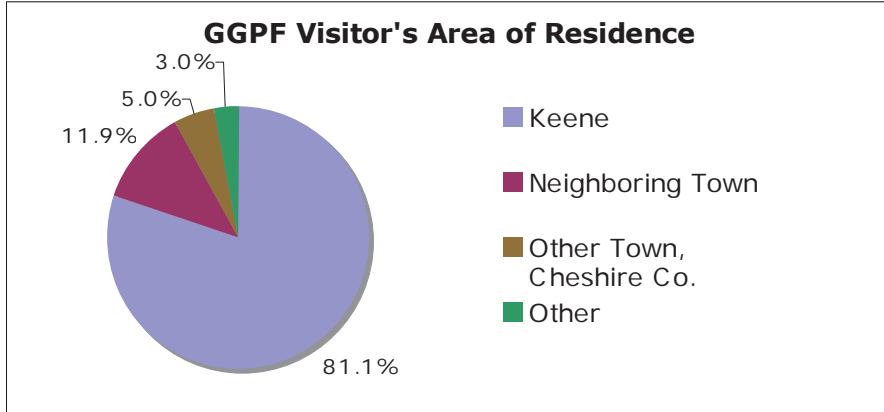


APPENDICES

APPENDIX I:
GGPF User Survey Results

1. From the options give below, please indicate where you live.

81.1% Keene **11.9%** Neighboring Town (*Surry, Westmoreland, Chesterfield, Swanzey, Marlborough, Roxbury, Sullivan, Gilsum*) **5.0%** Other Town, Cheshire Co. **3.0%** Other



Neighboring Towns Specified

- 1 Chesterfield
- 1 Gilsum
- 1 Marlborough
- 5 Swanzey
- 1 Westmoreland

Other Towns, Cheshire Co. Specified

- 1 Alstead
- 1 Fitzwilliam
- 1 Harrisville

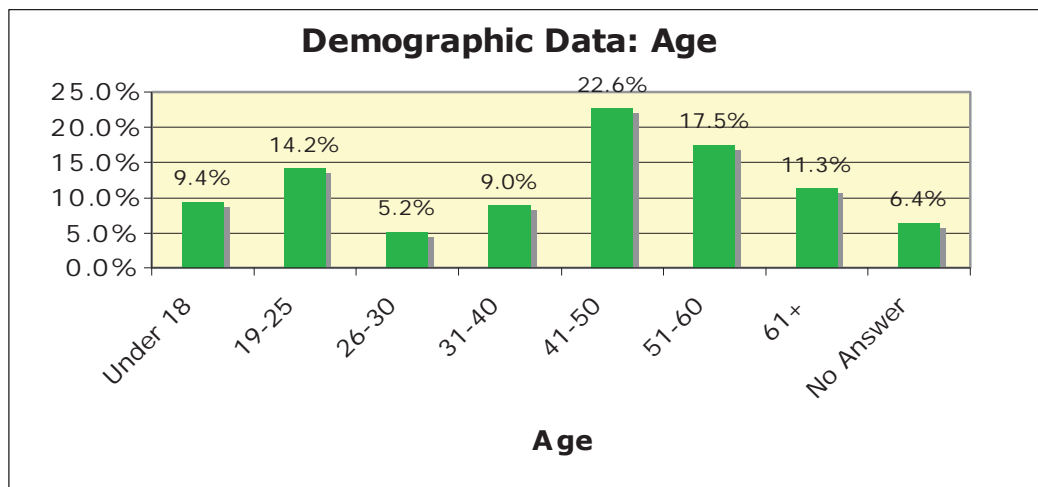
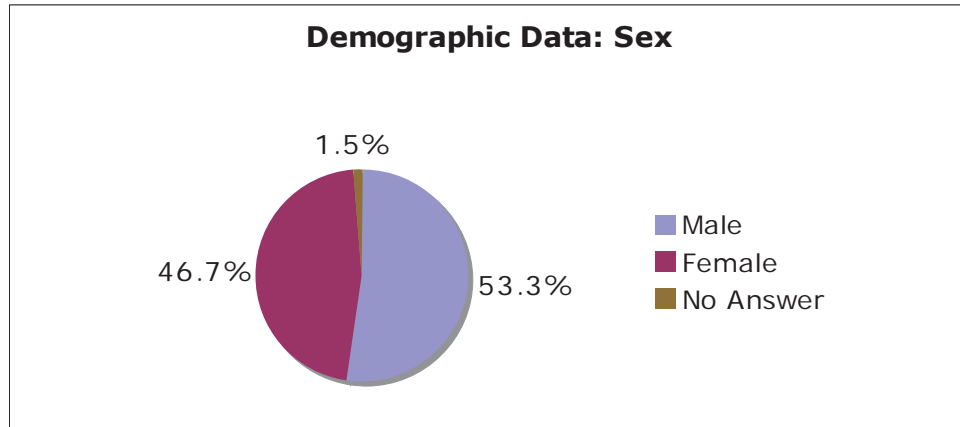
Other Towns Specified

- 1 Dover
- 1 Lee
- 1 MA
- 3 NJ
- 1 Salem, MA

2. Are you: *

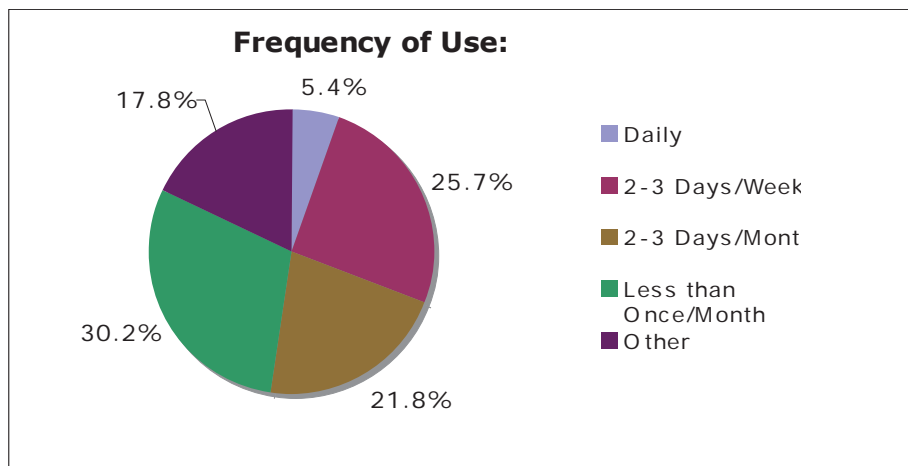
53.3% Male	9.4% Under 18 yrs old	14.2% 19-25 yrs old	5.2% 26-30 yrs ol
46.7% Female	9.0% 31-40 yrs old	22.6% 41-50 yrs old	
1.5% No Answer	17.5% 51-60 years old	11.3% 61+ yrs old	6.4% No Answer

** Demographic statistics were calculated based off the number of total male/female respondents (212 people). 212 is greater than the number of actual surveys returned (202) and is accounted by some respondents counting additional household members in their response.*



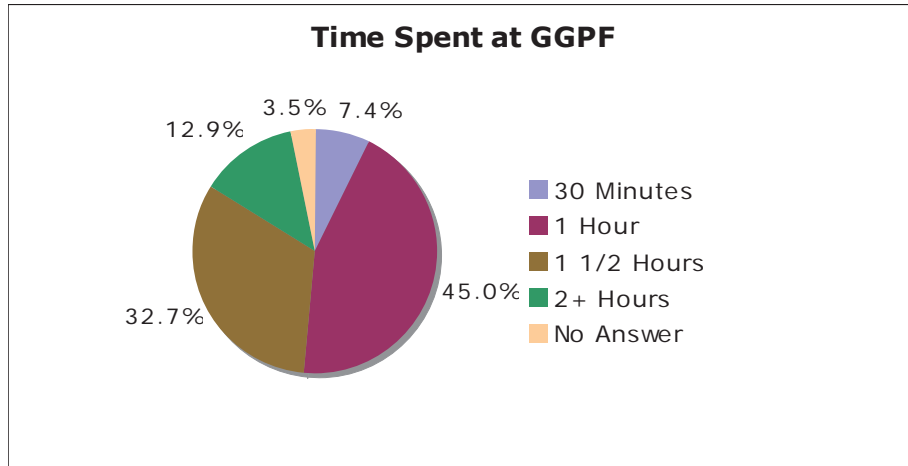
3. How often do you use GGPF?

5.4% Daily 25.7% 2-3 days/week 21.8% 2-3 days/month 30.2% Less than once/month
 17.8% Other 0.0% No Answer



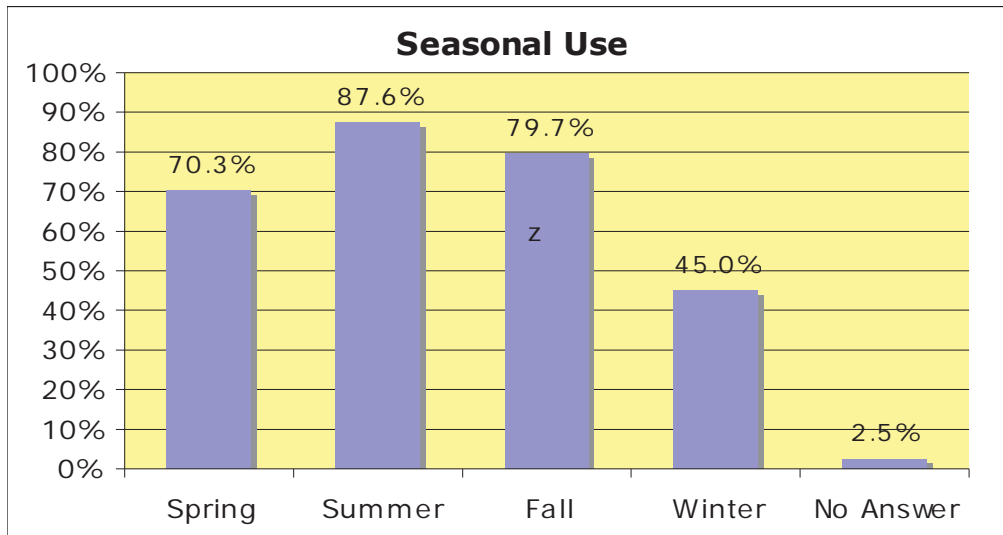
4. What is the average length of time you spend at GGPF per visit?

7.4% 30 minutes 45.0% 1 hour 32.7% 1 ½ hours 12.9% 2+ hours 3.5% No Answer



5. During what seasons do you use GGPF? (Respondents checked all that applied)

70.3% Spring 87.6% Summer 79.7% Fall 45.0% Winter 2.5% No Answer



6. What part of GGPF do you use? (Respondents checked all that applied. See map on page 30.)

45.5% A 79.2% B 40.6% C 29.2% D 19.3% E 12.9% F 6.4%
 No Answer

<u>Rank</u>	<u>Percentage</u>	<u>Area</u>
1	79.2	B
2	45.5	A
3	40.6	C
4	29.2	D
5	19.3	E
6	12.9	F

7. Which access points do you use to enter GGPF? (Respondents checked all that applied. See map on page 30.)

77.7% 1 19.3% 2 18.8% 3 10.9% 4 10.4% 5 3.5% 6
 5.9% 7 9.9% Other 3.5% No Answer

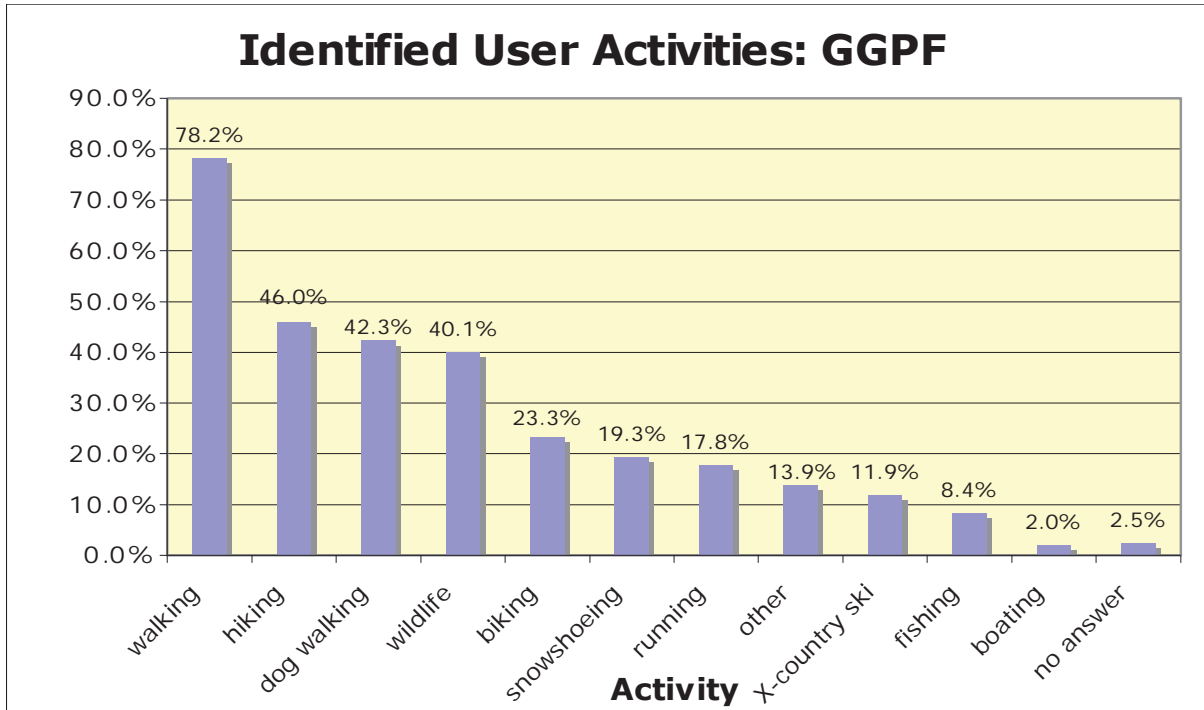
<u>Rank</u>	<u>Percentage</u>	<u>Access</u>
1	77.7	1
2	19.3	2
3	18.8	3
4	10.9	4
5	10.4	5
6	9.9	Other
7	5.9	7
8	3.5	6

Other Specified Answers

<u>Access Point</u>	
Acre Brook Rd	12
Private Property	3
Algonquin Dr.	1
Area D	1
Access Road	1
Gunn Rd. Gate	1

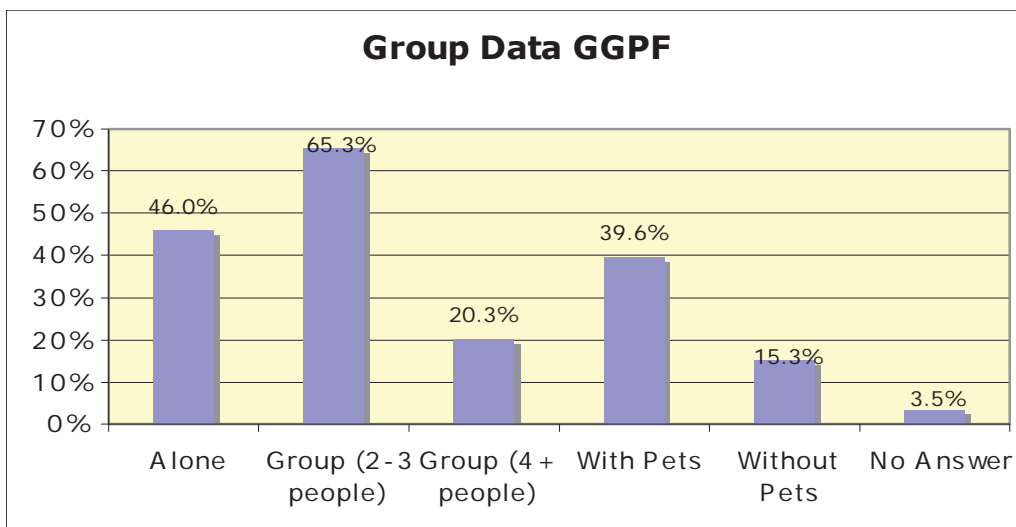
8. What activities do you enjoy at GGPF?

