NORTHWOODS
STEWARDSHIP CENTER

Forest Management Plan

for the Property of the

NorthWoods Stewardship Center

located in the town of

Charleston, Vermont

prepared by

Jayson Benoit
Director of Land Management
NorthWoods Stewardship Center

December, 2007

Walter Medwid date	George Buzzell date
NorthWoods Executive Director	*Orleans County Forester*

Introduction

This document summarizes the natural and cultural features of land owned by the NorthWoods Stewardship Center and serves as a guide for the sustainable management of the forested part of this land over the coming decade (2008-2017). The plan addresses enrollment requirements for Vermont's Use Value Appraisal program, and for the Vermont Forest Land Enhancement Program's Landowner Forest Stewardship Plan Development (FLEP-1), which has provided cost-share funds for its development.

The current ownership of the NorthWoods Stewardship Center includes two non-adjacent parcels located in the town of Charleston, Vermont. The east parcel encompasses 40.6 acres and includes the Center's main facility, as well as the staff cabins, woodshop, and ropes course. A 59-acre forested parcel, also owned by NorthWoods, is located less than a quarter mile to the west and is accessed by a trail right-of-way held by NorthWoods.

Despite their proximity to one another, these two parcels have experienced distinct land-use histories and ownership patterns. While logging has been the primary historic impact on the west parcel, the east property supported a succession of small-scale farming operations for much of the 19th and early 20th centuries, before largely converting to forest within the past eighty years. The 2004 acquisition by NorthWoods marked the first time since settlement by Euro-Americans that these parcels were joined under a single ownership.

As a non-profit organization dedicated to teaching and conservation work, the NorthWoods Stewardship Center brings a diverse and somewhat unique set of management goals as a landowner. Most unique among these is the desire to utilize the site as a powerful educational tool, incorporating hands-on activities such as forest research, demonstration of sustainable forest management, school outings, and recreational opportunities.

Above all, the NorthWoods Stewardship Center intends to improve the health, resilience and productivity of the parcel's forests during its ownership tenure. The primary goal of this plan is to assist in that effort through specific short (ten year) and longer-term management recommendations that draw upon current conditions on the ground, the land-use histories of these parcels, and the needs and priorities of NorthWoods.

Table of Contents

Management Goals and Objectives

Three overarching goals will advise forest management on the NorthWoods Stewardship Center parcels. These are (in order of priority);

1) to improve overall forest health, resilience, and long-term productivity,
2) to provide a community resource and support a range of educational activities, and
3) to provide a steady and sustainable yield of high-value forest products

More specific goals falling within the above three overarching themes include:

- Returning forest stands to more natural and compatible tree species compositions
- Enhancing natural forest structural elements such as snags and downed woody debris
- Protecting soils and sensitive areas through appropriate management practices, timing, equipment, and the use of limited or no-harvest buffers

- Coordinating management activities with other NorthWoods programs to maximize opportunities for research, education, and recreation, and to minimize conflicts
- Improving and maintaining forest access roads and bridges (for recreational, educational, and management access)
- Promoting educational values through signage, careful management accounting, and enhancement of special features located along access corridors

- Maintaining a continuous source of firewood and lumber for NorthWoods needs
- Gradually improving stand quality by promoting higher value species and individual trees
- Transitioning to an uneven-aged forest structure

To achieve these goals, future management should incorporate the following objectives:

- ✓ Weighing natural community types and other mitigating factors (such as climate change), promote tree species that are best suited to their site, and that are of greatest long-term commercial value. This will be accomplished primarily through uneven-aged management, employing the single tree/ small group selection systems and promoting shade tolerant species such as sugar maple, red spruce, and beech, and mid-tolerants such as yellow birch and white ash.

- ✓ Increase the quality and quantity of natural forest structure elements such as snags, downed woody debris, and all-agedness through a transition to uneven-aged management and active recruitment and protection of these features during management entries.

- ✓ Maintain or increase soil organic matter and nutrients by leaving cull logs of non-firewood species in the forest, especially hollow butt pieces. Also avoid whole tree harvesting and leave all limbs <4" diameter in the woods.

- ✓ Improve the quality of growing stock with each entry. Maintain stocking at or above the B-line and limit harvesting to less than 70% of annual growth.

- ✓ Protect water quality in streams and woodland seeps by minimizing crossings and retaining an intact canopy buffer of at least 30 feet (stocking at or above the A-line). Protect wetlands by operating only in frozen ground conditions and conforming to the

Vermont AMPs. Use the latest available guidelines for protecting vernal pools.

- ✓ Protect soils from compaction and erosion by operating in frozen ground conditions whenever possible, utilizing appropriate equipment, carefully laying out skid trails to avoid wet areas, and prioritizing cabling over skidding from the stump. Use check dams and water bars to limit erosion – as specified in the Vermont AMPs.

- ✓ Improve wildlife habitat and protect against potential damage from insects or disease by maintaining 10-25% of stocking in minor species. Also remove trees that are infected with beech bark disease or other infectious pathogens.

- ✓ Retain healthy beech, hophornbeam, black cherry and apple trees as sources of mast for black bear, wild turkey, and other wildlife.

- ✓ Limit residual stand damage, including basal wounds, broken and/or scraped tops, and exposed roots to 5% or fewer of the dominant trees.

Property Overview

Landowner Name: *NorthWoods Stewardship Center*
Address: P.O. Box 220
East Charleston, VT 05833
Telephone: 802-723-6551 (x113)

Charleston Grand List Description (as of August, 2006):
West parcel **(**ID # 4350300- *formerly TR43001.A*) – 59.0 acres
East parcel **(**ID # 4350154- *formerly TR43006*) – 40.6 acres
Total: 99.6 acres

1999 VT Mapping Program basemap orthophotos for the site are #192256 and #196256

Property Description

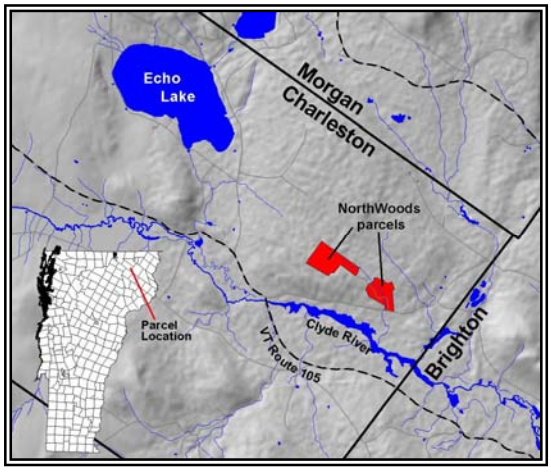


Figure 1: Location of parcels

The two parcels currently owned by the NorthWoods Stewardship Center are located in northeastern Vermont, in the headwaters of the upper Clyde River watershed. They lie in the eastern corner of the town of Charleston (Orleans County), near the Brighton town line (also the Essex County line).

The east parcel (40.6 acres) occupies a gentle south-aspect slope from 1,210-1,360 feet in elevation and is bounded to the south by the gravel Ten Mile Square Road. It is 83% forested, with the remaining land containing open fields, the NorthWoods main facility, and staff cabins. Access roads and multi-season public trails also cross this parcel.

The west parcel (59.0 acres) is located at a slightly higher elevation (1,390-1,520 ft), with variable topography that includes a small hardwood ridge and the lower wetlands and drainage associated with the Lang Brook headwaters. It is completely forested and is crossed by the Center's longest loop trail. Known as the Echo Lake Connector, this trail also provides access from the east parcel and is legally bound to NorthWoods through a deeded right of way, with the exception of a short stretch that crosses a neighboring property.

