a consistent overstory canopy. A second variant, C2, is found on the west side of Stratham Hill. This stand is distinctly two-aged, with residual large hardwoods that survived the 1991 microburst and surrounding, dense 25-year hardwood growth. This stand contains some of the oldest trees on the property.

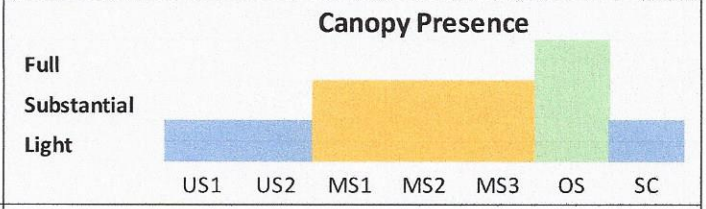
A diversity of healthy hardwoods are found in Forest Type C. Variant C1 is mostly even-aged.



A large white oak, survivor of the 1991 storm, is surrounded by young trees that grew in the aftermath.

Species Composition	**Describing Variant C1**
Primary	Red oak, red maple.
Secondary	Black oak, black birch, shagbark hickory, pignut hickory.
Tertiary	White oak, beech.
Regeneration (saplings)	White pine, beech.

Forest Structure	**Variant C1**	**Variant C2**
Composition		
Stand Structure	Even-aged with older residuals or two-aged	Two-aged
Successional Stage	Late-intermediate	Regenerating//Mature
Stand Age	40-50//75-95± years	25-30//100 to 120+
Tree Size		
DBH range	6 – 20± inches	1 to 4"//12 to 30"
Mean DBH	14± inches	n/a
Avg. Max. Height	75± feet	70± feet
Stand Density		
Relative Stocking	Dense	Young growth—Dense
Basal Area/Acre	150± sq. ft./acre	Young growth – 1000± saplings/acre Old residuals – 6 to 10±/acre
Trees/Acre	130± trees	
Canopy Closure	100± %	Large-crowned older trees provide 50% cover

Wildlife/Ecological	**Describing Variant C1**
Habitat Features	Abundant and diverse mast sources: oak, hickory, beech.
Canopy Stratification	
Woody Deadfall	Good accumulation, including large trunks on the ground.
Invasive Plants	None observed.

Management Recommendations

Upland Hardwood Forest Type

Considerations/Discussion

Management Option 1: Minimal intervention

This forest type may be largely left to the course of nature, with the exception of continued monitoring and removal of exotic invasive plants.

A benefit of non-intervention is the day-by-day unaltered appearance of the forest to recreational users. However, inevitably, an acute natural disturbance such as a damaging windstorm or hurricane will occur. At that time, a well-planned reaction may include salvage removal of uprooted or damaged trees. In the aftermath, reforestation should occur largely through natural regeneration.

A potential long-term disadvantage with non-intervention is the forest's natural trend towards shade tolerant species, especially beech and hemlock. In the absence of a large natural disturbance, the forest's species diversity will likely diminish.

Management Option 2: Silvicultural management

The removal of a long forest strip (1200 to 1500± feet) is under consideration to allow the improved performance of emergency communications equipment atop Stratham Hill. Silvicultural management of the surrounding upland hardwood stand may be done in conjunction with the strip clearing.

Light harvesting may be applied for two major purposes: 1) Thinning to improve the growth of a diverse species mix of healthy trees; and 2) Selection, with micro canopy gaps (<2500 sq. ft.) to create small openings for new forest growth.

The advantages of this approach are improved forest health and growth, and the continued natural regeneration of the forest. Wildlife habitat also benefits. A mixed age forest develops over time.

The disadvantage of silvicultural management is largely aesthetic. Harvests alter the forest's appearance, no matter how carefully planned and implemented.

Recommendations:

1) Monitor for, and (immediately) remove all exotic invasive plants.
2) If non-intervention approach is taken, do nothing further except maintain trails. If a large natural disturbance occurs in the future, consider a salvage operation.
3) If the communications tower strip is to be cleared, consider silvicultural management of adjacent stands. Carefully plan, prepare and implement harvest. Post-harvest, apply visual mitigation. Over time, work to release natural regeneration from shade.

D. Mixed Hardwood – 11.3± acres

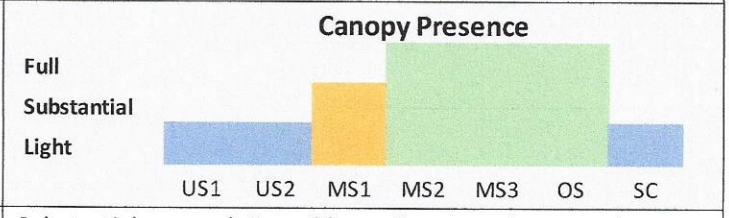
Description – This forest type is distinguished by its broad diversity of hardwoods. Unlike the upland hardwood forest type which tends to occupy somewhat drier sites, this forest type is not dominated by a single species. While red oak is common, sugar maple and black birch are also abundant. A substantial area of this forest type occupies the site of the 1991 blowdown on Stratham Hill.
Three variants of the mixed hardwood forest type are described: D1, found mostly on Stratham Hill, contains a predominance of older hardwoods; D2, also on Stratham Hill, includes areas severely affected by the 1991 storm that now contain a predominance of 25 to 30 year old hardwoods with scattered older residual trees; and, D3, which describes small pockets of mixed hardwoods on the edges of forested wetlands in the southerly sections of the property.

A variety of hardwoods are found on this site D1 site on Stratham Hill.