42.1% Dog walking	23.3% Biking	46.0% Hiking	11.9% Cross-country skiing
8.4% Fishing	78.2% Walking	19.3% Snowshoeing	17.8% Running
2.0% Boating	40.1% Wildlife viewing/nature study	13.9% Other	2.5% No Answer

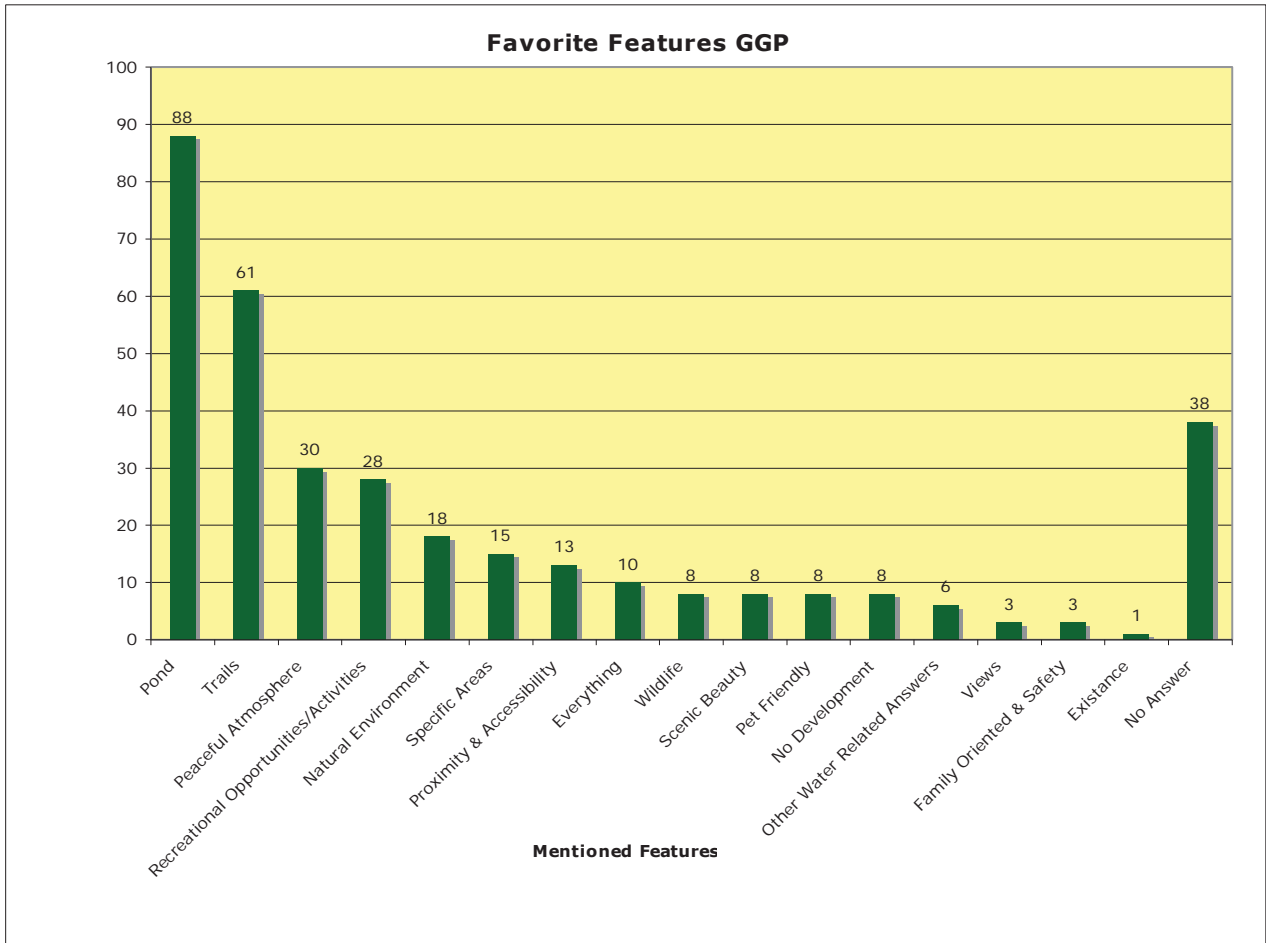


9. When you visit GGPF, do you visit: (Respondents checked all that applied)

46.0% Alone	65.3% As a group (2-3 people)	20.3% As a group (4+ people)
39.6% With pets	15.3% Without pets	
3.5% No Answer		

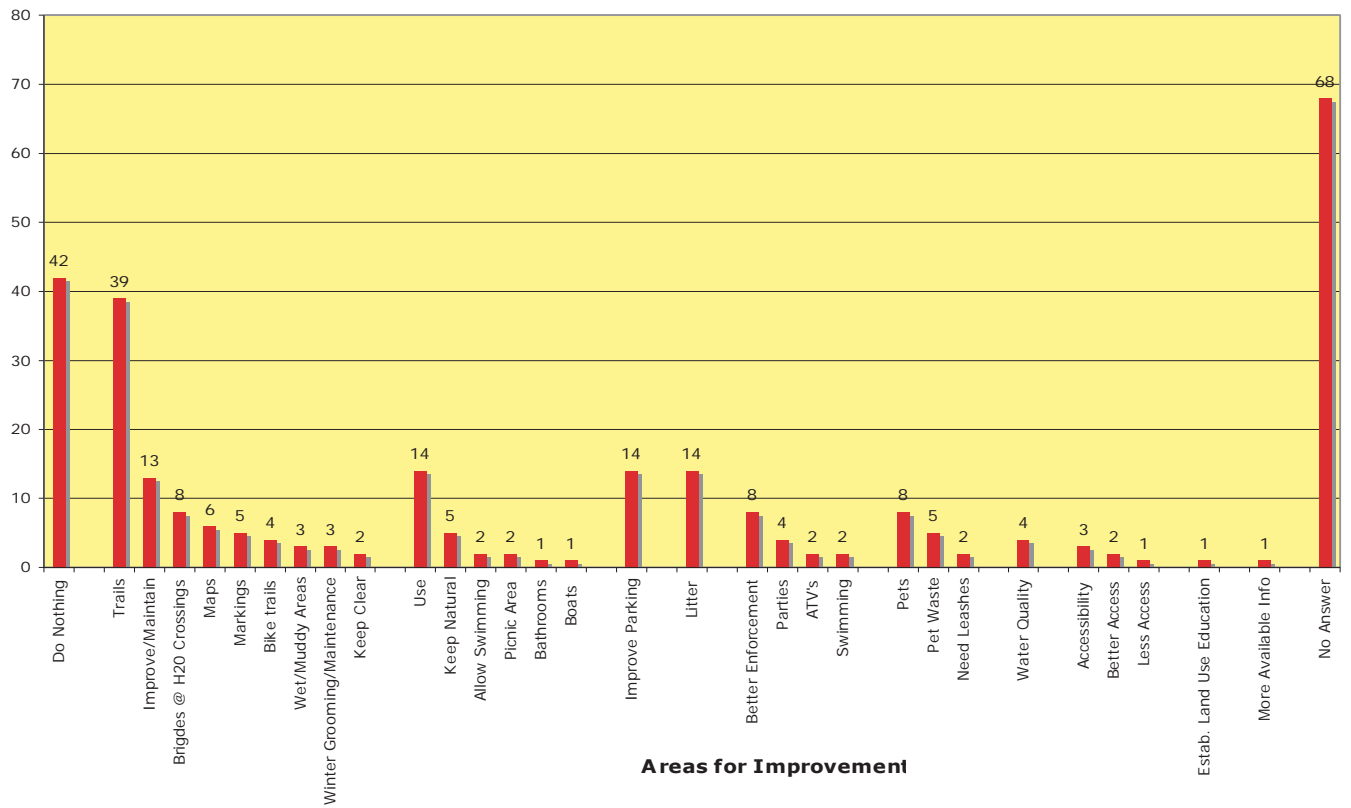


10. What are your favorite areas or features of GGPF?



11. What things about GGPF would you change or improve?

Things to Improve: GGPF



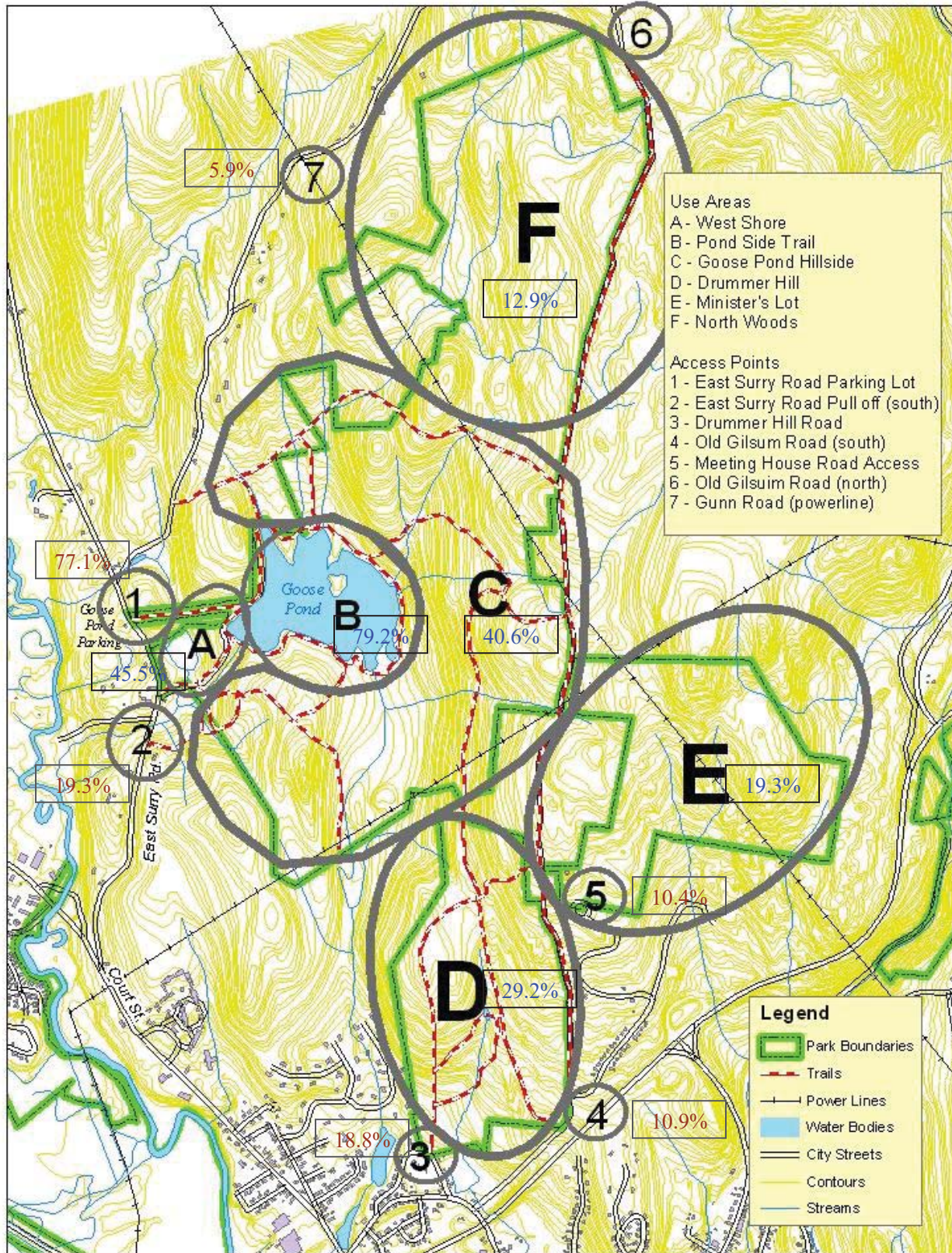
12. What do you think are priorities for future management of GGPF? (Please check all that apply)

49.5% Forest health 21.3% Forest diversity 41.1% Passive recreation 47.5% Trail network
 53.5% Wildlife habitat 49.0% Water quality 29.7% Educational/study purposes 33.7% Leave it as is
 7.4% Timber harvest 14.4% Sustainable forestry 3.5% Other 5.9% No Answer

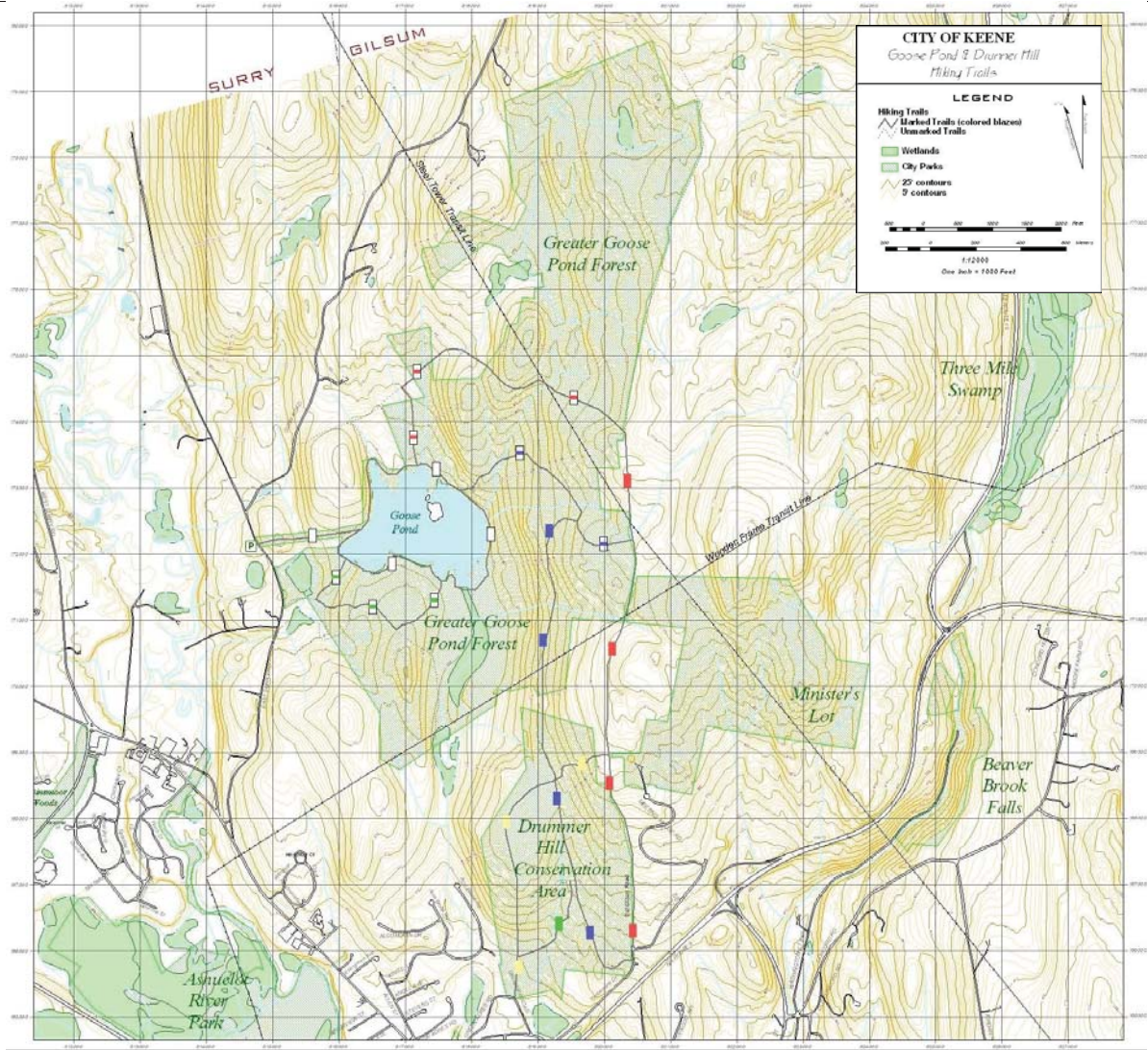
<u>Rank</u>	<u>Percentage</u>	<u>Management Priorities</u>
1	53.7	wildlife habitat
2	49.8	forest health
3	49.3	water quality
4	47.8	trail network
5	41.3	passive recreation
6	33.8	leave as is
7	29.9	educational purposes
8	21.4	forest diversity
9	14.4	sustainable forestry
10	7.5	timber harvest
11	3.5	other

Other Specified Answers

swimming	1
easement/land acquisition	2
town park	1
clean up Drummer Hill pond	1



APPENDIX II:
GGPF Trail Map



APPENDIX III:
Goose Pond Trail Report

November 27, 2005

Peter Throop
City Planner
3 Washington Street
Keene, NH 03431

Dear Pete,

I thoroughly enjoyed the opportunity to walk the trail system of Goosepond Preserve with yourself and members of the Keene Conservation Commission. With few exceptions, the trails are in great shape. I feel that with the accomplishment of some priority projects, the trails could easily be brought to a solid state.

To help with planning, I have taken the liberty to prioritize the sites we visited into seven projects. These are:

1. Bridge Re-Construction and Reroute 1
2. Bridge Construction and Reroute 2
3. Entrance Timber Stairs
4. Entrance Drainage
5. Brushing of Entire Trail System
6. Step Stones Along Wet Sections
7. Tread Work to Allow Proper Drainage

As mentioned on the trail, I have a crew that can accomplish the above mentioned projects. There are, however, other local labor resources that could be used for the less technical projects. I could be available to provide tools and supervision during construction for that type of endeavor.

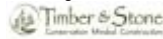
Please contact me with any questions related to the attached information or to schedule construction.

Thanks again for the opportunity.

Onward,

Joshua Ryan
Timber & Stone

Goose Pond Preserve Project Prioritization Submitted by Joshua Ryan



Project 1

Bridge Re-Construction and Reroute 1



Details

- The current bridge was washed out by the recent storms. The existing trail is extremely close to the water's edge and is allowing for no drainage.
- Bridge = 20' long x 4' feet wide
- Re-construct bridge up stream
- Move trail to connect with new bridge site and to re-connect with old trail
- Brush in old trail

Project 2

Bridge Construction & Reroute 2

Details



- This section of trail offers the hiker no clear option of crossing this wide drainage.
- Bridge = 15' long x 4' wide
- Construct bridge at narrowest location, use stone to build up cribbing
- Relocate trail to connect with bridge from both directions
- This reroute has the potential to be extensive due to the problems encountered down trail where there is no clear path to follow.