Bedrock

Bedrock affects forest management through its influence on access, topography, water movement, and the forest nutrient budget. The gradual weathering of bedrock supplies nutrients critical to tree growth and health – and the rate and quality of nutrients supplied depend in part upon bedrock type. Bedrock beneath the NorthWoods parcels is entirely granitic, part of the large Echo Lake pluton, and contains mostly quartz and feldspar. This rock yields little calcium, magnesium or other minerals important for plant growth due to the nutrient composition of its minerals and their hardness, which slows weathering. Another consequence of low calcium content is a reduced ability to buffer the acids that are created by decomposition and rainfall, resulting in somewhat acidic soils.[1]

[1] Average pH of rainfall at the nearby NorthWoods Stewardship Center is 4.9 (with a low measurement in July 2005 of 3.9). Soil pH averages 5.3, with a range of 4.7 to 6.4 (NorthWoods 2006).

Though some areas are slightly enriched through seepage of groundwater, the combined effects of granitic bedrock and acid precipitation could increasingly limit macronutrient availability to trees in many parts of the site. Tree tops and branches under 4"diameter (which hold a high proportion of the nutrients) should be left in the woods and stands should be monitored periodically for signs of declining tree health.

Soils

Overlying the bedrock are three broad classes of glacial-till derived soils, ranging in depth from 10 to over 60 inches. The best-drained soils (fine sandy loams of the Tunbridge-Lyman complex) are found in the upper elevation ridge areas of the west parcel, where scattered bedrock outcrops can be seen. These areas are moderately well suited to forestry and support a northern hardwood natural community type with a high beech component (white in figure 2).

Mid-elevation slopes on both parcels occupy moderately well drained Tunbridge-Dixfield soils with sandy loam and fine sandy loam textures (yellow in figure 2). Well suited to forestry, these soils best support northern hardwood natural communities. When cleared of surface stones, they also become suitable for agriculture, and where this has occurred on the east parcel (the plantation area) these soils are ranked as Statewide ag soils. A land use history of farming and some tree planting in these areas has resulted in forest cover types with an artificially high component of conifers (mostly red pine, white pine, balsam fir, and white and red spruces).

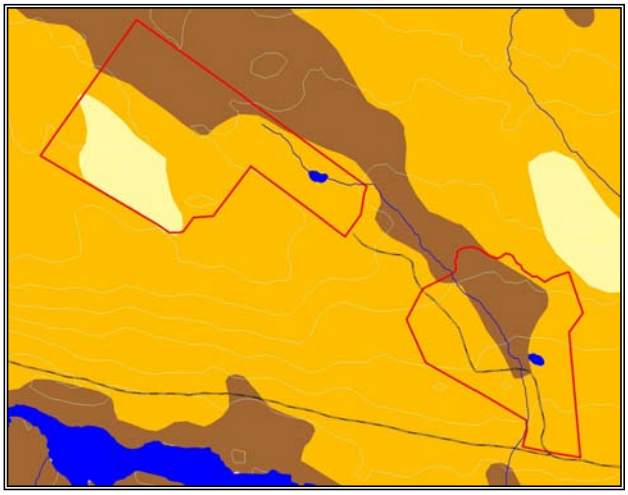


Figure 2: Broad Soil Types

Finally, soils in upper Lang Brook drainage are poorly drained Cabot silt loams (brown in figure 2). These are shallow to a dense basal till, resulting in seasonally high water tables and limitations both for equipment and tree growth. Windthrow potential is high, as well as danger of root damage and soil compaction from heavy equipment use. Equipment should be operated in these areas only in frozen ground conditions. Trees on the type generally grow more slowly and must be well adapted to a seasonal high water table to prosper. Suitable species include balsam fir, red spruce, northern white cedar, tamarack, red maple, and black ash.

Hydrology

Lang Brook, a small intermittent stream named for the family that first settled the site, is the most noticeable hydrological feature. Emerging from headwater wetlands on the west parcel, this brook meanders gradually to a small beaver pond, before descending more rapidly through the east parcel and emptying into the Clyde River. The Lang Brook headwaters area (occupying much of stand 3) is recognized by the State of Vermont as a Class 2 significant wetland. Special management considerations resulting from this designation are described in the stand 3 summary portion of the management plan. A vernal pool located in stand 4 is also addressed in more detail in the stand summary.

Ecological Values
The parcels are contiguous with a large block of forested habitat that is minimally fragmented and protected from future development. Factoring in Current Use and conservation easement protections on adjacent properties, this macro-site occupies the western edge of nearly continuous core habitat linking the large public and timber investment ownerships of the Nulhegan Basin to the shores of Echo and Seymour Lakes and the Clyde River. This connectivity accommodates the seasonal movement patterns and large home ranges of large mammals such as black bear, bobcat, moose, and fisher, all of which regularly utilize the site. On a more localized scale, two high value habitats located in stand 4 are a vernal pool and a beech stand with a history of utilization by black bears. These features and recommendations for their protection are described in more detail in the stand 4 description.

Two structural forest components that are lacking on the ownership are snags and downed woody material. These elements provide a suite of important benefits including wildlife habitat, soil organic matter, carbon storage, sites for nitrogen-fixing bacteria and mychorrizhal fungi, nurse logs for seedlings, and water storage. Decades of intensive high grading in the forest have resulted in low volumes of large diameter dead wood- both standing and on the forest floor and multiple cutting cycles will be required to re-introduce this material. Based on existing studies in the Northern Forest region, an appropriate target range for downed woody material in mixed stands is 350-900 ft^3/acre. Our only current data for the site - collected in the recently thinned plantation where downed woody material was recently introduced, is 464ft^3/acre.

Current Snag Density (snags per acre)
(goal is at least two stems 12-18" and two stems >18")

	<12"dbh	**12-18"dbh**	**>18"dbh**	***Total***
hardwood	12	2	0	*14 (42%)*
softwood	17	2	0	*19(58%)*
	29	***4***	***0***	***33***

Current snag densities (see above table) are variable between stands, but are low overall in the upper size classes. As the forest grows, existing snags and downed logs should be retained, and new ones recruited – particularly in the larger size classes. Hollow trees and logs are particularly valuable for wildlife and should be marked and retained in all future management work.

Forest Condition, History, and Management Priorities
Twenty-one (21) species of trees were observed in the course of field surveys conducted in 2005. Twenty of these are summarized in the table below by parcel-wide relative abundance (% BA) and average volume per acre. A single Scots pine was also noted in the plantation area.

For its relatively small acreage, the ownership encompasses a diversity of forest types, including pine plantation, northern hardwood, and mixed forest. Overall, softwoods make up two thirds of the stocking, due mainly to a combination of the pine plantation and an abundance of balsam fir across the acreage. Balsam fir and the three main plantation species (white pine, red pine, and Norway spruce) together comprise over 60% of total stocking. Although smaller in acreage, hardwood forests on the parcels offer several unique and important wildlife habitats, including a large vernal pool and a ridge with a grove of bear-scarred beech.

Age and size classes on the ownership are less diverse, with even-aged forest structure and smaller size classes dominating. As a result of a history of intensive human use, every part of the

ownership has been impacted by either a major logging event or agricultural use within the past half century. Most recently, the forest surrounding the NorthWoods main facility was logged heavily in the mid 1980s. Earlier events included heavy logging of the west parcel in the late 1960s and conversion of former hayfield to plantation pine on the east parcel around 1960.