Young birch and maple intermix with large black birch that survived the 1991 microburst.

Species Composition	
Primary	Sugar maple, black birch, red maple.
Secondary	Shagbark hickory, white birch.
Tertiary	White ash.
Regeneration (saplings)	Black birch, red maple, red oak, white pine, sugar maple.

Forest Structure	
Composition	
Stand Structure	3-aged w/ scattered residuals
Successional Stage	Mid-intermediate
Stand Age	25-30±//50±//80-100± years
Tree Size	
DBH range	3 – 20± inches
Mean DBH	(D1) 11± inches; (D2) 7± inches
Avg. Max. Height	60± feet
Stand Density	
Relative Stocking	Considerable to dense
Basal Area/Acre	140± sq. ft./acre (variable)
Trees/Acre	150 to 480± trees (variable)
Canopy Closure	100± %

Wildlife/Ecological	
Habitat Features	Mixed species stands provide diverse food (seed, fruit) sources.
Canopy Stratification	
Woody Deadfall	Substantial accumulation of forest floor woody material.
Invasive Plants	Moderate—Multiflora rose, Japanese barberry, European barberry noted.

Management Recommendations

Mixed Hardwood Forest Type

Considerations/Discussion

An important concern is immediate removal of scattered exotic plants. As with stands in Forest Types B and C, a continued approach of no intervention can be taken, except in response to natural disturbances. Silvicultural management of the stands, has several benefits: 1) improved growth; 2) the retention of mixed species composition; 3) the development of a mixed-aged forest; and 4) improved wildlife habitat. However, there will likely be a degree of objection to the altered forest scenery. D3 stands which are near forested wetlands and are difficult to access should generally left unmanaged.

Recommendations:

1) Remove all exotic invasive plants.
2) If non-intervention approach is taken, do nothing further except maintain trails. If a large natural disturbance occurs in the future, consider a salvage operation.
3) If silvicultural approach is taken, apply low-impact harvesting and take post-harvest measures to mitigate visual impact.

APPENDICES

Map Unit Legend

Rockingham County, New Hampshire (NH015)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
43B	Canton gravelly fine sandy loam, 3 to 8 percent slopes, very stony	14.7	6.8%
43C	Canton gravelly fine sandy loam, 8 to 15 percent slopes, very stony	14.6	6.7%
67D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	28.3	13.0%
67E	Paxton fine sandy loam, 25 to 35 percent slopes, very stony	21.2	9.7%
97	Greenwood and Ossipee soils, ponded	5.0	2.3%
125	Scarboro muck, very stony	3.0	1.4%
295	Freetown mucky peat, 0 to 2 percent slopes	29.4	13.5%
299	Udorthents, smoothed	3.2	1.5%
446A	Scituate-Newfields complex, 0 to 3 percent slopes	5.8	2.7%
447B	Scituate-Newfields complex, 3 to 8 percent slopes, very stony	8.1	3.7%
510A	Hoosic gravelly fine sandy loam, 0 to 3 percent slopes	18.5	8.5%
510B	Hoosic gravelly fine sandy loam, 3 to 8 percent slopes	44.1	20.3%
547A	Walpole very fine sandy loam, 0 to 3 percent slopes, very stony	15.3	7.0%
W	Water	6.5	3.0%
Totals for Area of Interest		**217.6**	**100.0%**

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Maine Forester License #2000

EDUCATION

B.S. FORESTRY – University of New Hampshire, Magna Cum Laude, May 1980
SAF Study Tour of France – Three-week study of French silvicultural methods, September 1983

PROFESSIONAL SERVICE and AFFILIATIONS

Forest Stewards Guild – Board of Directors (1999-2005), Chair (2005)
Society of American Foresters (SAF) – NH Chairman (1996)
New Hampshire Tree Farm Program – Executive Committee (1984-87)
Society for the Protection of New Hampshire Forests

WORK EXPERIENCE

1980 - Present	FORESTRY CONSULTANT, founder and proprietor of Moreno Forestry Associates. Thirty-six years experience managing private and public forests in New Hampshire. Projects include forest and wildlife management planning and implementation, ecological assessments, forest inventory and appraisals, timber sales, mapping, forest taxation and litigation, forest improvement and habitat enhancement, and conservation plans for towns, corporations, and private landowners. 30,000+ acres under management.
1984- Present	TOWN FOREST MANAGER for the Towns of Exeter, Londonderry, Candia, Plaistow, Brentwood, East Kingston, Deerfield, Epping, Brentwood, Sandown, Rye, Pittsfield, Derry, Dover, Madbury, Strafford, and Rochester developing/implementing multiple-use plans for publicly owned forests.
1985- 1992	ALTON TOWN FORESTER. Consultant to the Town on Current Use Assessment and NH Timber Tax matters.
1980- 1988	K-F TREE FARM, Forest Manager. Experience in all areas of woodland and wildlife management in this intensively managed, 700-acre property in Alton, New Hampshire. Selected as 1988 Belknap County Tree Farm of the Year.

PROFESSIONAL RECOGNITION

New Hampshire Outstanding Forester Award (Society of American Foresters) -- 2001
National Outstanding Tree Farm Inspector Award -- 1999
Austin Cary Practicing Professional Award – (New England SAF, 1998)
NH Wildlife Stewardship Award – 1995
Outstanding New Hampshire Tree Farm Award 1987, 1992, 2002, & 2006
NH Tree Farm Inspector of the Year – 1985, 1990, 1992, 1993, 1998
Xi Sigma Pi (Forestry Honor Society, 1978)
Eagle Scout (1976)

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