Project 3

Entrance Timber Stairs

Details



- Entrance to trail system is worn due to erosion and user impact. By installing a timber staircase, hikers will have a safer and more enjoyable entrance to the trails.
- Staircase could extend to the top of the rise, by the large boulder.
- 8x8 or 6x6 pressure treated timbers
- Ballast stone
- 1/2" Rebar
- Crushed granite surfacing
- Handrail optional
- \$8,000—\$12,000, including materials, depending on final length of staircase

Timber Staircase in North Carolina

Project 4

Entrance Drainage

- As the entrance trail heads uphill toward the pond, there is a need for extensive drainage work.
- Water is running down the trail from multiple seeps.
- Drainage ditches and turnpiking will help to elevate the tread and keep hikers on a specific trail.
- Ballast stone, timbers, mineral soil



Project 5

Brushing the Entire Trail System



Details

- The trail is choked with branches that limit the hiker's vision of the path. By removing the branches, the hikers will be less likely to cause the trail to widen.
- Sunlight will reach the trail and help to dry wet sections. These branches hang much lower when laden with snow.
- Remove trees that confuse trail intersections
- Remove branches that hang lower than 10 feet
- Establish a consistent trail corridor that is 4 x 10

Project 6

Step Stones Along Wet Sections



Details

- Along the trail there are five areas that would require the installation of step stones. Hikers who have tried to avoid running water and mud have widened the trail. The step stones would allow for the water to run and the hikers to pass without incident.
- Large stones to be harvested on site

Project 7

Treadwork to Allow Proper Drainage

Details

- Along multiple sections of the trail water is trapped from being able to drain across the tread.
- Remove the soil berms that have been created over time by trail use.
- Remove downed trees that are causing the water to pool up on the trail.
- Cross slope the trail tread so it will allow for drainage.

APPENDIX IV:
Timber Cruise Report

**Timber Cruise Report
Greater Goose Pond Forest
Keene, NH**

**Completed for the
Greater Goose Pond Forest Land Management Committee**

**by
Heidi Brannon
Antioch New England Graduate School**

August 2004

Special thanks goes to:

Timber Cruise Design Team

Leo Maslan

Pete Throop

Chris Hilke

Tom Sintros

Keene High School AP Environmental Science Students

Timber Cruise Group Leaders

Emily Hague

Mike Burgess

Carl Jacobs

Kristen Armstrong

Luke & Heather Brannon

TIMBER CRUISE REPORT GREATER GOOSE POND FOREST – KEENE, NH

INTRODUCTION

The focus of this study is to provide the Greater Goose Pond Forest Management Committee (Committee) with quantitative data regarding health, stand diversity, and structure of the Greater Goose Pond Forest (GGPF). The Committee felt a timber cruise was necessary because despite several previous natural resource inventories (NRIs) completed for the property, little data existed regarding GGPF’s timber resources. In this study, we focused on the contiguous properties surrounding Goose Pond, excluding the Drummer Hill, Grant, and Minister’s Lot parcels, by running East-West transects from Old Gilsun Road. (Figure 1)

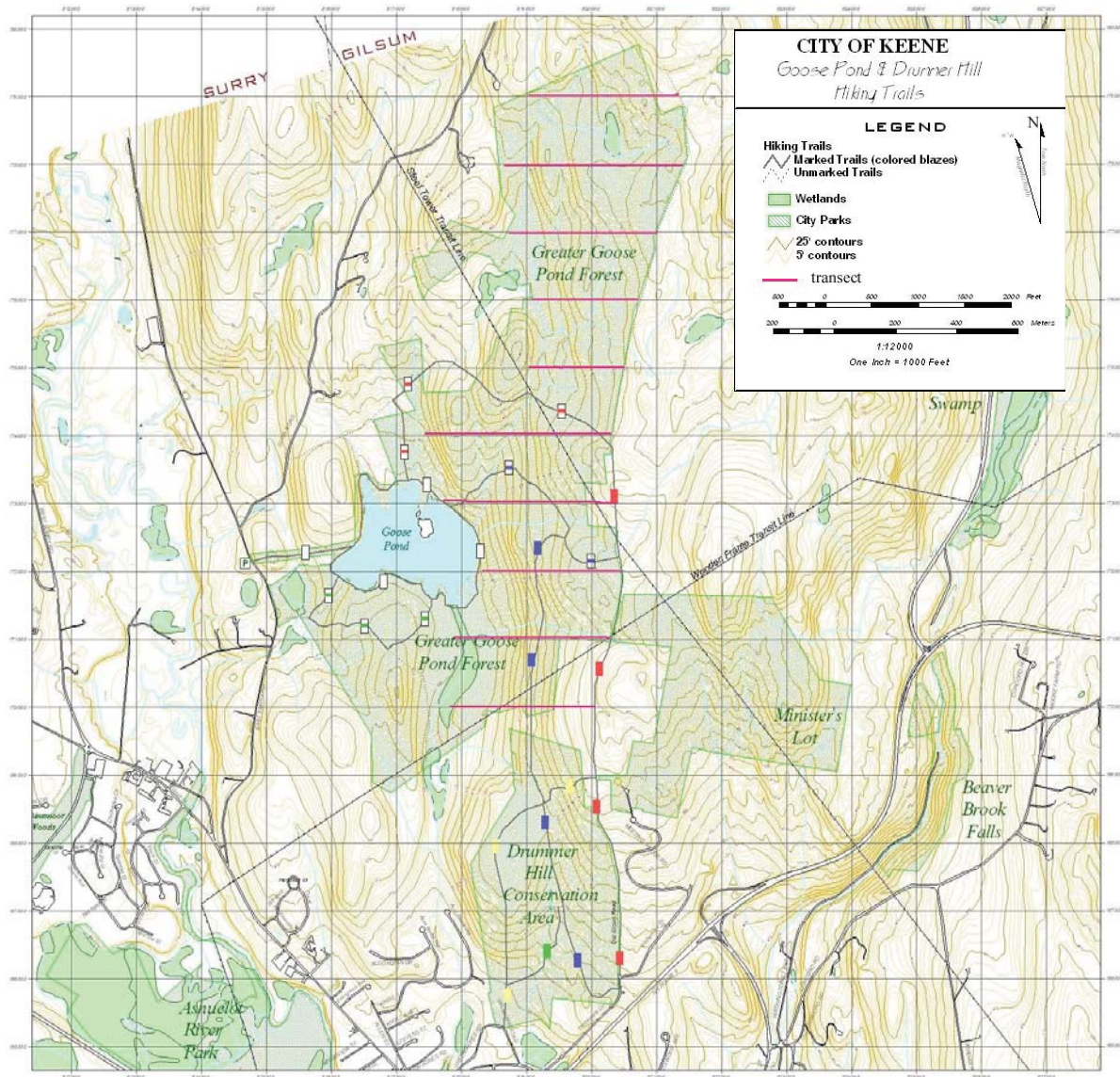


Figure 1: Greater Goose Pond Forest, Transect Map

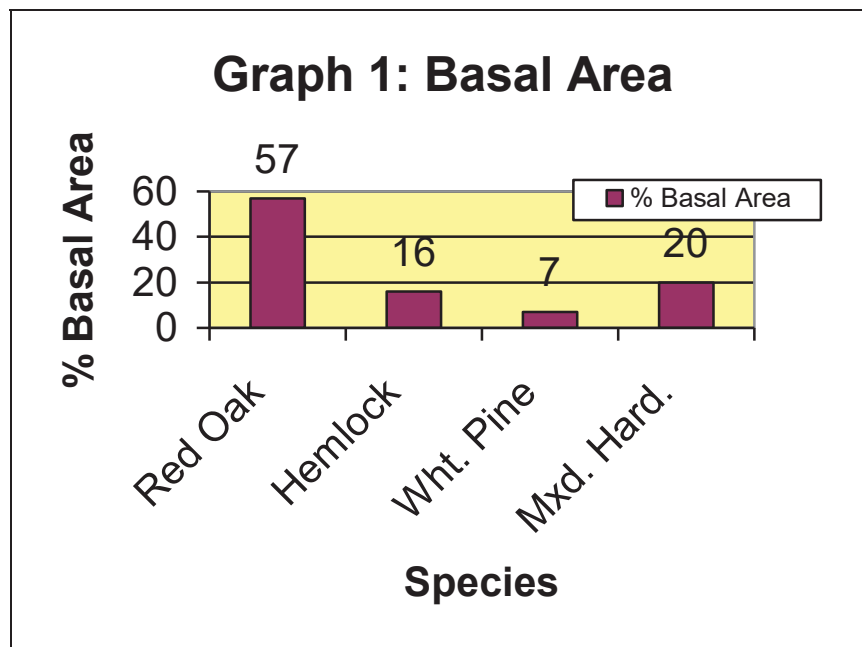
METHODS

In order to collect the necessary data, ten transects were set one thousand feet apart on Old Gilsum Road. Along each transect, sample sites were established every five hundred feet using compass (bearing due West) and pacing techniques. At the sampling sites, the sampling group was selected using a 10-factor angle gauge. The following data was recorded for each tree determined to be a part of the sampling group: diameter at breast height (dbh); number of eight-foot log lengths, log type (saw log or pulp wood); and species type. (Appendix A) Other data also noted were: species type for understory and sapling layers; any identifiable wildlife indicators; and forest health. Once completed, all data collected was entered into MultiCruise, a computer program, to calculate mean dbh, species composition, and timber volume.

RESULTS

The total acreage subject to this study was 485 acres out of GGPF's total 1,046 acres. Within this area, data was collected from forty-one sampling sites. Average trees/acre was calculated to be 173, with a mean stand diameter at 9.7 inches dbh. Hardwoods comprised nearly eighty percent of species sampled. Red oak is the predominant hardwood species found within the area sampled. Softwoods (hemlock and white pine) comprise the remaining twenty percent of species sampled.

The following graphs show percentages by species for basal area (Graph 1), saw log volume (Graph 2), and pulp wood volume (Graph 3). Graphically represented are hardwood species exceeding ten percent in each selected category. Hemlock and white pine are represented individually due to the fact that hemlock exceeded ten percent in all categories and white pine is the only other softwood species sampled.



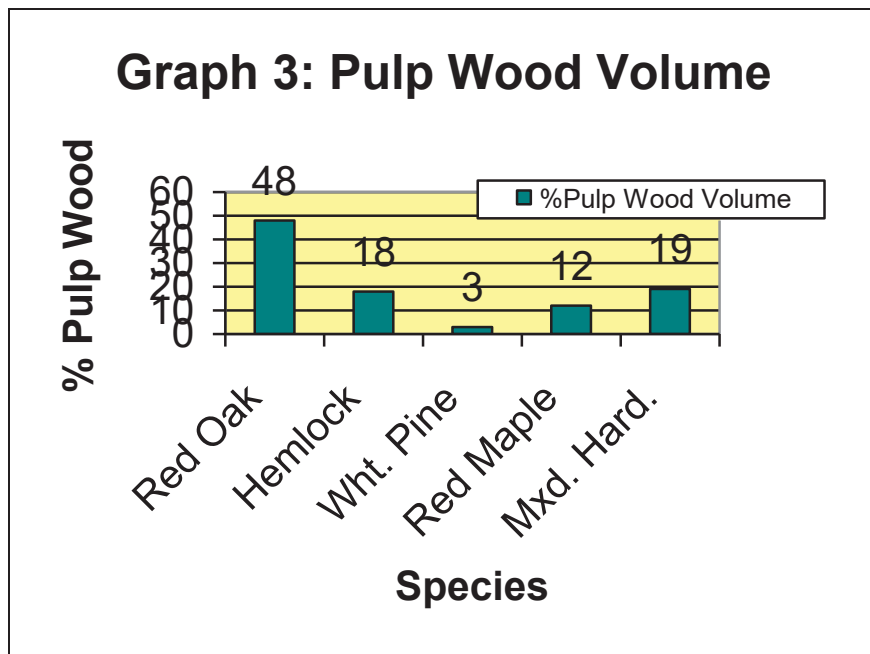
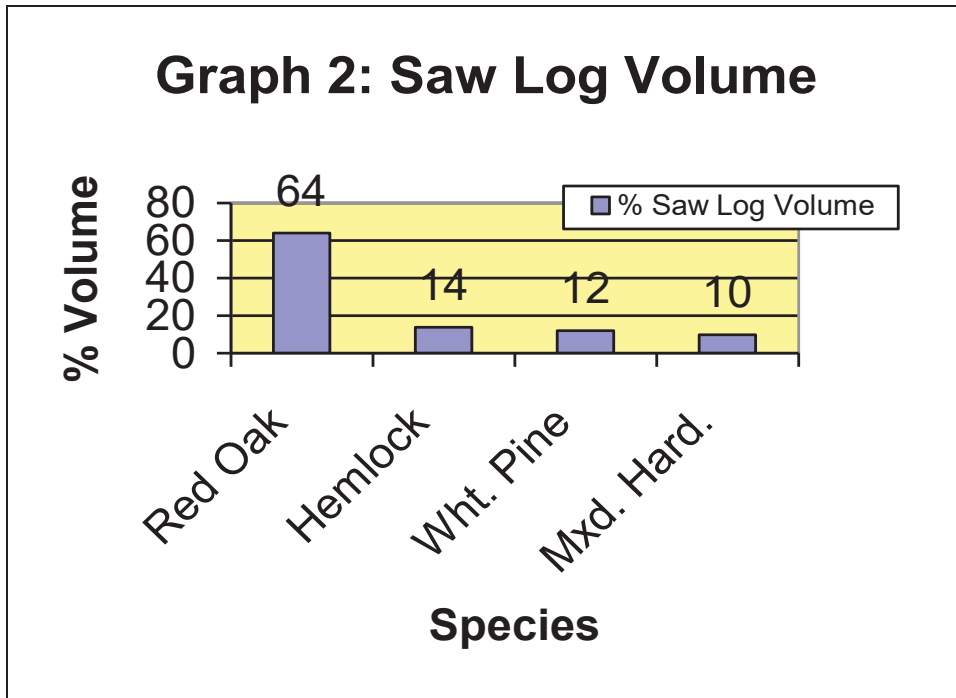


Table 1, below, gives the percentages for all species sampled during the inventory.

Table 1: Species Composition by Percent

<i>Species</i>	<i>Basal Area</i>	<i>Saw Log Volume</i>	<i>Pulpwood Cords</i>
Red Oak	57.2	64.3	48.4
Hemlock	16.0	14.3	17.8
Red Maple	9.1	4.9	11.7
White Pine	6.9	12.7	3.4
White Birch	3.3	1.2	5.6
Beech	3.0	1.2	6.3
Sugar Maple	1.7	0.6	2.8
Black Birch	1.4	0.6	1.9
Yellow Birch	0.8	0.0	1.0
White Ash	0.6	0.3	1.1
All Hardwoods	77.1	73.0	78.8
All Softwoods	22.9	27.0	21.2

To determine the present stocking levels of GGPF, the all species average of basal area per acre (88.3 dbh) is graphed against the number of trees per acre. (Figure 2) GGPF falls between the A (overstocked) and B (target stocking level) trend lines.

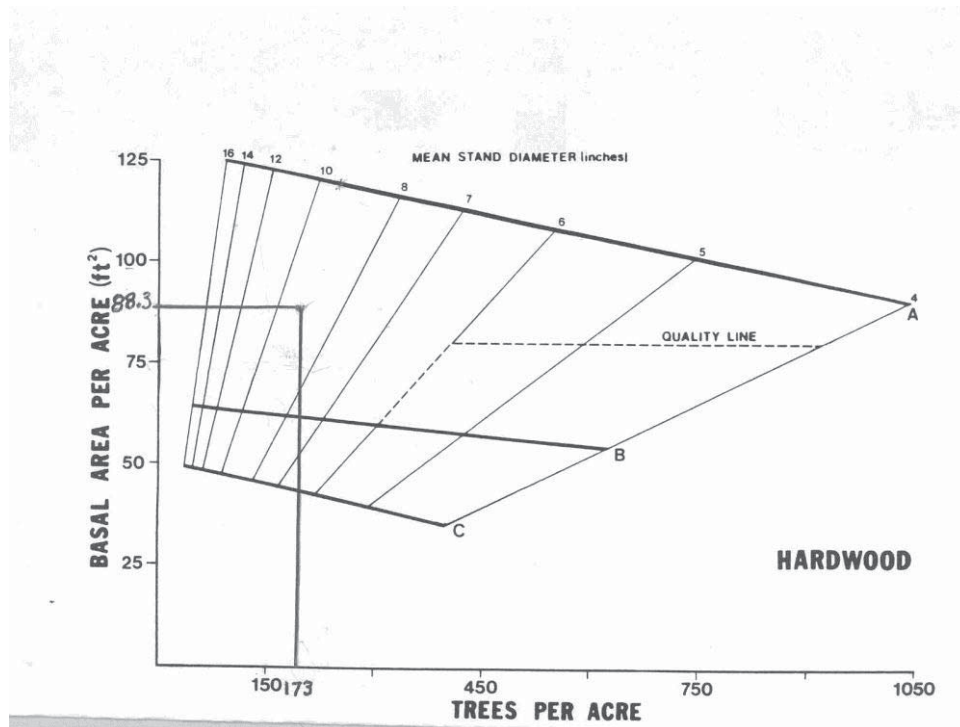


Figure 2: Stocking Level Diagram

DISCUSSION

In reviewing Sperduto and Nichols *Natural Communities of New Hampshire*, GGPF is most characteristic of a hemlock-beech-oak-pine forest. Hemlock-beech-oak-pine forest is a sub-category of the Northern Hardwood Forest classification and is a “broadly defined community found on glacial till and terrace soils of low to mid elevations...” (59).