Since the 1960s, the parcels have changed ownership independently several times, joining under NorthWoods Stewardship Center ownership in 2004. NorthWoods began using this land base for educational programs, forest research, and public recreational trails in 1989. Updated UVA management plans for the east parcel (then owned by Bill Manning and Pat Moyer) were compiled by forester David McMath and NorthWoods staff member Jayson Benoit in 2000 and 2003.

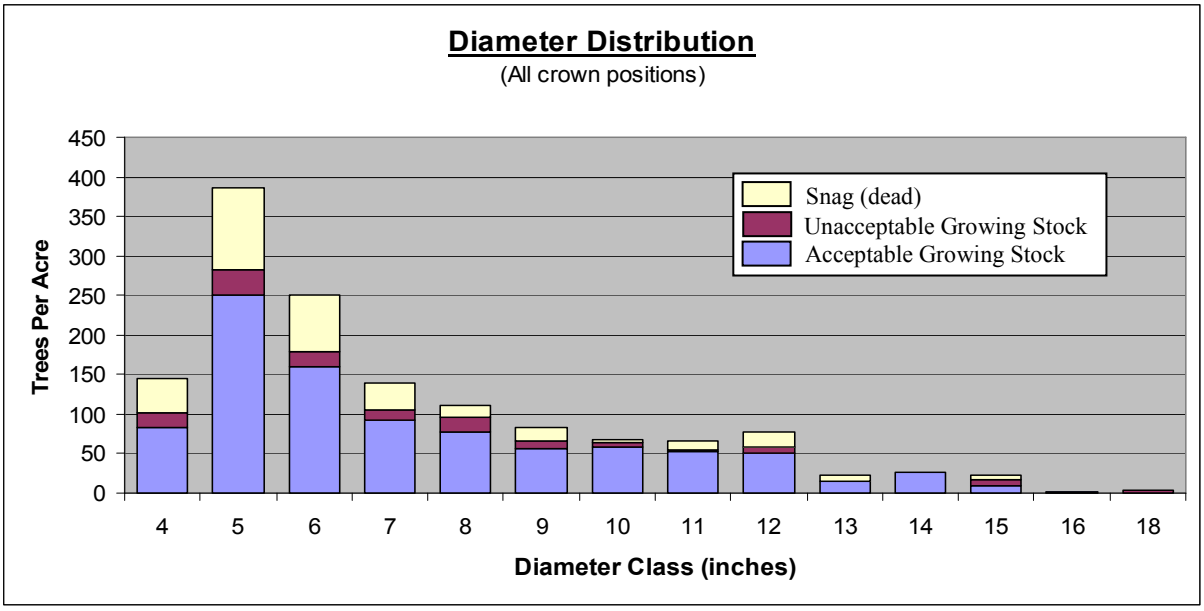
Mean Per-Acre Volumes By Species and Products

Group	Species	% BA	Veneer (bf)	Sawlog (bf)	Pulp (cds)	Cull (cds)	Total Cords	AGS Saw
Hardwood	Sugar Maple	8.1%	0	888	5	1	7	813
	Yellow Birch	7.7%	0	71	4	0	4	71
	Red Maple	6.3%	0	254	3	0	4	254
	Paper Birch	2.4%	0	0	2	0	2	0
	American Beech	2.3%	0	235	2	0	2	235
	Black Cherry	1.8%	0	0	1	0	1	0
	Quaking Aspen	1.1%	0	131	1	0	1	131
	White Ash	0.8%	0	0	0	0	0	0
	Grey Birch	0.7%	0	0	0	0	0	0
	Pin Cherry	0.5%	0	0	0	0	0	0
	Striped Maple	0.4%	0	0	0	0	0	0
Hardwood Total		**32.2%**	**0**	**1,579**	**17**	**1**	**21**	**1,504**
Softwood	Balsam Fir	19.1%	0	1,095	12	0	14	1,095
	Norway Spruce	11.8%	0	1,596	8	0	12	1,596
	Red Pine	11.7%	0	3,945	6	0	14	3,945
	White Pine	10.8%	0	2,702	5	0	11	2,397
	White Spruce	6.1%	0	525	4	0	5	525
	N White Cedar	3.8%	0	323	2	0	3	268
	Red Spruce	3.1%	0	91	1	0	2	91
	Tamarack	0.8%	0	0	0	0	0	0
	Eastern Hemlock	0.6%	0	126	0	0	0	126
Softwood Total		**67.8%**	**0**	**10,403**	**38**	**1**	**60**	**10,043**
Grand Total		**100.0%**	**0**	**11,981**	**55**	**3**	**81**	**11,546**

Little intermediate improvement work has been done in the site's forests, with the exception of the plantation. This area has seen fairly intensive management and, at 45 years old, is currently undergoing a third thinning, incorporating several experimental ecological forestry techniques to improve biological diversity and natural forest characteristics. The remaining three stands include large areas of overstocked large saplings and pole timber, with some dieback resulting from these high densities (see Diameter Distribution chart below).

To improve the health, structure and quality of the ownership's forests, intermediate activities are scheduled for each of the four stands over the ten-year period covered by this management plan (2008-2017). These are largely pre-commercial cleaning and thinning activities, though they will also yield firewood for use at the Center's facilities. Silvicultural goals of these

thinnings will be to promote well-formed commercial shade-tolerant and mid-tolerant species, while reducing the proportion of intolerants, poorly formed individuals, and balsam fir. Ecological goals will be met by retaining snags and downed woody material, promoting minor tree species as up to 25% of total stocking, promoting important mast trees such as beech and serviceberry, and where possible, initiating a new cohort. The shift to uneven-aged management will be a gradual one and will be pursued more actively during the next cutting cycle, when average stand size and quality have increased.



The near-term implication for management will be a minimal economic return from timber revenues over the next decade as new trees emerge and existing trees respond to recent thinnings. The emphasis will need to be on improving species mix and stem quality by removing unfavorable trees, while maintaining the appropriate canopy density to promote only desirable new growth. This process will nevertheless offer a relatively steady supply of firewood, and will result in much improved long-term timber value and forest health in the decades to come.

Other work needs include surveying and marking of new property lines, road and bridge improvements, and signage to help interpret management activities to the public. A new forest-wide inventory will be needed in 2017, and a management plan update will be due to the Use Value Appraisal program by April 2018.

Management Schedule (2008-2017)

Stand	Year	Silvicultural Activity	Acres	Other Work
1	2009	Thinning from below	3	*Educational signage/ mark wildlife trees*
2	2010	Cleaning/ pre-commercial thinning	22	
3	2011	Cleaning/ pre-commercial thinning	36	*Bridge repair and access ROW from adjacent landowner*
4	2013	Cleaning/ pre-commercial thinning	27	
All	2012	Re-visit all stands and assess need for adjustments to plan	95	*Survey and blaze boundaries*
All	2017	Re-inventory property and submit management plan update to UVA	95	

Management Plan

Stand 1

Above: *Pre-thinning (2005)*
Below: *Same view post–thinning (2007)*

Overview:
Acres: 8.4
Current Forest Type: Softwood Plantation (Red Pine- White Pine – Norway Spruce)
Natural Communities: Northern Hardwood Forest
Site Class: I[2]

Soils: Fine sandy loams and sandy loams of the Tunbridge-Dixfield complex. These soils are moderately well drained and moderately deep (16-72" to bedrock or dense basal till). Seasonal high water tables in some areas reach to within 18"of the surface. Somewhat vulnerable to erosion. Ranked as a "Statewide" agricultural soil.

Stand Description & History:
Stand 1 occupies a moderate south-facing slope on the east parcel and is dominated by red and white pine plantation, with a more localized component of Norway spruce.