Characteristic tree species in hemlock-beech-oak-pine forests are eastern hemlock, American beech, red oak, and white pine. Canopy dominance by these species, is relative to different successional stages. In early to mid-successional forests, hemlock and American beech may mostly be present in the understory and will increase in prominence over time (Sperduto and Nichols 2004). In the GGPF, red oak comprises fifty-seven percent of the total basal area for species sampled, while hemlock and beech were noted as the predominant understory species. It is likely, if left to natural succession, GGPF will shift over time to a forest that has a greater dominance of hemlock and beech in the canopy. Other species indicative of a hemlock-beech-oak-forest sampled during this study are: paper birch; red maple; black birch; sugar maple; white ash; and yellow birch (Sperduto and Nichols 2004).

Soils found in hemlock-beech-oak-pine forests are moderate to extremely well drained sandy loams or loamy sands formed in glacial till (Sperduto and Nichols 2004). Of the soils listed in the *City of Keene Natural Resource Inventory for Greater Goose Pond Forest and Stearns Hill Natural Area* (Dubois and King 2002), all but two are derived from glacial till and nearly all the soils described, except those found in wet or depressional areas, are moderately well drained to excessively well drained with textures that vary between sandy loam and loamy sand.

Many indications of past human disturbance exist on the property. Given the history of land use within the region, it is logical to assume that at one time GGPF was logged and converted to agricultural uses. The multitude of stone walls that crisscross the property as well as relatively even aged timber stands support such an assumption (Wessels 1997). Although logging may have historic significance to the property, its application as a management tool today bears careful consideration, especially under management guidelines set by the GGPF Master Plan.

The 1992 Greater Goose Pond Forest Master Plan recommends “lumbering operations” within the GGPF “should be designed to diversify and improve the wildlife habitat to attract a larger variety of wildlife” and have the overall goals of “sound management to improve the stands of species... and to benefit the overall Goose Pond area and forest” (p. 31). Therefore under guidelines set in the GGPF Master Plan, the potential scope of timber management project is limited to ecological considerations.

With red oak comprising fifty-seven percent of the basal area sampled, a thinning cut to remove red oak from the canopy to increase species diversity could be a potential recommendation for forest management. While red oak is a valuable timber resource, several factors need to be taken into account when determining a timber management plan for GGPF.

The presence of productive, high-quality red oak stands often make forests like GGPF susceptible to timber harvesting practices that result in the selective removal or “high-grading” of red oak. An article provided by the Massachusetts Forestry Association (MFA) defines high-grading as: “... a term used to describe forest harvesting which removes the valuable trees, leaving behind trees primarily of poor form, health, value or potential value. The direct benefit of high-grading

is short-term economic gain. ... The costs of high-grading, however, are borne primarily by the landowner alone, costs which may not even be revealed until long after the harvest.” (MFA 08-01-05)

High-grading tends to leave invaluable trees behind which are more “prone to damage by weather and pests” decreasing the actual quality of the remaining stand of timber (MFA 08-01-05). The practice of high-grading has made oak dominated forests rare in New England since most oak has been removed to take advantage of historically strong market prices (Wessels, personal communication).

The heavy removal of oaks could have an impact on wildlife. Oaks are New England’s primary nut bearing species (Wessels, personal communication) and provide a reliable source of food and shelter for wildlife (Baughman and Jacobs 1992). While the intent behind cutting red oak may be to increase the diversity of species (both plant and animal) it may put strain on wildlife populations that have come to depend on the resources a predominantly oak forest provides. The importance of red oak to wildlife for forage and shelter needs to be taken into consideration before harvesting as red oak does not necessarily “grow back” once removed.

Red oaks (and most oaks in general) are difficult to regenerate (Baughman and Jacobs 1992). Oaks regenerate in two ways, either from seed (acorns) or by stump sprouting. According to Baughman and Jacob’s “Woodland Owner’s Guide to Oak Management,” oaks mast (produce a large crop of seeds) every two to five years, but while the masting cycle seems frequent, oaks produce few seeds compared to many other tree species (Wessels, personal communication). Oak seeds that are not eaten by animals need to be covered by forest litter (Wessels, personal communication) or they will deteriorate rapidly (Baughman and Jacobs 1992).

Oaks will also stump sprout by sending up shoots from their root system when damaged by fire, drought, and sometimes after harvesting. Typically, younger trees receiving lots of sunlight are more vigorous at stump sprouting than older, large diameter trees (Baughman and Jacobs 1992). If the regeneration of red oak is desired after a cut, cuts should occur during a mast year and provide plenty of sunlight to the forest floor, as red oak is not shade tolerant. Masting cycles however are unpredictable, making planned red oak regeneration problematic (Wessels, personal communication).

Additionally, according to Log Pro, Incorporated’s June 2005 *Update!*, which gives price changes and updates for log markets, low red oak log prices have experienced only a slight rebound. Red oak prices have “sank further than the level that can be explained by lumber prices alone” (1-2). Low market prices for red oak have left many sawmills with a substantial amount of “expensive, winter-cut red oak logs in inventory that are too expensive to saw at current lumber prices. As long as this inventory hangs over the market, there can be little movement in log or lumber prices” (Log Pro, Inc. 2005, 2). While there are many factors that contribute to depressed market prices for red oak, a primary factor has been market competition from overseas (Maslan, personal communication).

This study provides little conclusive evidence that the proportional distribution of tree species sampled in GGPF is ecologically unsound. Little is presently known about the processes of hemlock-beech-oak-pine forest because there are few mature examples that have been studied through their various successional stages (Sperduto and Nichols 2004) (Thompson and Sorenson 2000). The rarity of oak dominated forests in New England and apparent lack of successional information bears careful consideration when developing a timber management plan for GGPF.

Before any specific timber management plan can be recommended for GGPF, a certified forester, or other qualified forest manager, needs to more fully inventory and map GGPF's natural communities. Whatever plan is adopted, it should be based on information gathered about locally occurring successional trends and encourage species occurring in the area at their natural proportions.

WORKS CITED

- Baughman, Melvin J. and Rodney D. Jacobs. "Woodland Owner's Guide to Oak Management." U.S. Forest Service. (1992) University of Minnesota Extension Service. 01 August 2005.
<http://www.extension.umn.edu/distribution/naturalresources/DD5938.html#Management%20Considerations>
- Duboise & King. "City of Keene Natural Resources Inventory: Greater Goose Pond Forest." 2002
City of Keene. *Greater Goose Pond Forest Master Plan*, 1992
- Log Pro, Inc. *Update!* Fairlee, VT. June 2005
- Maslan, Leo. Personal Communication. 08 August 2005.
- Sperduto, Daniel D. and William F. Nichols. *Natural Communities of New Hampshire*. New Hampshire Natural Heritage Bureau. 2004
- Wessels, Tom. *Reading the Forested Landscape: A natural history of New England*. Woodstock: Countryman Press, 1997
- Wessels, Tom. Personal Communication. 15 August 2005.
- Thompson, Elizabeth H. and Eric R. Sorenson. *Wetland, Woodland, Wildland: A guide to the Natural Communities of Vermont*. Hanover: University Press of New England, 2000.

APPENDIX A: Greater Goose Pond Forest Timber Cruise Protocol

Equipment

10 Factor Angle Gauge
Compass
Cruising Stick (aka Biltmore Stick)
Survey Tape
Clipboard

Each group will be assigned to a flagged transect (A-J) off Old Gilsum Rd. From the marked flag, you will take a compass bearing due west and pace 500 feet to your first sampling plot. (Each transect should have 4-5 sampling plots.)

Hold the 10 factor angle gauge at eye level. The end of the attached chain should be held to your chin to ensure the proper sampling technique. Determine which trees at the sampling plot are to be sampled within a 360° radius. (Figure 1)

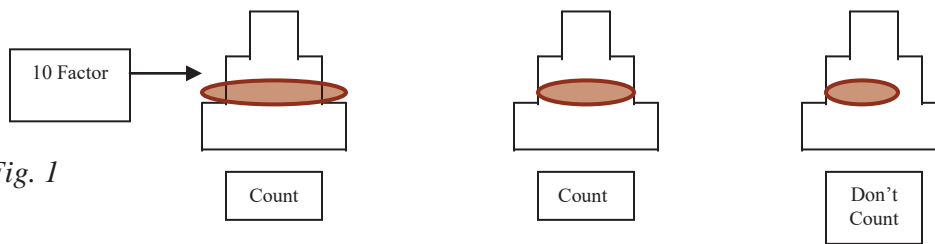


Fig. 1

For the trees that fall within the sample, determine the species and measure their DBH and merchantable timber/height (to an 8" diameter) with the Biltmore stick and hypsometer found on your cruising stick.

To measure DBH:

Hold the Biltmore stick at arms length against the tree roughly 4.5 feet off the ground. Align the left end of the stick with the outside edge of the tree.

Without moving your head look to the right edge of the tree. The number on the Biltmore stick at the right edged of the tree is its DBH.

To measure merchantable timber (Height):

Stand back from the tree 66' or one chain. (A chain is a surveying unit of measurement.) Hold the cruising stick vertically and look at the Hypsometer. On the Hypsometer scale, determine the number of 16' segments the tree trunk can be divided into.

Measure the number of log lengths only up to where the trunk reaches roughly an 8" diameter. Remember to tally log lengths in 8' increments.

Fill in the data sheet. (There will be a data sheet for each sampling plot.)

	Species*	DBH	½	1	1 ½	2	2 ½	3	3 ½	4	4 ½	Rep.
1	WP	19	S	S	S	S	P	P				//
2	BB	12	S	S	S	S						
3	WP	15	S	S	S	P	P					

S = Saw Log

P = Pulp Wood

As you walk your transect note landscape features you cross between each sampling point. (I.e. rock walls, streams, vernal pools, wetlands, etc.)

Also, record the number of saplings (< 4” dbh) by species at your sampling plots along with any observations regarding forest health, structure, and wildlife indicators.

**For notation purposes, use the following abbreviations for the trees you ID.*

- Red Oak RO
- White Oak WO
- Sugar Maple SM
- Red Maple RM
- White Ash WA
- Black Cherry BC
- Black Birch BB
- White Birch WB
- Yellow Birch YB
- Beech Be
- White Pine WP
- Hemlock He
- Red Pine RP
- Black Spruce BS
- Balsam Fir BF

APPENDIX V:
Grant Parcel Vegetation Analysis

**Vegetation Analysis of the City of Keene's Grant Parcel in the Greater Goose Pond Forest
Keene, New Hampshire – Spring 2005**

Christopher J. Hilke
Natural Resource Inventory
Grant Parcel (Lot 15)
05/10/05

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Figure 1:	Total parcel size class distribution
Figure 2:	Total parcel significant values
Figure 3:	Oak, beech, maple, hemlock significance values
Figure 4:	Oak, beech, maple, hemlock size classes
Figure 5:	Oak, beech, maple size classes
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Introduction

The Greater Goose Pond Forest (GGPF) is public recreational land, managed by the City of Keene. The GGPF is located within Cheshire County in southwestern New Hampshire, 4 miles north of Keene, NH. Totaling 1044.9 acres (425.05 ha), the forest is comprised of 15 parcels of acquired land, and is directly managed by the City of Keene Conservation Committee. In 2004, the committee requested that an up-to-date resource inventory be conducted on the property. A Conservation Subcommittee was formed to oversee the implementation of a Natural Resource Inventory (NRI) of the vegetation within the entirety of GGPF. The data for the NRI was collected during April 2005 in cooperation with the City of Keene Conservation Subcommittee, Peter Throop, Leo P. Maslan, Antioch New England graduate students Heidi Brannon and Christopher J. Hilke, and Tom Sintros. The scope of this proposal, however, will focus exclusively on the Grant lot, parcel #15 of the GGPF (Map 1).

Christopher J. Hilke, a student in the Department of Environmental Science at Antioch New England Graduate School, conducted the NRI of the Grant parcel. Field assistance was provided by Antioch student Robert Baranek, as well as Keene High School students Charles Bruch and Nick Sarsfield. Parcel 15 was both qualitatively and quantitatively analyzed, utilizing sampling methods determined by the GGPF NRI investigative members, and modified to include suggested protocols outlined by Antioch New England NRI-Vegetation class, as well as several methods found within *Field and Laboratory Methods for General Ecology* (Brower, Zar, and Ende, 1998). Data collection focused on the quantitative analysis of the upper and middle synusia, with specific emphasis on the delineation of community type, as well as the qualitative assessment of American beech (*Fagus grandifolia*) health within the parcel. The quantitative evaluation of community type was based upon compositional features, species dominance and frequency. Qualitative determination of community health included the delineation of the extent of beech bark scale disease among American beech within the parcel. The combination of a quantitative and qualitative assessment provided a comprehensive floristic analysis of the dominant community types within parcel 15.

Past Work

Several NRIs have been conducted in the past fifteen years within GGPF. The City of Keene management plan for GGPF was drafted in 1992, and included an incomplete analysis of “Biologically Significant Interest Areas” (BSAI) within the GGPF. Andrew Jennings and Edwin Dehler-Setzer, from Antioch New England Graduate School, conducted a “*Winter Mammal and Habitat Survey of the Greater Goose Pond Forest*” submitted in May of 1994. The forest cover types delineated by that NRI included: hardwoods, softwoods, mixed woods, mixed hardwood dominated, and mixed softwood dominated communities. In the fall of 1994, a group of Antioch students, led by Rick Van de Poll, conducted an NRI of “*Four Biologically Significant Interest Areas.*” This was a preliminary investigation for the City of Keene which aimed to update/complete the City of Keene management plan for GGPF. In 1996, the “*Deer Wintering Area and Vernal Pool Assessment*” NRI was conducted, and in 2002 the “*City of Keene Natural Resources Inventory of Greater Goose Pond Forest and Stearns Hill Natural Area*” was conducted by DuBois and King, Inc. DuBois and King delineated four primary cover types: hardwood dominated, softwood dominated, mixed hardwood/softwood dominated, as well as wetland dominated communities.

NRI – Lot 15 – Grant Parcel

The macro-scale ecoregion wherein the Greater Goose Pond Forest is located is classified as Vermont/New Hampshire Upland. The property is specifically located between the Sunapee Uplands and the Hillsboro Inland Hills and Plains (NH Heritage Inventory). The geology of GGPF is characterized by numerous formations of folded Oliverian gneiss, which, after millions of years of erosion of Ammonoosuc volcanics, now lies exposed at the surface throughout much of the GGPF property (Moore 1949). The outlying area includes swaths of New Hampshire Devonian/Littleton formation comprised of low-high grade metasediments and minor metvolcanics (Van Diver 1987). The surficial geology of the GGPF region is composed primarily of glacial till and sedimentary deposition from glacial Lake Ashuelot. As such,

lowlands have thick accumulated outwash deposition, while the uplands show signs of lakeshore features including glacial lakeshore terracing (Van Diver 1987).

The *Soil Survey of Cheshire County, New Hampshire* delineates the primary soil types within the Grant parcel as Tunbridge-Lyman Rock Outcrop Complex (8-15% slopes), Tunbridge-Lyman Rock Outcrop Complex (15-25% slopes), Monadnock Fine Sandy Loam (8-15% slopes, very stony), and Monadnock Fine Sandy Loam (15-25% slopes, very stony)

(Map 2). Utilizing a modified acreage grid, I estimated the total acres of each of the four soil types found within the boundaries of the parcel. The Tunbridge-Lyman Rock Outcrop Complex (8-15% slopes) accounts for 19.2 acres within the parcel. The Tunbridge-Lyman Rock Outcrop Complex (15-25% slopes) accounts for 25 acres, the Monadnock Fine Sandy Loam (8-15% slopes, very stony) for 34 acres, and the Monadnock Fine Sandy Loam (15-25% slopes, very stony) for approximately 15 acres (Chart 1).

The Grant parcel is composed of 96.7 acres (39.2 ha), and is located to the southeast of Goose Pond proper, and west of Rt. 10. The site is of varied topography, containing sections of three low hilltops (high elevation 342m), with a primary slope orientation of east-southeast (Map 3). The forest within the parcel is a southern mixed hardwood containing: mixed hardwood dominated, hardwood dominated, as well as softwood dominated communities. These general classifications were supported by the results of an NRI conducted by DuBois and King Inc., 2002. They found the mixed hardwood forests to be dominated by red oak (*Quercus rubra*), red maple (*Acer rubrum*), white pine (*Pinus strobus*), American beech, and eastern hemlock (*Tsuga canadensis*) to varying percentages. The softwood communities were found to be dominated by hemlock and white pine, while the hardwood communities were dominated by A. beech, red maple, and to a lesser extent, paper birch (*Betula papyrifera*), black birch (*Betula lenta*), and grey birch (*Betula populifolia*).