Located at mid slope on the north side of the Clyde River valley, this stand has a long history of use by human inhabitants. Less than 400 ft. south of the stand are the remains of a homestead first settled by Jacob Lang in 1828. By 1850, forty acres (including all of stand 1) had been cleared and were being farmed by Jacob's son Andrew. The farm at that time included 12 sheep, 2 swine, 9 cattle and 2 horses and was producing wheat, oats, corn, potatoes and maple sugar (U.S. Agricultural Census).

Over the later half of the 19th century, Andrew Lang worked this land to become one of the most successful farmers and entrepreneurs in Charleston, eventually co-owning several nearby starch factories and sawmills. By 1870 his farm was among the most productive in the town, producing most notably 1,800 lbs of butter and 5,600 bushels of potatoes. This potato production along represented more than a third of the amount grown in Charleston that year and probably occupied about 18 acres of land.

In 1908, only six years after Andrew Lang's death, his son Adelbert ("Bert") Lang built a 100-foot diameter round barn built at the homestead site along Ten Mile Square Road, very similar in construction to the still-standing Robillard barn in Irasburg. Although the property left the Lang family a year later and the round barn burned in 1918, the land continued to be farmed off and on and

[2] Site classes were delineated using a combination of NRCS soil mapping and field observations of plant communities, soil characteristics, tree growth form, and tree cores/ height measurements made during 2005 field surveys.

was acquired by Bert Lang's stepson Will Gardner in 1920. Following in the spirit of his step-grandfather, Will successfully raised a large family through the depression by working the land for timber and crops and succeeding at various entrepreneurial ventures.

Between 1959 and 1961 Will (then in his mid 70s) had most of his fields planted in red pine, white pine, and Norway spruce, including what is now stand 1. Brendan Whittaker, who assisted in this planting as County Forester, remembers that some red pine nursery stock in Vermont was later grown from native red pines in Island Pond, but that the stock planted on this site was probably non-native.

In 1984 Bill Manning and Pat Moyer, founders of what is now the NorthWoods Stewardship Center, purchased the property from the late Will Gardner estate. In 1986 the site's first management plan was completed by forester Ross Morgan, the property was enrolled in the Current Use program, and the plantation north of the Ten Mile Square Road (including this stand) was row thinned, with every third row removed. Agricultural Stabilization and Conservation Service (now NRCS) cost share funds were received for this thinning, which treated all 25 acres of the original plantation. Several years later Manning began to develop the site for educational programming, building a ropes course and log cabin within the stand and several stick-frame cabins nearby. A second row thinning took place in 1994. The goal of the row thinnings was to bring the stand from 210 sq ft of basal area in 1986 to 110 sq ft through 2 thinnings. The 1994 thinning removed roughly 9,000 bd ft and 30 cords of red pine and more thinning in 1995 removed roughly 3500 bd ft and 14 cords of red pine (per UVA conformance reports).

Since this time, as the NorthWoods Stewardship Center has grown and broadened its programming, the stand has seen steady use by school groups and by the general public and adult groups (ski trails). In 1999 several permanent forest inventory plots were installed as part of NorthWoods' Ecosystem Management Project and more plots were added and surveyed in 2005. Due to the stand's unique character and proximity to the Center, other annual ecological monitoring surveys were also initiated between 1998 and 2007, most notably bird surveys and small mammal surveys.

By 2003, canopies in the stand were closing again due to a good growth response from the 1994 thinning. To optimize the educational opportunity and best achieve the Center's management goals, several demonstration treatments were planned. These included (1) thinning from below and leaving large diameter downed woody material on the ground, (2) a quarter-acre patch cut to release a patch of advanced hardwood regeneration, and (3) a traditional thinning from below where all merchantable material would be removed.

Left: Pre-thinning (2006) **Right:** Same location post-thinning

In early 2004 NorthWoods purchased the property from Bill Manning and Pat Moyer, and in the winter of 2005 roughly a third of the stand was thinned using a 4WD tractor with winch. Another third of the stand was thinned/ harvested the following winter and the final third is now marked for a 2008/2009 thinning. Thinned areas were reduced from roughly 190 sq.ft. of basal area to 133 sq. ft., with 120 sq. ft. of the residual stocking being acceptable.

Silvicultural Information[3]*:*

Stand Type: Softwood (S3A)
Cruise Intensity: 5 plots (1 plot per 1.7 acres)
Age Class Distribution: Even (46 years)
Regeneration: Currently understocked, with 543 stems per acre of desirable species (mostly black cherry, with lesser amounts of red maple, sugar maple, and quaking aspen). Small patches of mixed hardwood regeneration can be found along a former pasture fence line and in several small areas under canopy gaps.

Note: The data presented below was collected prior to the 2005-2006 thinnings.
Overstory Stocking Level: well-stocked **Canopy cover/ height:** closed to patchy/ 70 feet
BA per Acre: 150 sq ft **AGS BA per Acre:** 129 sq ft (86%)
Trees Per Acre: 308 (AGS- 212)
Quadratic Mean Stand Diameter: 9.6" (AGS- 10.6")

Per Acre Volume By Species and Product (live stems over 4"dbh)

Group	Species	% BA	Veneer (bf)	Sawlog (bf)	Pulp (cds)	Cull (cds)	Total Cords	AGS Saw
Hardwood	*Black Cherry*	1%	0	0	0	0	0	0
	Other Hardwoods	2.3%	0	0	0	0	0	0
Hardwood Total		**2.4%**	**0**	**0**	**0**	**0**	**0**	**0**
Softwood	*Norway Spruce*	29.5%	0	1,596	8	0	12	1,596
	Red Pine	29.1%	0	3,945	6	0	14	3,945
	White Pine	24.5%	0	2,702	5	0	10	2,397
	White Spruce	9.9%	0	347	2	0	3	347
	N White Cedar	2.3%	0	0	1	0	1	0
	Balsam Fir	1.4%	0	0	1	0	1	0
Softwood Total		**96.7%**	**0**	**8,589**	**22**	**1**	**40**	**8,284**
Grand Total		**100%**	**0**	**8,589**	**23**	**1**	**40**	**8,284**

Stand Health/ Quality:

- *Tree form and health:* Fair to excellent. Trees had become crowded in some areas prior to thinning, so some released canopies are smaller than optimum. A higher number of poorly formed stems remain in the un-thinned area and will be removed in the planned thinning.
- *Disease/Damage:* Some evidence of blister rust and minimal stem damage from past thinnings.
- *Other:* A small number of stems have been girdled from ropes course attachments. Also, exotic herbaceous plants are found in higher abundance here than elsewhere on the property.

Access/ Operability: Excellent access from the NorthWoods cabin loop (gravel). Maximum skid distance to the gravel landing area is 700 feet. Some limitations for larger truck access due to the narrow bridge crossing Lang Brook. Due to a seasonal high water table to 1.5 feet below the surface, logging should be limited to late summer/ early fall or, preferably, to frozen ground conditions.

Ecological and Social Values:

Snags and Downed Woody Material: As is commonly true in intensively- managed plantations, snags are rare in this stand, especially in the more important >12" dbh size classes. Prior to the 2006-

[3] See Appendices A and B for explanations of sampling methods and the data presented in this section for each stand.

2007 thinnings, large diameter cull trees were identified with flagging and left to grow (for snag recruitment purposes), on the order of 1-2 per acre. Future thinnings should retain these trees and identify at least four future snags per acre on average. Hardwood snags and downed woody material will remain unavailable until these species are re-established in the stand.