There are no buildings, structures, or roads within the property. The parcel is intersected by two state-maintained power-lines which run northeast-southwest, and northwest-southeast respectively (Aerial photo 1). The Grant lot is primarily forested, except for the power-line cuts. There are numerous stone walls

within the site, some comprised of only large stones and others containing both large and small stones. The property has only sporadic and shallow (worn) pillow and cradle. These clues, in combination with a number of split-trunk white pine (indicating full sun grown, weevil hit trees), reveal a history of both pasture and agricultural land-use. Decaying remnants of old white pine and red oak stumps, and numerous coppice trunks, indicate a history of timber harvest as well. The disturbances suggest human land use activity dating back to at least the early 1800's.

Another disturbance immediately evident within the Grant parcel is the widespread presence of the fungus *Nectria coccinea*. The disease is a commensalist relationship between a scale insect and the fungus, wherein the fungus is spread from tree to tree by the insect (Wessels 1997). The immediate result is the “pitting” and “cracking” of the beech bark, which provides progressive access to the vulnerable inner-wood for a host of other species, and disrupts internal biochemical processing to the extent that the tree eventually succumbs to stress (Wessels 1997).

Methods

Sampling Design

The data for this study was collected during April of 2005. Utilizing a systematic sampling approach, a 200 x 200ft grid was superimposed on the property. The grid delineates 13 transects (A-M) (Map 4), with a sample point plotted for each line intersection. The layout creates 97 total forested sample points, with transects running southwest and northeast respectively. Given the transition edge imposed by the denuded area occupied by the power-line, the sample points began 50ft past treeline on either side. Data ceased to be collected 200ft from a developed edge on the southern boundary of the parcel (Map 3). An examination of the aerial photo of the property indicated homogeneity in community type, northeast of the power lines (Aerial photo 1). As such, the density of sampling points was scaled down to a 400 x 400ft sampling grid within the area of obvious homogeneity. Given the vegetative homogeneity in conjunction with the proximity of developed land to the south, the total number of informative forested sample points

was reduced to 74 (Map 4). The sampling design supported an unbiased approach in that the plot locations along transects were evenly spaced, regardless of the terrain or community type.

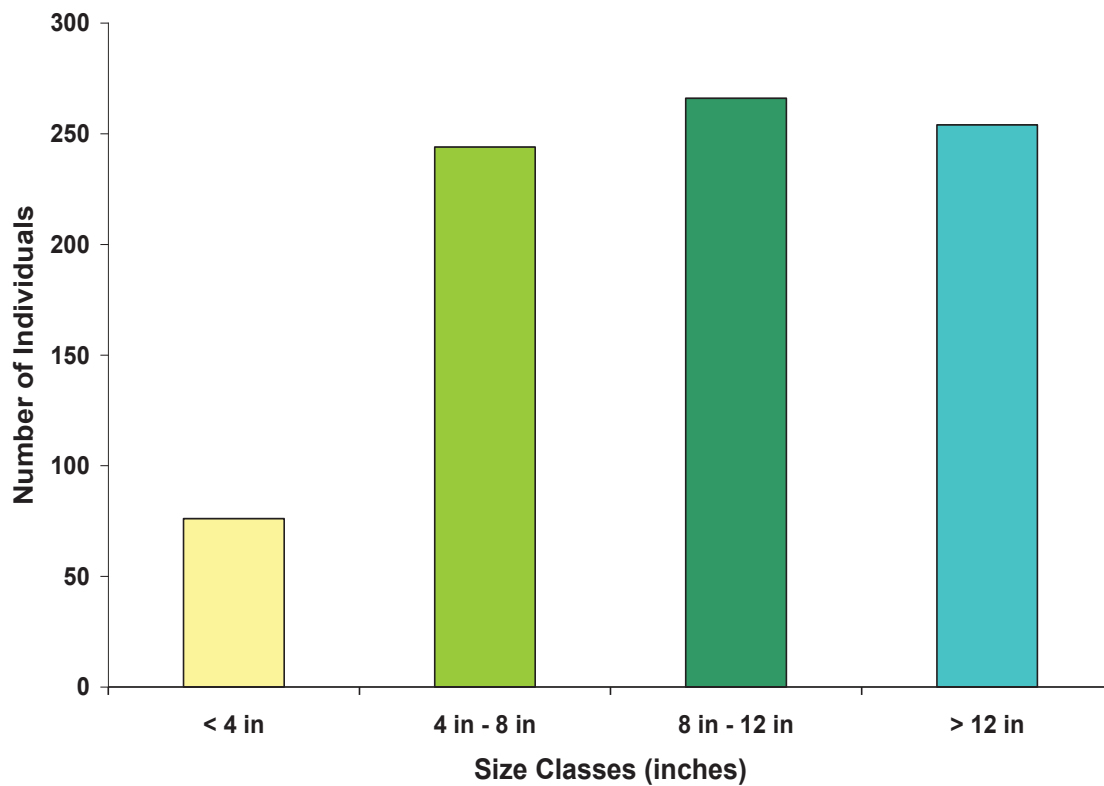
Data Collected

Given the time of year, data collection focused primarily on woody plants within lot 15. Stand data was acquired using the variable radius plot (VRP) (Avery and Burkhart 2002). Trees $> 4''$ (dbh) were defined as woody vegetation, while saplings consisted of all woody vegetation between $1'' - 4''$ dbh. In utilizing a 10 Basal Area Factor (BAF) prism (10 square ft of basal area per acre per tallied tree), the VRP data in combination with dbh measurements (diameter at breast height), allowed for the calculation of the individual total basal area (ft^2/acre) per species, the number of trees per acre, and mean stand diameter distributions throughout the parcel. These measurements provided the ability to estimate frequency, density, and coverage, which ultimately allow for the calculation of an importance value for each species. The importance value is a comprehensive categorization that facilitates comparative analysis between species as well as between communities. Apart from the VRP data, every measured American beech was identified as either infected or not infected with beech bark scale disease. With this information, I was able to calculate what percentage of the measured trees were beech, and what percentage of the beech were infected. Determining the extent of the disease within the parcel is one way of describing stand health, and aids in forecasting the successional direction of the delineated community.

Results

The collected data indicates that the Grant parcel contains an average of 334.3 stems/acre and 110 ft^2/acre of total basal area. The upper synusium (trees $\geq 4\text{in}$), made up 90% of the total number of trees measured. The 738 measured individuals of the upper synusium had an average dbh of $10.95 \pm 4.8\text{in}$, while the saplings (trees $> 4\text{in}$), which accounted for 10% of the trees measured, had an average dbh of $2.07 \pm 0.8\text{in}$. As such, the majority of trees on the property fell within the 8 – 12in dbh size class (Figure 1).

Figure 1. Total size class distribution for trees within the Grant Parcel, Greater Goose Pond Forest, May 2005.



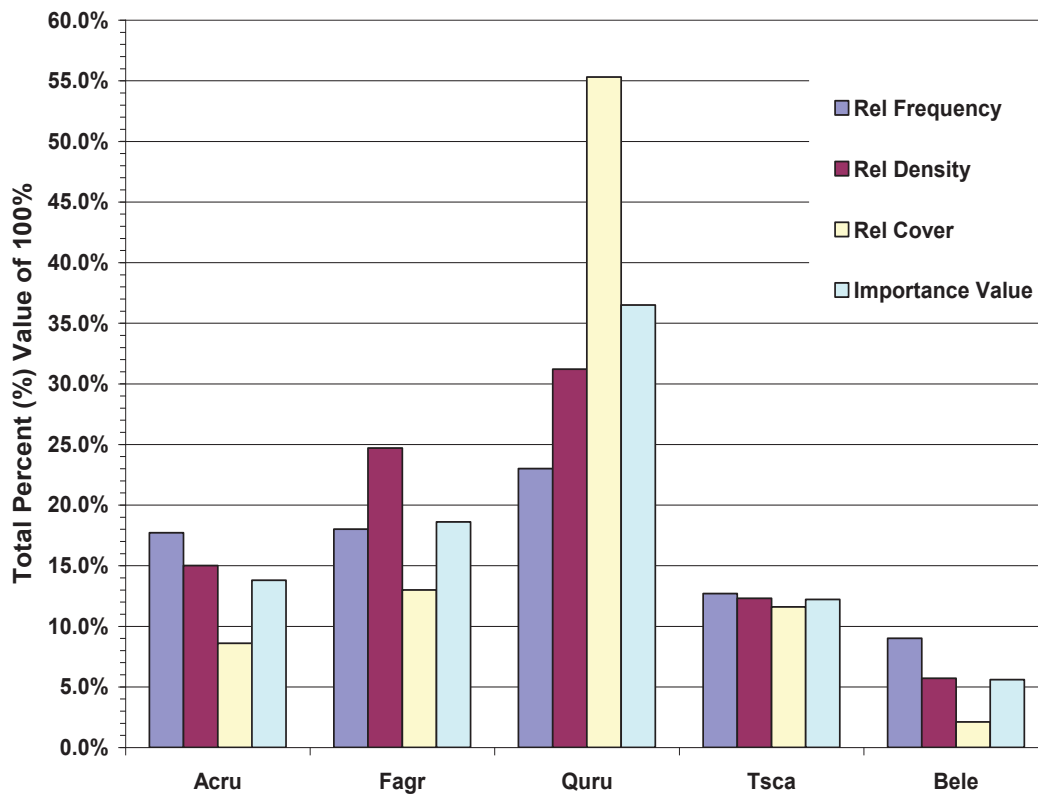
The largest tree recorded was a red oak, with a dbh of 42in. The largest trees on the property were also the most frequently occurring (Table 1). Red oak accounted for 31.2% of the total number of trees calculated, and had an average dbh of 14.5 ± 4.8 in. The next most frequently occurring were the beech, which constituted 24.8% of the total, and red maple which included 14.9% of the total number of trees. The most frequently occurring species also yielded the higher significance values (Figure 2). Red Oak is the most important species (IV=36.5%), having the highest relative density at 31%, the most number of occurrences ($n = 254$), and the greatest relative cover (RC = 53%). American beech was the next most important species (IV=18.6%), even though its relative frequency of 18.1% was lower than that of red maple (RF = 18.8%) (Figure 2).

Table 1. Total distribution of species occurrence and average dbh with standard deviation. Five most frequently occurring species are highlighted.

Species	Occurrences	Mean dbh (in) and Standard Deviation (in)
Acpe	8	1.4±0.6
Acru	122	8.2±2.8
Acsa	10	3.6±1.1
Beal	8	7.3±3.0
Bele	46	6.0±3.6
Bepa	27	8.6±2.1
Bepe	3	7.8±1.6
Bepo	1	7.5±0.0
Fagr	201	7.3±4.1
Fram	1	8.5±0.0
Frax?	7	9.7±1.8
Osvi	1	4.5±0.0
Pist	24	14.7±6.5
Qual	1	10.5±0.0
Quru	254	14.5±4.7
Tsca	100	10.2±4.5
Totals:	815	8.1±3.0

With only 12.9% relative cover in the upper synusium, A. beech dominated the middle synusium (trees < 4in) with 46.7% relative cover, 50% relative density, and an importance value of 47%. Black birch (*Betula lenta*) followed in importance with 16.3%. Striped maple (*Acer pensylvanicum*), sugar maple (*Acer saccharum*), and eastern hemlock (*Tsuga canadensis*), while fluctuating in density, frequency, and cover, all shared similar overall importance values (IV = 8.7 – 9.1%) within the parcel. Of the 103 total trees < 4in, 49% were American beech 15% were black birch, and 9.7% were red maple. The overall parcel sapling layer is clearly dominated by beech and black birch.

Figure 2. Total distribution of significant values per five most frequently occurring species within Grant Parcel, Greater Goose Pond Forest, May 2005.



Initial observations made from the aerial photos of the Grant parcel suggested that the property consisted of multiple communities (Aerial photo 1). The collected measurement data, in conjunction with

numerous ground-referencing trips to the parcel, confirmed this suspicion. The Grant parcel is composed of 3 distinct communities (Map 5). The 250ft-wide, denuded, power-line strip running NE-SW through the parcel acts as a physical boundary between the two primary communities. The south half of the parcel consists of an oak, beech, maple, hardwood community with a hemlock component that totals 39.7 acres (16.1ha), and is the largest of the three communities. This section of the property is topographically less severe than the northern section and has one small stream and two seasonal drainage routes running SW through the community. The north end of the parcel is designated as an oak, beech, maple upland, and totals 37 acres (14.9ha). The north end of the property is primarily dry upland, despite a small moist lowland area to the east end of the parcel. The third community is a small subsection of the upland oak, beech, maple community composing 4.98 acres (2ha) atop the ridgeline at the far north end of the property. The habitat within this area is that of a dry, rocky upland hardwood / softwood transitional forest.

Oak, beech, maple, hemlock community

The oak, beech, maple, hemlock community (OBMH) consisted of 50 sampling plots, and 613 total measured individuals. The OBMH community is dominated by red oak, American beech, red maple, and hemlock. The community contains 141 trees/acre and 122 ft²/acre of basal area. Of the 613 total trees sampled, 28% were American beech, 26% were red oak, 14% hemlock, and another 14% red maple. The upper synusium included 530 individuals of which oak (IV=32.6%) and beech (IV=20.7%) were the most important, facilitating a dominant/co-dominant role in the upper synusium (Figure 3). Eastern hemlock and red maple were prevalent to a lesser degree, with 85 and 89 occurrences respectively. The mean dbh of the upper synusium was 10.4 ± 43in, with the largest trees being composed primarily of red oak (Figure 4). The hemlock component to this community included 85 individuals >4in, that had an average dbh of 10.8 ± 4.2in, and culminated in an importance value of 15.9%. The saplings were dominated by American beech, which had a 47.8% relative frequency, a 50.6% relative density, and a 47.8% relative cover within that size class (Figure 4).

Figure 3. Distribution of significance values per five most occurring species of the oak, beech, maple, hemlock community. Grant Parcel, Greater Goose Pond Forest, May 2005.