Downed woody material (DWM) was not sampled prior to the most recent thinning, though visual estimates and photo records suggest an average volume per acre of less than 100 ft^3 (stems >3"). Sampling after the 2006-2007 thinnings recorded a stand average of 464 ft^3/ac of DWM over 9 plots (range of 0-1430 ft^3). By comparison, studies at other locations have measured 360-860 ft^3/acre of DWM in managed hardwood stands and up to 2860ft^3/ac in old-growth forest.

Snags Per Acre: *(goal is at least two stems 12-18" and two stems >18")*

	<12"dbh	12-18"dbh	>18"dbh	Total
Hardwood	5	0	0	5
Softwood	24	0	0	24
Total:	**29**	**0**	**0**	**29**

Unique and/or Fragile Natural Communities: N/A

Plants: Prior to thinning, the understory was sparse, with scattered native species including red raspberry, black raspberry, lowbush blueberry, Canada mayflower, one-flowered pyrola, and exotic herbs such as orange hawkweed, common speedwell, dandelion, and helleborine. The exotics have increased slightly in abundance following the thinning, though no invasive species have yet been noted.

Wildlife: The most notable vertebrate in stand 1 is clearly the red squirrel, which makes good use of the concentration of pine and spruce seeds. Deer also commonly traverse the stand, though understory cover is limited. Bird surveys conducted since 1998 in the stand have identified black-capped chickadee, American robin, yellow-rumped warbler, golden-crowned kinglet, red-breasted nuthatch, and blue-headed vireo as the most abundant species. A wild turkey nest was also encountered in logging slash following the 2005 thinning.

In August 2007 small mammal surveys were initiated in stand 1 to measure the impacts of downed woody material (DWM) and hardwood regeneration on species composition and richness. Though preliminary, results supported the hypothesis that increasing DWM and saplings in this barren understory may result in an increase in small mammal diversity. Specifically, the survey yielded five species (2 shrews, 2 voles, and red squirrel) in areas with fresh DWM and saplings, and only one species (red squirrel) in adjacent plantation without these habitat features. Surveys will be continued in the coming years to better explore changes in the small mammal and bird populations following management in the stand.

Recreation/ Education: Cross-country ski trails are maintained through the stand, as is a high/low ropes course and several group initiative events. The NorthWoods Adirondack lean-to, used by visiting groups for camping, is located at the upper edge of the stand. This forest is also frequently used by NorthWoods education staff for on-site lessons with students of all ages. Current and future management will seek to balance these goals mainly by using management as a vehicle for teaching about forest stewardship, and by prioritizing aesthetical and access values in the ropes course area.

Water Quality/ Wetlands: Stand 1 is bordered on the east by Lang Brook, which despite its small size is known to support a diverse aquatic community, including brook trout, mink, northern two-lined and spring salamanders, and many aquatic invertebrates. A 50-foot forested buffer will be maintained (where it currently exits) to provide shade and to limit runoff. Operation of equipment within this zone will be discouraged, and minimal A-line stocking will be maintained.

Special Considerations: None

Silvicultural Plan:
Management Age Class System: Even **Cutting Cycle:** 10 years

Long Range Goals: Intensive use of the stand for NorthWoods programs requires several overlapping long-range goals, with distinct management approaches. In the ropes course area (east end of the stand) management will prioritize tree health, aesthetics, and safe and easy access for groups. This will be achieved by frequent light thinnings to maintain large canopies on the crop trees, which will be retained as long as their health permits (possibly another 150+ years). Depending upon the goals of a future NorthWoods board of directors, this area may then be regenerated back to pine, or allowed to return to a more natural mixed hardwood forest.

The remainder of the stand will be managed as a demonstration forest, illustrating the process of gradually transitioning a softwood plantation back to an uneven-aged northern hardwood forest. This process will require multiple entries to complete, though each entry will seek to re-introduce missing elements of natural forest structure.

The current forest has only recently reached commercial size, so the emphasis will remain on crop tree canopy release for at least 4 more entries, with a target diameter of 18-24 inches. During each thinning entry, ecological goals will be met by recruiting large-diameter future wildlife snag trees and by increasing downed woody debris – particularly in the larger (>12") diameter classes. This process was initiated in the most recent thinnings. In addition, shade tolerant northern hardwood tree species will be gradually re-established to the stand by creating a small ($1/10^{th}$-1/4 acre) opening during every other entry to promote regeneration of these species. This process was begun in the 2006 entry with a ¼ acre overstory removal in an area of advanced mixed hardwood regeneration. The resulting uneven-aged forest will be managed for high-quality sawlogs and species diversity for educational purposes, using the single-tree selection method with target diameters of 18-22"dbh.

Planned Management Practices: Finish the low thinning that was initiated in 2005, selecting poorly formed, unhealthy, and smaller stems, with a target residual BA of 110-120 (on the higher end for areas dominated by white pine). Products from this entry will be cabin logs down to 9" and pulp down to 4". Other slash may need to be piled to permit access and movement within the ropes course area. After this thinning is completed, the stand will be left to grow for ten years and then re-evaluated.

Stand 2

Overview:
Acres: 21.6
Current Forest Type:
Yellow Birch- White Ash- Balsam Fir
Natural Communities: Red Spruce-Northern Hardwood Forest
Site Class: II

Soils: Two broad soil types dominate. In the northwest corner of the stand and along the east side soils are moderately well drained Tunbridge-Dixfield fine sandy loams. These soils are well suited to forestry, and support a Northern Hardwood Forest community type. The central part of the stand (along and northeast of Lang Brook) is characterized by poorly drained Cabot silt loam soils, which are less well suited to forestry. The seasonal high water table in these hydric soils often reaches the surface and common natural communities are Lowland Spruce-Fir Forest, Northern White Cedar Swamp, Alder Swamp, and Spruce-Fir-Tamarack Swamp. Both soil types are very stony.

Stand Description: Stand 2 includes all parts of the east parcel falling outside of the plantation and the 5-acre building exclusion area. A quarter of the stand area is made up of the lower and upper meadows, which are managed as grassland and orchard for wildlife, education, and recreational purposes. The forested portion of the stand can be summarized broadly by two conditions, influenced largely by soil types and land use history.

Condition 1: The area west of Lang Brook (lying mainly on either side of the upper meadow), is mixed forest with a combination of age classes and a canopy with a high proportion of red and white spruce, balsam fir and white pine. Until the 1960s, this area experienced the same land use as described for stand 1 (namely agricultural use beginning around 1840). In 1961, when stand 1 was planted in pine, this part of stand 2 likely continued to be used as pasture. Later, it was gradually re-colonized by a variety of pioneer species, including the many conifers that have now reached pole to small-sawtimber size classes. Subsequent patchy logging, most likely in the early 1980s, created a younger age class of mixed species scattered among the older trees. This area is also crisscrossed by a variety of trails and campsites, used by visitors to NorthWoods and for educational programs. Areas with dense regeneration would benefit from pre-commercial cleaning to release the more desirable stems, especially if volunteer or low-cost labor could be used to complete this work.

Condition 2: Forested areas east of Lang Brook show more of an influence from past logging than from agriculture. Although this area was most likely also used at one time for pasture, the majority had returned to mixed forest by 1940. About 1985 the area was heavily high-graded, reducing stocking to well below the C-line. The resulting regeneration is a mix of conifers and broad-leaved hardwoods in the Cabot soils (west of Leadership Trail) and slightly more developed northern hardwoods in the better-drained eastern area. Several skiing and walking paths also cross this area. The forest in condition 2 areas is in the early stage of transitioning from sapling to pole size-class and is overstocked in some areas, with many stems that are poorly formed (especially stump sprouts) or of non-commercial species. In these overstocked areas it would benefit from a light pre-commercial cleaning, with the goal of releasing the highest quality stems of commercial species.

Silvicultural Information:

Stand Type: Mixed (HS1-2A/B)
Cruise Intensity: 10 plots (1 plot per 2.2 acres)
Age Class Distribution: Even (24 years)
Regeneration: 3,050 stems per acre (93% of these are desirable species). 43% of subplots were stocked with regeneration of commercial species. Overall, the stand is somewhat overstocked in the 2-4" size class.

Note: The stocking and volume data presented below refer only to stems >4"dbh. Because stems less than 4"dbh are abundant, actual stocking is higher than reported here and was not captured in the variable radius plot sampling (see regeneration description above).
Overstory Stocking Level: under-stocked
Canopy cover/ height: closed to somewhat patchy (40-60 feet)
BA per Acre: 55 sq ft **AGS BA per Acre:** 37 sq ft (67%)
Trees Per Acre: 217 (AGS- 144)
Quadratic Mean Stand Diameter: 7.0" (AGS- 6.9")

Per Acre Volume By Species and Product (live stems over 4"dbh)

Group	Species	% BA	Veneer (bf)	Sawlog (bf)	Pulp (cds)	Cull (cds)	Total Cords	AGS Saw
Hardwood	*Yellow Birch*	17.9%	0	71	0.5	0.2	0.8	71
	White Ash	9.0%	0	0	0.3	0	0.3	0
	Red Maple	7.5%	0	0	0.2	0	0.2	0
	Quaking Aspen	6.0%	0	131	0.4	0	0.7	131
	Black Cherry	4.5%	0	0	0.1	0	0.1	0
	Paper Birch	4.5%	0	0	0.3	0	0.3	0
	Other Hardwoods	3%	0	0	0.1	0	0.1	0
Hardwood Total		**52.2%**	**0**	**202**	**2**	**0.3**	**3**	**202**
Softwood	*White Spruce*	13.4%	0	0	1.2	0	1.2	0
	Balsam Fir	11.9%	0	105	0.6	0	0.8	105
	N White Cedar	9.0%	0	323	0.9	0	1.6	268
	Tamarack	4.5%	0	0	0	0	0	0
	Eastern Hemlock	3.0%	0	126	0.1	0	0.4	126
	Red Spruce	3.0%	0	91	0.2	0	0.5	91
	White Pine	3.0%	0	0	0.3	0.4	0.6	0
Softwood Total		**47.8%**	**0**	**645**	**3**	**0.43**	**5**	**590**
Grand Total		**100%**	**0**	**846**	**5**	**0.76**	**8**	**791**

Stand Health/ Quality:

- *Tree form and health:* Fair to good. The main concerns are poor form and small canopies in saplings from stump sprouts and high stocking. Some larger softwoods in the former agricultural areas also have an open growth form with large lower branches.
- *Disease/Damage:* None noted.
- *Other:* Some girdling of red maple saplings by snowshoe hare. Rutting from 1980s logging still clearly visible throughout stand. Windthrow fairly common in Cabot soil areas.

Access/ Operability: Variable. All parts of the stand are within 300 feet of an access trail or one of

the meadows, which can be used as landings. The frequency of perched water tables nevertheless limits access to frozen ground conditions.

Ecological and Social Values:

Downed Woody Debris: Not sampled. Based on field observations, downed woody debris is sufficient in diameters below 12" but lacking in the >12" diameter sizes.

Snags Per Acre: *(goal is at least two stems 12-18" and two stems >18")*

	<12"dbh	12-18"dbh	>18"dbh	Total
Hardwood	0	2	0	2
Softwood	14	0	0	14
Total:	**14**	**2**	**0**	**16**

Unique and/or Fragile Natural Communities: N/A

Plants: Plant diversity and abundance is variable in the stand, depending upon canopy cover and soil moisture. In moist areas with canopy gaps, the diversity in both the shrub and herb layers is high. Widespread shrub species include wild raisin, mountain ash, beaked hazelnut, mountain holly, and alternate-leaved dogwood. Common forbs include New York fern, long-beech fern, Canada mayflower, foamflower, goldthread, rough-stemmed goldenrod, various Rubus species and starflower. Exotic species are notably less common than in stand 1 and no invasive species were noted.

Wildlife: Three habitat features in the stand offer a unique attraction to a variety of wildlife. A long pool in the northeast corner, deepened with equipment around 1992, serves as an amphibian breeding pool every spring and a concentrated food source for other wildlife. Egg masses and/or vocalizing males of spring peeper, green frog, American toad, spotted salamander, and wood frog have been observed here annually for the past decade.

Other important habitat values are provided by Lang Brook. Northern two-lined salamanders, spring salamanders, many species of stream invertebrates, and mink are among the diverse wildlife attracted to the Lang Brook riparian corridor.

Finally, the patchy, moist, mixed conifer/deciduous forest that characterizes the western half of the stand provides the unique combination of cover and food resources that attract a suite of species including American woodcock, snowshoe hare, bobcat, white-throated sparrow, veery, hermit thrush, Nashville warbler, and Canada warbler. Most of the bird species listed here are experiencing region-wide declines, most notably the Canada warbler. This species benefits from moist forest with a mixture of softwoods and hardwoods, some super canopy trees, some canopy gaps, and a well developed shrub layer.

Recreation: Several cross country ski trails and walking paths, maintained for public and visiting group use, crisscross the stand. Tent campsites are also located in the western part of the stand around the upper meadow area.

Water Quality/ Wetlands:. Lang Brook, though small and intermittent in drought years, is a relatively healthy stream, important to wildlife, and valuable for education and aesthetics. Soon after leaving the property, this brook also drains directly into the Clyde River wetlands at an S2-ranked

intermediate fen natural community. During future management activities a riparian buffer of at least 30 feet on either side of the stream will be retained to minimize erosion and preserve water quality. Very minimal tree removal will occur within this zone, maintaining stocking at or above the A-line. Stream crossings and other activities will conform to Vermont's Acceptable Management Practices for Water Quality.

Special Considerations: Windthrow is a concern due to moist soils.

Silvicultural Plan:

Management Age Class System: Uneven **Cutting Cycle:** 10 years
Diameter Objectives: 18- 20" for sugar maple, yellow birch, and red spruce; 14-16" for white ash and other hardwoods; 12-15" for balsam fir

Long Range Goals: The primary goal for this stand is the production of high quality sawlogs in a manner that maintains long-term forest health and is sensitive to the educational and recreational uses. Small diameter and cull materials removed in each entry will also provide firewood for NorthWoods facilities. The existing patchy but moderately well-stocked status of the stand and its moist soils support a gradual shift to uneven-aged management, though adequate stocking in the larger diameter classes will require multiple cutting cycles to achieve.

The current focus should be on pre-commercial tending operations in the existing overstocked sapling areas, with the goal of improving stem quality and promoting existing well-formed commercial species, especially shade-tolerant and mid-tolerant types. The cost of these operations can be off-set by utilizing volunteer labor or by enrollment in cost share programs, and other benefits can be gained by integrating them with NorthWoods educational programs and helping to meet the annual NorthWoods firewood demand. After one more cutting cycle, new age classes can be introduced during each entry using the single tree and small group selection systems. Marking should promote red spruce, yellow birch and white ash as primary crop trees, with a minor component of other on-site species (northern white cedar, balsam fir, red maple in wetter areas; sugar maple and black cherry in drier ones). Location of groups will be governed in part by variations in topography and soil moisture, to mitigate the threat of wind throw, and in part by the distribution of desirable stems. The overall structural goal will be q=1.5, with a maximum diameter of 22".