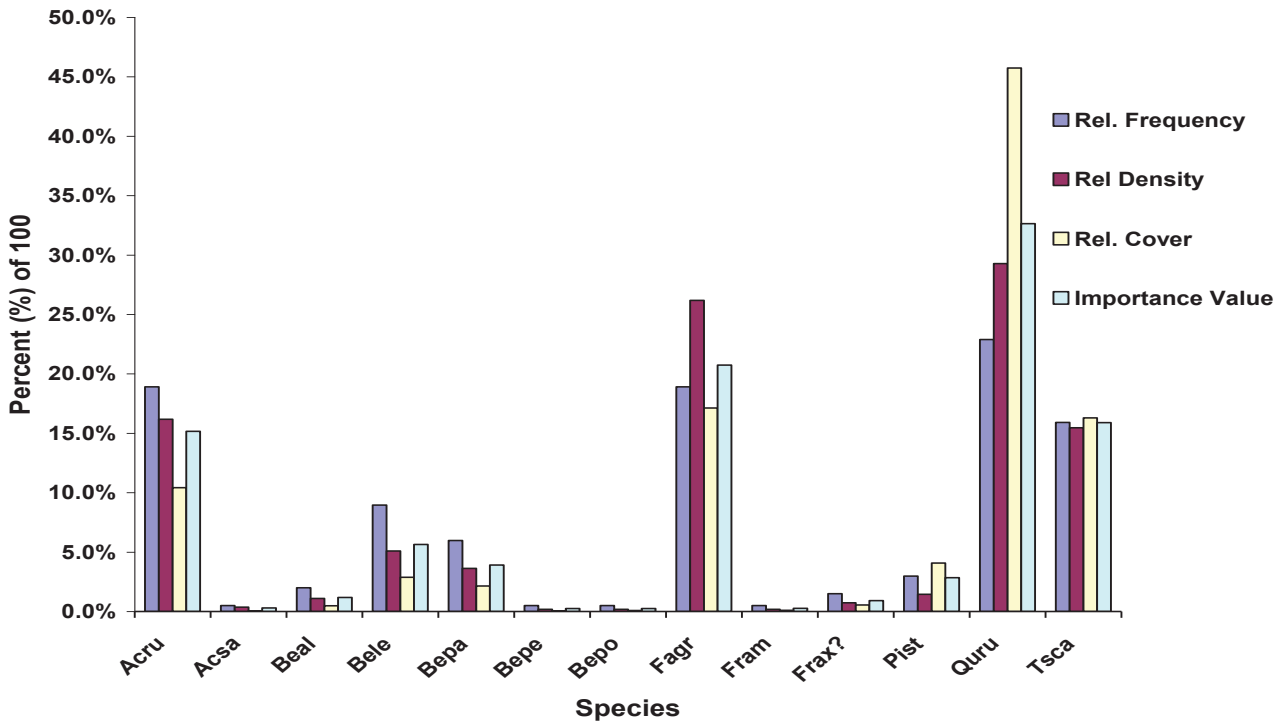
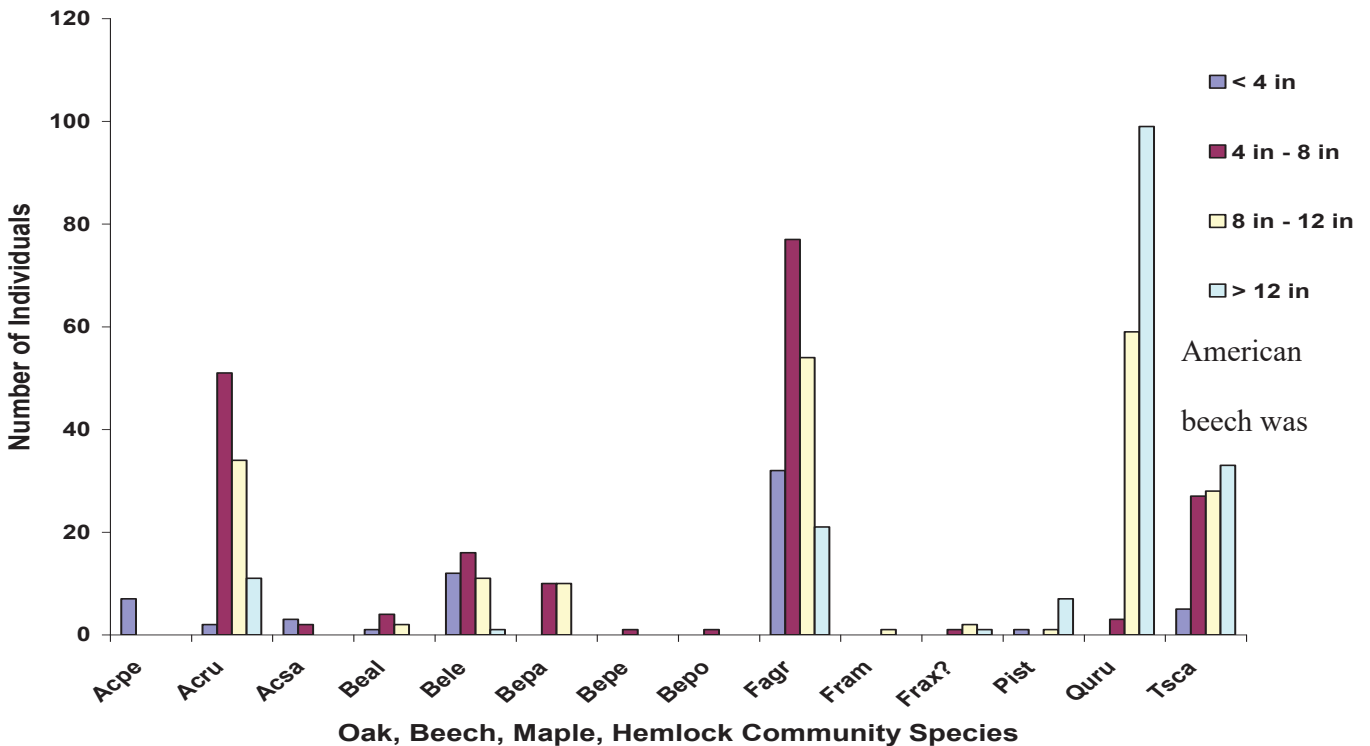


Figure 4. Size distribution within oak, beech, maple, hemlock community. Grant Parcel, Greater Goose Pond Forest, May 2005.



overwhelmingly the most dominant species of the lower synusium, with an importance percentage of 47.3% that vastly exceeded other IV values. The next most important species was black birch (IV=14.8%).

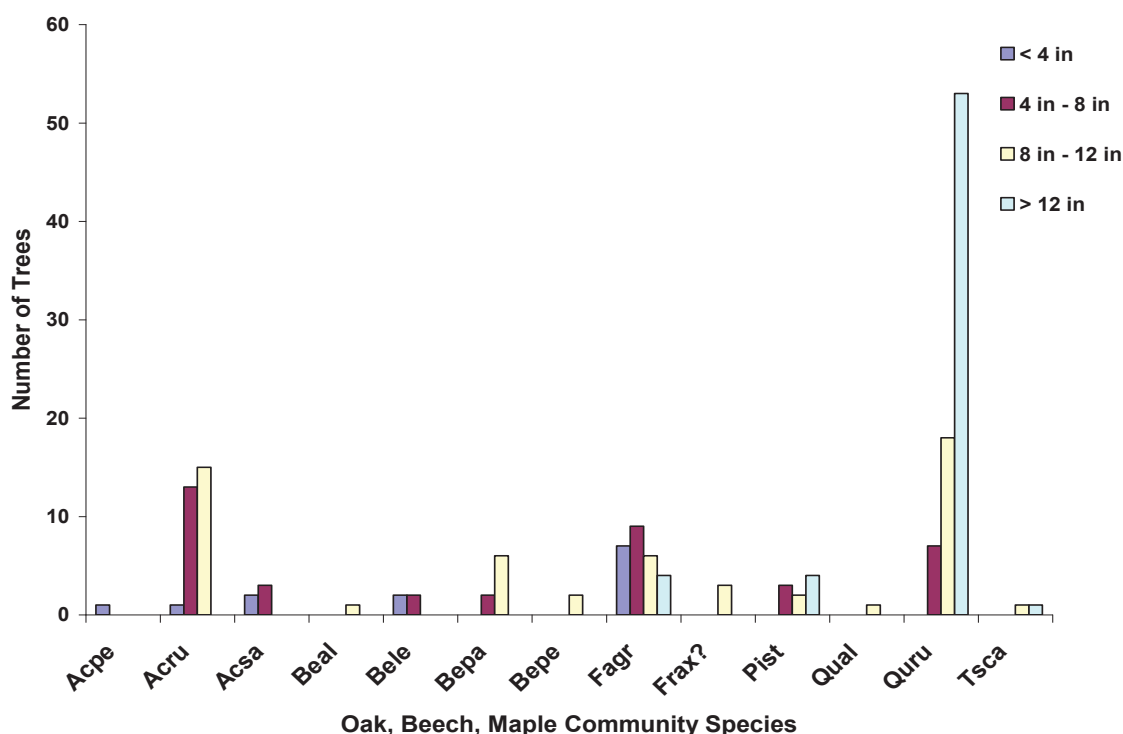
Oak, beech, maple upland community

The oak, beech, maple upland community is to the north of the power-line, and included 19 sampling points and 162 measured individuals. The community had 598.8 stems/acre, with 85 ft²/acre of total basal area. Of the trees in the upper synusium (≥ 4 in), red oak was by far the most dominant species, totaling 46.9% of the measured trees, and having an average dbh of 15.7 ± 5 in. (Figure 5). Red oak is the most frequently occurring (RF = 28%), has the greatest density (46.9%), the most cover (74.8%), and is the most important species within the upper synusium of the community (IV = 49.9%). American beech and red maple play an equal secondary role, with very similar density, frequency, and coverage values (beech IV = 14.4%, red maple IV = 13%) (Table 2).

Table 2. Significance values of the lower synusium of the oak, beech, maple upland community, Grant Parcel, Greater Goose Pond Forest, May 2005.

Species	Rel. Frequency	Rel.Density	Rel. Cover	Importance Value
Acpe	9.9%	8%	2%	6%
Acru	9.9%	8%	8%	9%
Acsa	19.9%	15%	14%	16%
Bele	19.9%	15%	20%	19%
Fagr	39.7%	54%	56%	50%

Figure 5. Size distribution within the oak, beech, maple upland community. Grant Parcel, Greater Goose Pond Forest, May 2005.



The sapling layer is dominated primarily with American beech, which accounted for 53.8% of the total number of trees < 4in, and had an importance value of 50%. The next most important saplings in this size class are black birch (IV = 19%), and sugar maple (IV = 16%), which each accounted for 15.4% of the total number of individuals measured (Table 3).

Table 3. Total oak, beech, maple upland community species significance values, with the three most important species highlighted. Grant Parcel, Greater Goose Pond Forest, May 2005.

Species	Mean dbh and SD	tree ba	Rel. Freq	Rel.Density	Rel. Cover	Importance
Acpe	2.0±0.0	0.02	1.6%	0.6%	0.0%	0.7%
Acru	7.7±2.0	9	17.2%	16.0%	5.9%	13.0%
Acsa	3.8±1.5	0.42	6.2%	3.1%	0.3%	3.2%
Beal	12.0±0.0	0.79	1.6%	0.6%	0.5%	0.9%
Bele	4.8±2.1	0.59	4.7%	2.5%	0.4%	2.5%
Bepa	9.3±1.3	3.35	7.8%	4.3%	2.2%	4.8%
Bepe	8.8±0.4	0.83	1.6%	1.2%	0.5%	1.1%
Fagr	7.3±4.2	10.28	20.3%	16.0%	6.7%	14.4%
Frax?	10.0±0.9	1.64	1.6%	1.9%	1.1%	1.5%
Pist	12.9±6.1	8.71	4.7%	4.9%	5.7%	5.1%
Qual	10.5±0.0	0.6	1.6%	0.6%	0.4%	0.9%

Quru	15.7±5.5	114.68	28.1%	46.9%	74.8%	49.9%
Tsca	14.5±3.5	2.37	3.1%	1.2%	1.5%	2.0%

Oak, pine, hemlock upland community

The oak, white pine, hemlock community is a subcomponent of the oak, beech, maple upland that is relegated to < 5 acres on a rocky ridge top on the north end of the Grant parcel. Initially, I was not going to include the small area of difference as a separate community. However, after ground-referencing and collecting data on two sample points within that area, I decided to add two more sample points as a means of capturing that difference. While a small area, and only consisting of 4 sample points, the community represents a significant departure from the surrounding area. The first primary difference was the lack of a smaller size class (Figure 6). Only 6.8% of the total number of individuals sampled were < 4in dbh.

Figure 6. Distribution of tree size within the oak, pine, hemlock community, Grant Parcel, Greater Goose Pond Forest, May 2005.

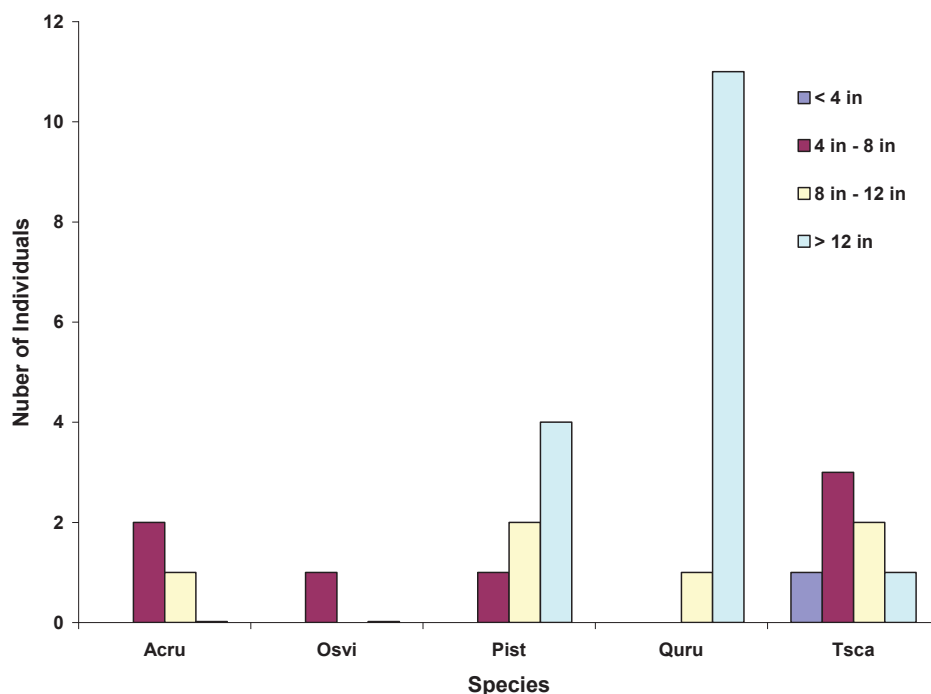
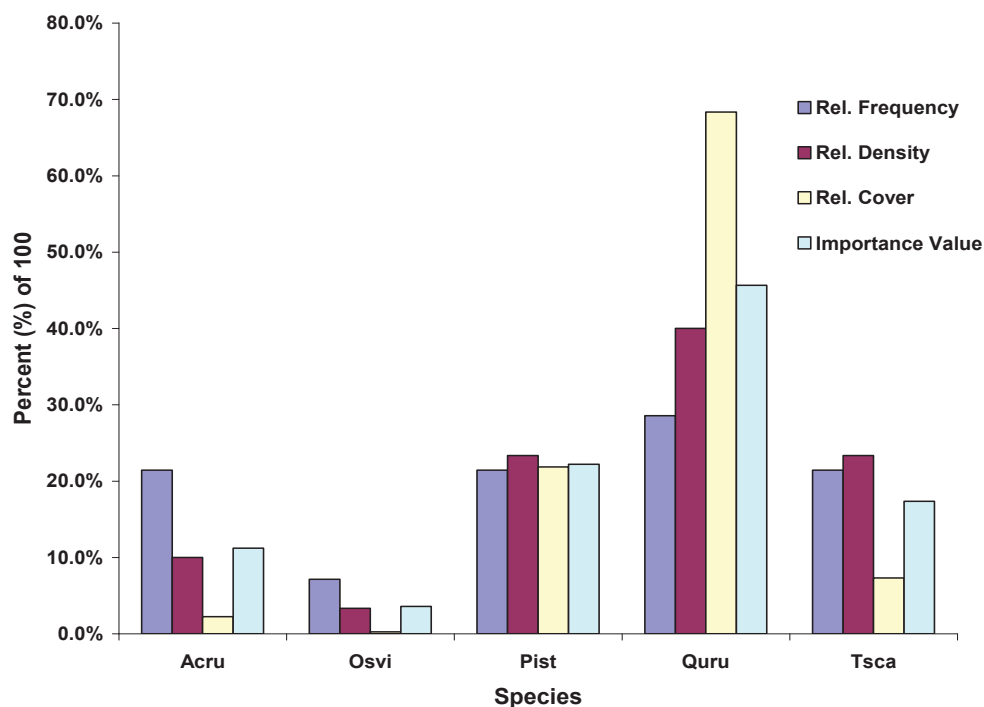


Figure 7. Distribution of species significance within the oak, pine, hemlock community, Grant Parcel, Greater Goose Pond Forest, May 2005.



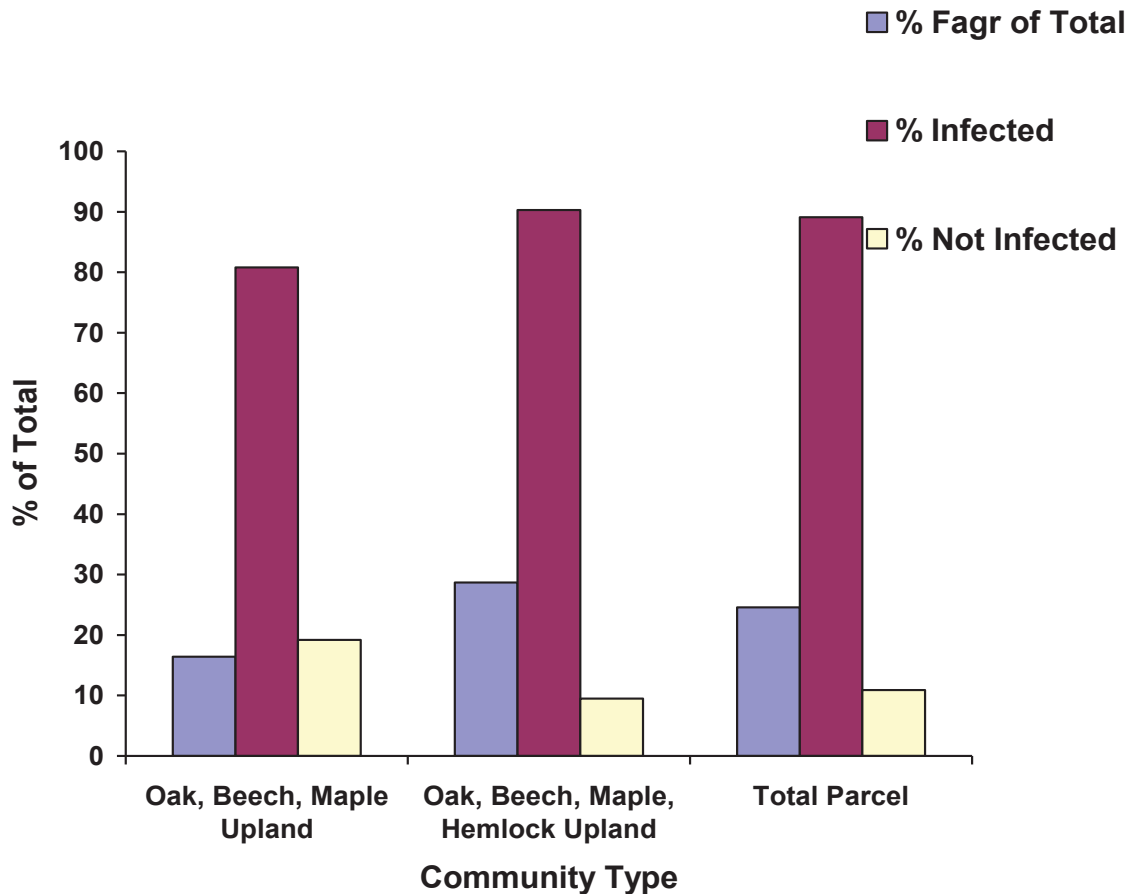
The second difference was the increased importance of white pine and hemlock as evergreen components of this hardwood forest (Figure 7). While red oak remained the dominant species (IV = 45.6%), pine and hemlock provided important compositional components as well (Pist IV = 22.2%, Tsca IV = 17.4%). The two co-dominant species had the same number of individuals sampled, as well as similar frequency and density values, however, they differed in percent cover (pine RC = 21.8%, hemlock RC = 17.3%). This difference can be attributed to the comparatively lower number of hemlocks > 12in dbh, which resulted in lower overall relative coverage.