Planned Management Practices: Cleaning operation in overstocked areas to release well-formed stems of the desirable species listed above. Residual stocking should be at least 350 stems per acre. The next entry will likely need to occur between 2018 and 2022, and will focus on additional improvement tending and initiating a new cohort in small groups.

Stand 3

Overview:
Acres: 36.3
Current Forest Type: Red Spruce- Balsam Fir *(variation with significant mixed hardwood component)*

Natural Communities: Red Spruce- Northern Hardwood Forest, Northern White Cedar Swamp, Lowland Spruce-Fir Forest

Site Class: II (some I)

Soils: Cabot silt loams dominate the northern part of the stand and field evidence suggests that these hydric soils also extend well into the central part of the stand (contrary to NRCS mapping). Dense basal till is close to the surface, resulting in a seasonal high water table at or within 16" of the surface. Textures are silt loams near the surface and fine sandy loams below.

Southern and eastern parts of the stand overlie Tunbridge- Dixfield complex soils. These are moderately deep and moderately well drained. They are generally well suited to forestry, though seasonal high water tables in Dixfield soils can reach within 16" of the surface. Textures are fine sandy loams and sandy loams.

Above: Southeast mixed woods.
Below: Central young spruce/fir forest

Stand Description: Stand 3 occupies the Lang Brook headwater region and is typified by gradual slopes, moist soils, and a cover type of balsam fir and red spruce with a mixed hardwood component. The northwest area is a broad flat, perched valley, with forest along the property line grading into the northern white cedar type that is more extensive across the line. Much of the rest of the stand is dense pole-sized spruce-fir or mixed forest, with a closed canopy interrupted by scattered open sedge-dominated seepages. In the southeast area, slopes increase and Lang Brook flows through a beaver flowage and mixed hardwoods, dominated by yellow birch/ red maple with red spruce and balsam fir.

Little is known about the early history of the stand, though evidence suggests that it was never used for agriculture. Aerial photographs from 1941 show an unfragmented forest with a major softwood component and fairly large canopies. The most recent logging of the stand was a heavy cut that took place between 1966 and 1969, when the property was owned by Poulin Pulpwood. Old stumps, skid ruts, and metal gas cans are still visible from this entry. This logging appears to have targeted the softwood component leaving a very scattered overstory of residual hardwoods- most concentrated in the eastern corner of the stand. In a 1985 management plan forester Richard Carbonetti reported a residual overstory basal area of 48 square feet and mean stand diameter of 7.6"dbh, though these data encompassed a much larger area than the current stand.

The heavy cutting of the late 1960s resulted in aggressive regeneration, most notably of balsam fir. No additional entries have taken place since that time, though the property has changed ownerships four times since 1968. In 2004 NorthWoods acquired the parcel from then board member Lydia Spitzer and NorthWoods founder Bill Manning. Ecological monitoring through fixed transects and point plots (of birds, large mammals, and forest vegetation) were initiated by NorthWoods beginning in 1999 and have been surveyed since that time.

Silvicultural Information:

Stand Type: Mixed (SH1-2A/B)
Cruise Intensity: 10 plots (1 plot per 3.6 acres)
Age Class Distribution: Even (30 years)
Regeneration: 2,580 stems per acre (2,510/ acre, or 97%, are desirable species); *well-stocked*
Stems captured in the regeneration surveys are mostly 1-4"dbh balsam fir (with lesser amounts of yellow birch, red spruce, and red maple) that originated from the regeneration cutting 35 years ago. Younger cohort regeneration is generally absent or understocked.

Overstory Stocking Level: well-stocked **Canopy cover:** closed
BA per Acre: 99 sq ft **AGS BA per Acre:** 76 sq ft (77%)
Trees Per Acre: 474 (AGS- 376)
Quadratic Mean Stand Diameter: 6.4" (AGS- 6.1")

Per Acre Volume By Species and Product (live stems over 4"dbh)

Group	Species	% BA	Veneer (bf)	Sawlog (bf)	Pulp (cds)	Cull (cds)	Total Cords	AGS Saw
Hardwood	*Yellow Birch*	12%	0	0	0.9	0	0.9	0
	Red Maple	11.4%	0	254	1.8	0.1	2.4	254
	Black Cherry	3.8%	0	0	0.3	0.1	0.4	0
	Grey Birch	3.2%	0	0	0.1	0	0.1	0
	Other Hardwoods	3.1%	0	0	0.2	0	0.2	0
Hardwood Total		**33.5%**	**0**	**254**	**3**	**0.2**	**4**	**254**
Softwood	*Balsam Fir*	48.1%	0	192	7.2	0	7.7	192
	Red Spruce	14.6%	0	0	1.2	0	1.2	0
	N. White Cedar	1.9%	0	0	0.6	0	0.6	0
	White Spruce	0.6%	0	178	0.2	0	0.6	178
	Other Softwoods	1.2%	0	0	0	0	0	0
Softwood Total		**66.5%**	**0**	**371**	**9**	**0**	**10**	**371**
Grand Total		**100%**	**0**	**625**	**12**	**0.2**	**14**	**625**

Stand Health/ Quality:

- *Tree form and health:* Fair to good. Canopy closure is limiting canopy size and has resulted in mortality in some areas. Also red maple stump sprouts are common.

- *Disease/Damage:* Minor. Evidence of trunk rot in some fir and butt rot (pileated woodpecker excavations).

- *Other:* Some windthrow observed, though this is limited due to the young age of the stand. Growth is slow in the wetter soils.

Access: Poor. The easiest access to the stand is via the Echo Lake Connector ski trail (NorthWoods holds a deeded Right of Way to use this trail). The nearest suitable landing area (NorthWoods' upper meadow) is at least 1,000 feet from the southeastern part of the stand. The northwest two thirds of the stand are less accessible, requiring two bridge crossings (needing repair) and travel through wet soils. The most distant (north) corner of the stand lies almost ¾ of a mile from the upper meadow landing area. Timber extraction would be improved through the use of a forwarder system.

Ecological and Social Values:

Downed Woody Debris: Not sampled. Based on field observations, downed woody debris is insufficient, particularly in the >12" diameter sizes.

Snags Per Acre: *(goal is at least two stems 12-18" and two stems >18")*

	<12"dbh	12-18"dbh	>18"dbh	Total
Hardwood	17	5	0	22
Softwood	22	5	0	27
Total:	**39**	**10**	**0**	**49**

Unique and/or Fragile Natural Communities: Northern White Cedar Swamp is an uncommon natural community type in Vermont. Areas in the northeast part of the stand regenerating in northern white cedar, and contiguous with cedar swamp on the Spitzer property, should be cultivated as this community type.

Plants: Plant diversity is low in much of the stand due to the closed canopy. Nevertheless, the understory includes an interesting mix of shrub and forb species, with boreal species well represented. Widespread shrub species include hobblebush, mountain ash, mountain holly, American honeysuckle, mountain maple, and striped maple. Common forbs are New York fern, long-beech fern, intermediate wood fern, Canada mayflower, goldthread, common wood sorrel, wild sarsaparilla, painted trillium, and the boreal herbs bluebead lily and shining clubmoss.