Fagus grandifolia health

Of the 815 total individuals measured, 201, or 24.7% were American beech. Of that 24%, 89.1% (or 179 individuals), were infected with beech bark scale disease (Figure 8). Within the oak, beech, maple, hemlock community, beech accounted for 28.7% (or 176 individuals), of the total number of measured trees. Of that 28.7%, 90.3% were infected. The oak, beech, maple upland community displayed similarly high

numbers, with beech accounting for 16.4% of the measured population, of which 80.8% were infected. Zero beech were measured within the oak, pine, hemlock community. In order to determine if there was a significant difference ($P = 0.05$) between size classes and the presence or absence of infection, I performed nonparametric analysis utilizing the Wilcoxon signed-rank test for the analysis of matched pairs. There was no significant difference in the distribution of infection among different size classes (Wilcoxon signed-rank, $z = -3$, $P = 0.25$). A qualitative assessment regarding the degree of infection of each infected tree indicated that $> 65\%$ of the infected trees were severely infected (severely equals $> 45\%$ visible exterior damage).

Figure 8. Distribution of infected and not-infected *Fagr* between the two primary communities within the Grant Parcel, Greater Goose Pond Forest, May 2005.



Discussion

The soils and species composition within the Grant parcel indicate that the forest is a southern, transitional, mixed hardwood, oak, beech, maple acidic upland forest. The oak, beech, maple community to the north of the power-lines, is a clear representation of this categorization. The oak, beech, maple, hemlock community is essentially a more lowland variant of the oak, beech, maple community, with the exception that the shift from the upland Tunbride-Lyman “outcrop” soils to the lowland sandy loams, provided a substrate more ideal for hemlock germination subsequent to disturbance. Both the oak, beech, maple upland, and the oak, beech, maple, hemlock community, are broadly defined by the NH natural communities classification system as an S5 Hemlock, beech, oak, pine forest. This community type is widely represented in southern New Hampshire, and includes numerous variations depending on the microhabitat and land-use history. The community can vary from hardwood, hardwood-softwood, or mostly softwood dominated stands (Sperduto and Nichols 2004).

The size distributions of trees within the parcel suggest an early to mid successional forest (Figure 1). This is evidenced by the fact that the majority of trees are 8-12 in dbh, as well as the fact that there is a general absence of hemlock (considered a “late successional species”) as a canopy species. Furthermore, numerous even-aged red oak with the extensive evidence of past land use history that includes: agriculture, pasturing, and logging as recently as 50 years ago, limits the time of undisturbed succession. The coppiced trunks of red oak and white pine indicate that the property has been logged at least once. Also, the absence of white pine growth after that event suggests that the most recent logging was not a clear-cut, but a selective cut, thus reducing the amount of full sun that is a prerequisite for white pine seedling establishment.

The widespread presence of red oak, in combination with the reduced number of saplings, indicates that the successional direction of the forest is toward an oak-beech dominated canopy, with large scale structural changes initiated only through widespread canopy disturbance. Save human disturbance, the most likely structural fluctuations to occur would be within stands where American beech have particularly high importance values. The prevalence of the fungus *Nectria coccinea* on the property indicates that it is only a

matter of time before the canopy opens up as the beech give way to the disease. Given that beech tends to respond to parasitic disturbance with clonal reproduction, one can expect the middle synusium to be beech dominated for the foreseeable future, possibly hampering the maturation of the present red maple and black birch saplings.

New Hampshire’s forested landscapes are full of physical indicators evidencing a history of poor logging practices. Even-aged stands lacking diversity within a maze of old logging roads are an abundant reminder of the clear-cutting that took place only a few decades ago. Logging that occurred during that time had few protocols regarding timber harvest within ecologically “sensitive” areas, or concerns regarding issues of erosion within clear-cuts. It is only recently that timber harvests have begun to incorporate ecological considerations into their practices. The primary data provided by this NRI will help to facilitate informed land use management decisions made by the City of Keene, and contribute to baseline data for future ecological studies within the Greater Goose Pond Forest.

Chart 1: Grant Parcel Soils Table

Soils associated with the Grant Parcel (lot 11) of the Greater Goose Pond Forest, Keene, NH

Soil Code	Soil Name	Slope	Acreage	Hardwood and Coniferous Tree Habitat	Management Concerns		Productivity	
					Erosion Hazard ¹	Wind Throw ²	Species	Site Index ³
143C	Monadnock fine sandy loam, very stony	8-15%	15.2	Good	Slight	Slight	<i>P. strobus</i> <i>Q. rubra</i> <i>P. rubens</i> <i>P. glauca</i>	63 55 60 55
143D	Monadnock fine sandy loam, very stony	15-25%	25.0	Good	Moderate	Slight	<i>P. strobus</i> <i>Q. rubra</i> <i>P. rubens</i> <i>P. glauca</i>	63 55 60 55
61C	Tunbridge-Lyman outcrop complex	8-15%	24.9	Good - Tunbridge / Poor - Lyman	Slight	Moderate	<i>P. strobus</i> <i>Q. rubra</i> <i>A. saccharum</i> <i>P. rubens</i> <i>B. alleghaniensis</i> <i>P. glauca</i> <i>F. americana</i>	70 70 60 45 55 55 65
61D	Tunbridge-Lyman outcrop complex	15-25%	34.0	Good - Tunbridge / Poor - Lyman	Moderate	Moderate	<i>P. strobus</i> <i>Q. rubra</i> <i>A. saccharum</i> <i>P. rubens</i> <i>B. alleghaniensis</i> <i>P. glauca</i> <i>F. americana</i>	70 70 60 45 55 55 65

¹Erosion Hazard – the probability that erosion can occur as a result of site preparation or cutting.

Slight – no particular measures need to be taken to prevent erosion under normal conditions

Moderate – erosion control measures are needed for silviculture activities

Severe – special precautions are necessary to control erosion in most silviculture activities

²Wind Throw – the likelihood that trees will be uprooted by wind

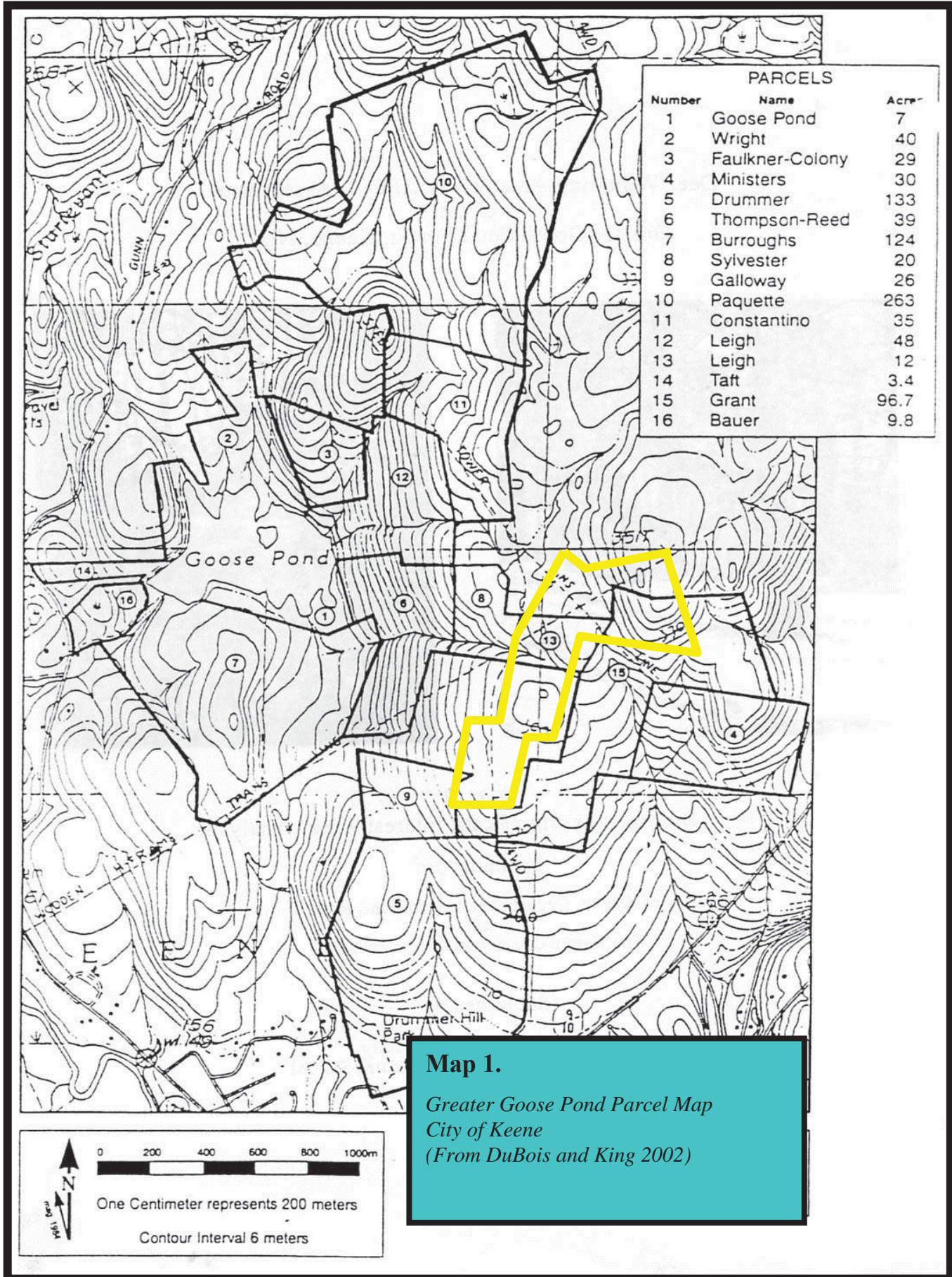
Slight – no trees are normally uprooted by wind

Moderate – moderate or strong winds occasionally uproot trees when soil is wet

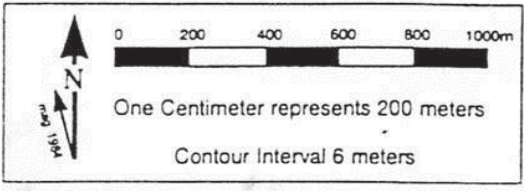
Severe – moderate or strong winds may blow down many trees when soil is wet

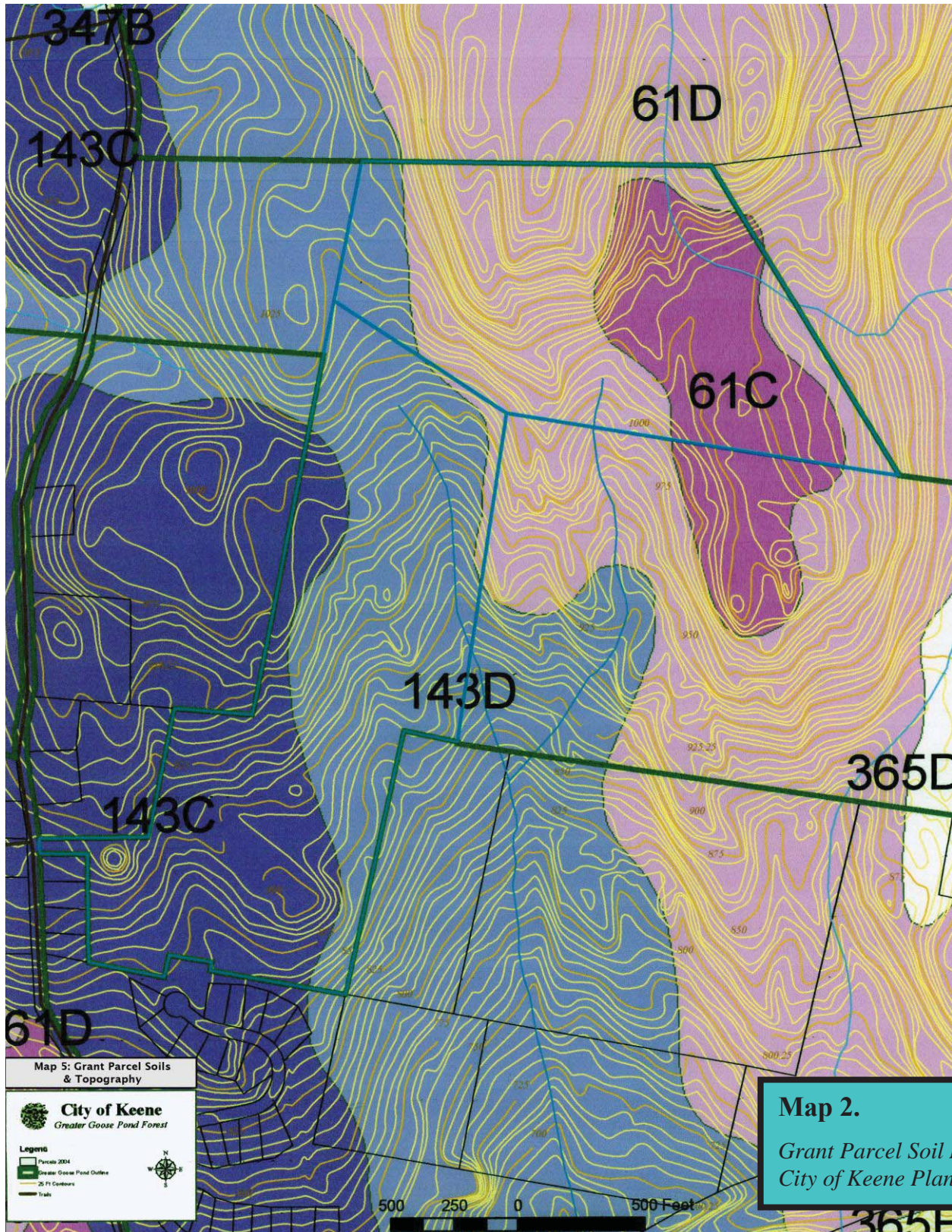
³Site Index – average height in feet that a dominant or co-dominant tree can reach in a specified number of years

*Source: United States Department of Agriculture. 1989. Soil Survey of Cheshire County New Hampshire. National Cooperative Soil Survey (United States Department of Agriculture Soil Conservation Service and New Hampshire Agricultural Experimental Station).

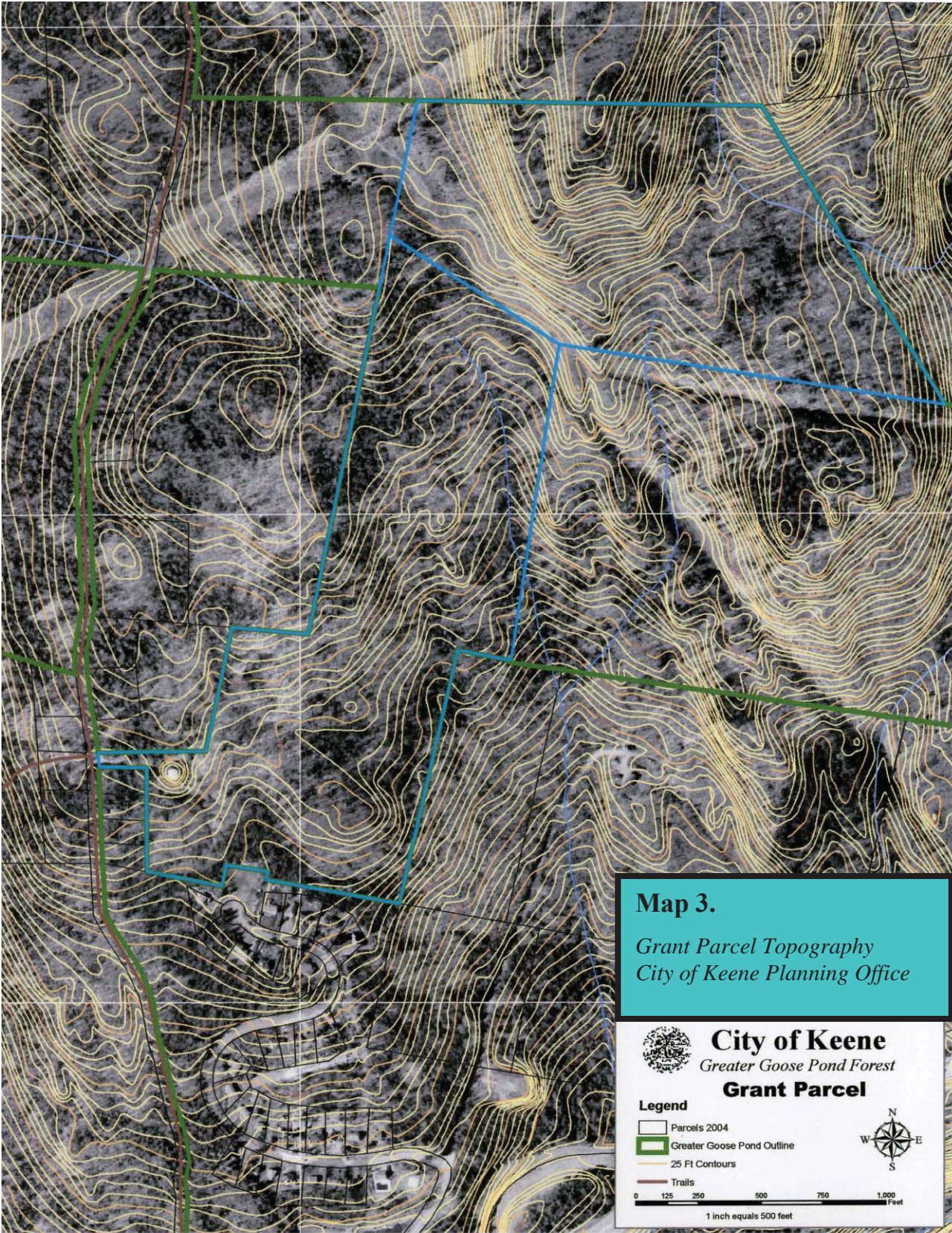


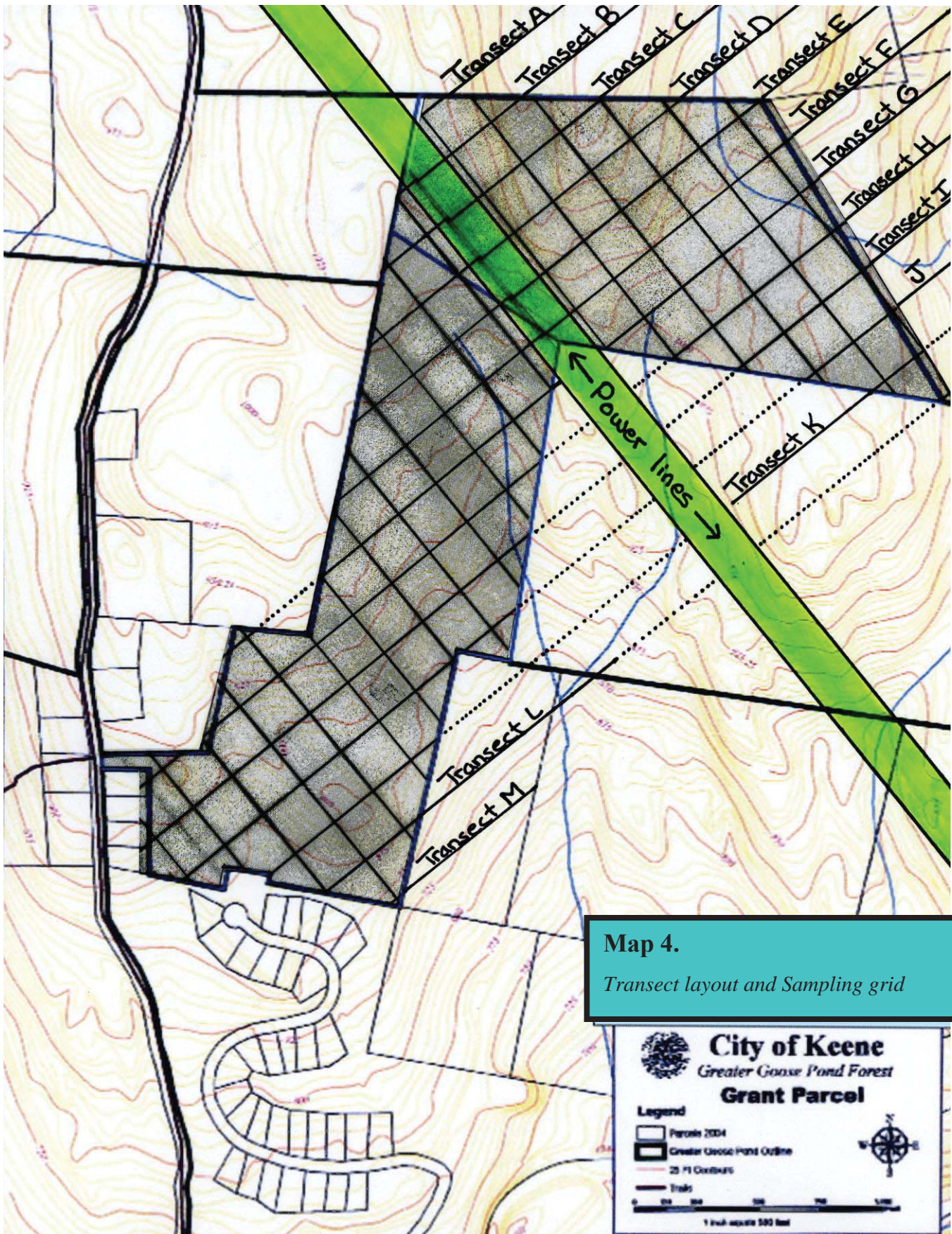
Map 1.
Greater Goose Pond Parcel Map
 City of Keene
 (From DuBois and King 2002)



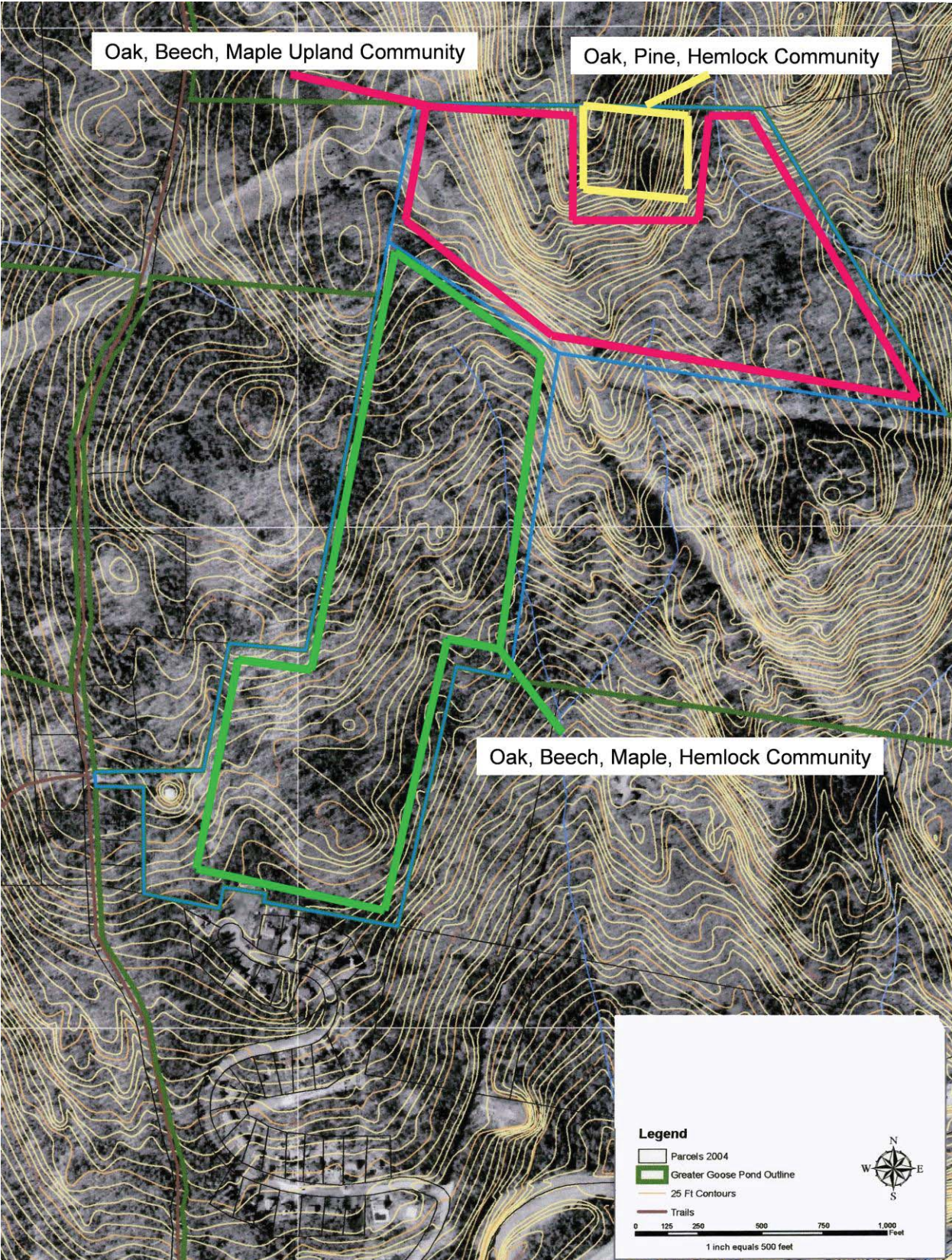


Map 2.
Grant Parcel Soil Map
City of Keene Planning Office





Map 4.
Transect layout and Sampling grid





Literature Cited

- Albers, J. 2000. Hands on the Land: A History of the Vermont Landscape. Orton Family Foundation, Rutland, VT.
- Avery, T.E., and Burkhardt, H.E. 2002. Forest Measurements. McGraw Hill. NY.
- Brower, J.E., J.H Zar, and C.N von Ende. 1997. Field and Laboratory Methods for General Ecology. 4th ed. Wm C. Brown Publishers, Dubuque, IA.
- City of Keene, City Planning Department. 3 Washington St. Keene, NH 03431. (603) 352-5474
- Dubois and King, Inc. City of Keene Natural Resources Inventory – Greater Goose Pond Forest and Sterns Hill Natural Area. (2002). 25 Wentworth Drive. Williston, VT. 05495.
- Moore, G.E. 1949. Geological Map and Structure Sections of the Keene and Brattleboro Quadrangles, New Hampshire.
- Petrides, G.A. 1986. Peterson Field Guide to Trees and Shrubs. Second edition. Houghton Mifflin, Boston.
- Sorenson, E.R. and Thompson, E.H. 2000. Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont. University Press of New England, Hanover, NH.
- Sperduto, D.D., and Nichols, W.F. 2004. Natural Communities of New Hampshire. The New Hampshire Natural Heritage Bureau and The Nature Conservancy. UNH Cooperative Extension, Durham, NH.
- Terraserver.com homepage. <http://www.terraserver.com>
- Trelease, W. 1967. Winter Botany: An identification guide to native trees and shrubs. Dover Publications Inc. New York, NY.
- Van de Poll, R. and Donahue, C. Vegetation Analysis of Four Biologically Significant Interest Areas of the Greater Goose Pond Forest. (1996). Antioch New England Graduate School. 40 Avon St. Keene, NH. 03431
- Van Diver, B.B 1987. The Roadside Geology of Vermont and New Hampshire. Mountain Press Publishing Co. Missoula, MT.
- USDA Soil Conservation Service, 1989. Soil Survey of Cheshire County, New Hampshire.
- Wessels, T. 1997. Reading the Forested Landscape: A Natural History of New England. The Countryman Press, Woodstock, VT.

**APPENDIX VI:
Additional Information – Forestry Resources**

Forest Management Resources – New Hampshire

UNH – Cooperative Extension

<http://extension.unh.edu/Forestry/Forestry.htm>

The UNH Forest and Trees Cooperative Extension provides information and assistance regarding the management of New Hampshire's forest resources. Assistance is provided through County Extension Programs.

The County Extension Forestry and Wildlife program provides technical assistance and information and educational services in the field of forest resources to private woodland owners, primary processors, organizations, communities, and the general public. Some of the areas in which assistance is provided include:

- Woodland management and planning
- Utilization and marketing
- Community forestry
- Wildlife management
- Multiple-use management
- Insect and disease concerns
- Christmas tree production
- Maple syrup production
- Forest taxation and finances
- Permanent land protection

Assistance is provided through individual contacts and site visits, workshops, newsletters, publications and demonstrations. Sound utilization and conservation of the forest resource is the prime objective of the County Forestry Program.

Society for the Protection of New Hampshire's Forests

<http://www.spnhf.org/>

The Society for the Protection of New Hampshire's Forests (SPNHF) is dedicated to protecting the state's most important landscapes while promoting the wise use of its renewable natural resources. SPNF provides assistance to land trusts, municipalities, state and federal agencies, and other conservation organization to protect land throughout the state. Since 1901, SPNF has protected over one million acres of open space, promoted good land stewardship through education and example, and advocated for public policies that encourage wise conservation.

New Hampshire Timberland Owners Association

<http://www.nhtoa.org>

New Hampshire Timberland Owners Association (NHTOA) is a non-profit statewide coalition of landowners, forest industry professionals, government officials, and supporters who work together to promote better forest management, conserve New Hampshire's working forests, and insure a strong forest products industry.

Forestry Certification Organizations

Forestry certification provides many added benefits to forest management operations. Primarily, bearing the trademark of a certifying organization provides industry and consumers with the assurance that the forest products used were harvested in a sustainable manner.

Forest Stewardship Council (FSC) -
FSC Small and Low Intensity Managed Forests Initiative

<http://www.fsc.org/en/>
<http://www.fsc.org/slimf/>

FSC has been recognized as an international organization that provides a system for different stakeholders interested in forest issues to work towards responsible forest management.

The forestry standards and requirements developed by the FSC are capable of being applied to any size forest. The Small and Low Intensity Managed Forest (SLIMF) initiative created by the FSC is designed so small and low intensity forestry operations can take advantage of FSC certification. Under SLIMF, a small forest is defined as comprising less than 100 hectares (247 acres) while a low intensity forest operation is where harvesting removes less than twenty percent of a forest's mean annual increment of forest production.

SmartWood

<http://www.rainforest-alliance.org/programs/forestry/smartwood>

SmartWood, established in 1989, was the world's first independent forestry certifier. Today, SmartWood is the world's leading non-profit forest certifier and leading FSC certifier. SmartWood certifies all types and sizes of forest management operations from large plantations to small family-owned operations. Beyond FSC certification programs, SmartWood offers four additional programs:

- *Verification* – provides companies using or purchasing forest products third party verification of the source and legality of raw materials being used in their products.
- *SmartStep* – provides more opportunities and incentives for forest management operation to pursue FSC certification.
- *Controlled Wood Verification* – gives acknowledgement to companies, under FSC's Controlled Wood Program, that the wood products used are not coming from controversial sources.
- *SmartLogging* – provides third party audit and certification system for loggers and enables them to demonstrate to customers that logging will be done responsibly.

Sustainable Forestry Initiative

<http://www.aboutsfi.org/core.asp>

The Sustainable Forestry Initiative (SFI) was developed by the American Forest & Paper Association (AF&PA). The program was developed to document the commitment of AF&PA members to keep our forests healthy and practice the highest level of sustainable forestry.

SFI is a comprehensive system of principles, objectives and performance measures developed by professional foresters, conservationists, and scientists that combines the perpetual growing and harvesting of trees with the long-term protection of wildlife, plants, soil and water quality.

American Tree Farm System<http://www.treefarmssystem.org/>

The American Tree Farm System (ATFS) is a part of the American Forests Foundation. The mission of ATFS is to promote the growing of renewable forest resources on private lands while protecting environmental benefits and increasing public understanding of all the benefits of productive forestry. ATFS seeks to sustain forests, watersheds, and healthy habitats through private stewardship. To become a certified tree farm, landowners must submit a management plan to ATFS that meets strict environmental standards and undergo inspection by an ATFS certified forester every five years.

**APPENDIX VII:
Friends of Open Space Letter**

Mr. John Bordenet, Chair
Keene Conservation Commission
3 Washington St.
Keene, NH 03431

October 5, 2005

Dear John,

The Friends of Open Space recently completed an inventory of open space land on the hillsides of Keene. We have developed this inventory to give us a picture of what land needs to be protected so that these hillsides remain forested in the future. This will protect our ‘viewscape’ as well as reduce the effects of runoff from development. The survey includes both private and city-owned land.

The Greater Goose Pond Forest is a key area which covers a good part of the hill side to the north east of Keene as viewed from the center of the city. This land is owned by the City. However, at some future date the land could be rezoned and sold by the City, if a future council so decided. The area could be developed for housing or for commercial use. While this scenario may sound highly unlikely to occur, it has happened in other communities under the pressure of city financial needs or of need for house lots.

One solution to the long term protection of this property is for the City to put a conservation easement on the land with a recognized land trust. The Friends of Open Space in Keene would like the opportunity of presenting to you the structure of such an easement with the hope that your group would include in your new long range plan for the Greater Goose Pond Forest a recommendation that the City place a conservation easement on a major part of the forest to insure that it would remain undeveloped forever. We would appreciate having 30 minutes or so at one of your upcoming meetings to make this presentation.

Very truly yours,

Peter D. Hansel
President