Wildlife: Mammal surveys conducted across the stand since 1999 have recorded a notable lack of activity through the regenerating balsam fir- red spruce forest. More species diversity has been noted along the ski trail, which is used as a wildlife travel corridor, and especially around the beaver pond along Lang Brook. Species using the trail include moose, coyote, bobcat, and black bear. Diversity is especially high at the beaver pond, where bird and small mammal monitoring has documented both high species richness and a high incidence of use for rearing young. Species confirmed to breed here include hermit thrush, rose-breasted grosbeak, three woodpecker species, wood frog, and spotted salamander. Other commonly observed species are golden-crowned kinglet, blackburnian warbler, black-throated green warbler, yellow-rumped warbler, red-backed vole, meadow vole, meadow and woodland jumping mice, and short-tailed shrew. Little brown bats also utilize the pond area during the summer months.

Recreation: The southern and eastern parts of the stand are crossed by public recreation trails maintained by NorthWoods and used mainly during the winter. These include the Echo Lake Connector trail (a 5-mile loop ski trail) and the beaver pond walking path.

Water Quality/ Wetlands: Almost all of stand 3 is influenced in some way by special hydrologic features, with a number of management implications. All but the eastern end of the stand is recognized by the State of Vermont as a Class II significant wetland, bringing the following

regulations into play regarding logging.

1) water flow in and out of the wetland cannot be impeded
2) logging activities must follow the Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont
3) equipment maintenance and storing of vehicles must be restricted to log landings, and
4) log landings must either be located in adjacent upland areas or, if located in the wetland area, must not involve fill and must be used only in frozen ground conditions.

For more complete reference prior to any management activities the Vermont wetland rules should be consulted. These can be found on-line at http://www.nrb.state.vt.us/wrp/publications/wetrule2002.pdf. Lang Brook also originates in and crosses the stand. During future management activities a riparian buffer of at least 30 feet on either side of the stream will be retained to minimize erosion and preserve water quality. Very minimal tree removal will occur within this zone, maintaining stocking at or above the A-line. Stream crossings and other activities will conform to Vermont's Acceptable Management Practices for Water Quality.

Special Considerations: Windthrow danger is a long-term concern in many parts of the stand and should influence choices regarding species selection and residual spacing.

Silvicultural Plan:

Management Age Class System: Uneven **Cutting Cycle:** 15 years

Diameter Objectives:

12-16"dbh ----- balsam fir
14-18"dbh ----- red maple, and red spruce
16-18"dbh ----- beech
18-20"dbh ----- sugar maple, white ash, yellow birch, hemlock
20-22"dbh ----- white pine

Long Range Goals: The primary goal for this stand is the production of high quality sawlogs in a manner that maintains long-term forest health and that is sensitive to recreational values along the existing trail system. The main objective, which will require multiple cutting cycles to achieve, will be to transition to an uneven-aged structure and a species composition with a lesser proportion of balsam fir and red maple and a higher proportion of red spruce, yellow birch, and other commercial species. Minor species well suited to the site and of special wildlife or NorthWoods facility use will also be promoted as up to 15% of the total stocking. Examples include tamarack, hemlock, northern white cedar, and black ash. Pulpwood is a low priority for this stand, as the difficult access will likely make it uneconomical to extract. Low-grade hardwood will be extracted for use as firewood at the NorthWoods facilities. The long-term structural goal is q=1.4.

Planned Management Practices: Canopies have closed in many parts of the stand and a pre-commercial cleaning/ thinning operation is needed to maintain forest health and to begin the shift toward more desirable species described above. Although uneven-aged management goals would suggest the need for group selection openings to initiate a new age class, the existing forest is still too young to ensure good seed production. This shift to uneven-aged structure should begin instead during the next entry – about 2023.

The pre-commercial thinning should be completed by 2012 and should reduce stocking by no more than 20% of the existing BA (99 sq ft now to 79 post-thinning). The residual stand should have an

average of 350 stems per acre. Marking should focus on retaining and releasing well-formed crop trees, prioritizing red spruce, yellow birch, northern white cedar, and to a lesser extent balsam fir. Where encountered, acceptable growing stock black ash, tamarack, and other minor species should also be retained as up to 15% of total stocking.

Cost share or grant funds should be investigated for this work, as the only likely product will be smaller diameter fuelwood for use on the NorthWoods site. Non-fuelwood material will be left on-site as downed woody debris.

Stand 4

Overview:
Acres: 27.0
Current Forest Type: Sugar Maple- Beech- Yellow Birch
Natural Communities: Northern Hardwood Forest *(standard and Beech-Red Maple-Hemlock Northern Hardwood Forest variant)*, Red Spruce- Northern Hardwood Forest, Vernal Pool
Site Class: II

Soils: Higher elevation, ridge areas of the stand are characterized by Tunbridge-Lyman fine sandy loams. These soils range from shallow (10") to moderately deep (40") to bedrock, though surface stone and even bedrock outcrops are not uncommon. They are well drained to excessively drained and are well-suited to equipment use, though tree growth can be inhibited by moisture limitations and thin soils.

Side slopes in west and northeast parts of the stand overlie Tunbridge- Dixfield fine sandy loams and sandy loams. These are moderately deep (20-40") and well drained, with some surface stone and bedrock outcrops. They are well-suited to forestry equipment use, but slope and erodibility can be limiting factors.

Stand Description: Stand 4 encompasses the ridge and side slopes of an unnamed prominence lying between the Clyde River and Tripp Hill, including the highest elevation on the NorthWoods parcels at 1,520 feet.

The "Echo Lake Connector" ski trail (maintained by NorthWoods) bisects the stand east to west. The forest south of this trail is nearly pure northern hardwoods, with a major component of bear-scarred beech on the dry ridge area and a sugar maple- beech- yellow birch- white ash mix in the adjacent gradual slopes. Descending north from the trail on east-facing slopes the hardwoods grade increasingly into a mixed forest, with red maple, yellow birch, balsam fir, and paper birch among the more common species.

For the first half of the 20th century, stands 3 and 4 were at the northeast extreme of a large (multiple town lot) ownership held by a sequence of farming families and were probably used as distant woodlots for the farm. The forest south of the ridge in stand 4 may have at one time been the upper part of a sugarbush operated by a farmer living along the Ten Mile Square road. No evidence of agricultural use has been found. A growth spurt recorded in the rings of a number of current canopy hardwoods suggests a possible thinning or natural disturbance around 1930. In 1941 most of the stand was forested in large-canopied hardwoods, with a conifer-dominated northern corner being the exception.

In 1966 Poulin Pulpwood acquired the property and during its three year ownership conducted a nearly property-wide liquidation cut. A patchy hardwood overstory (including beech, sugar maple and white ash) was left in much of stand 4, though the eastern part of the stand was clearcut. In a 1985 management plan, forester Richard Carbonetti reported 54 square feet of basal area (43 of this

acceptable) and a mean stand diameter of 10.6" for the stand.

No additional entries have occurred since logging of the late 1960s, although the property has changed ownerships four more times during this period. In the most recent transfer, NorthWoods acquired the property in 2004 from board member Lydia Spitzer and NorthWoods founder Bill Manning. Ecological monitoring through fixed transects and point plots (of birds, large mammals, and forest vegetation) were initiated by NorthWoods beginning in 1999 and have been surveyed since that time.

Silvicultural Information:

Stand Type: Mixed (M2-3B)
Cruise Intensity: 8 plots (1 plot per 3.4 acres)
Age Class Distribution: Even (37 yrs- with some overstory 75 yrs)
Regeneration: 1,426 stems per acre (1,290 per acre, or 38%, are desirable species)
Regeneration stocking is highest in the mixed portion of the stand north of the ski trail, and is 38% balsam fir, 10% red spruce, and 24% commercial hardwood species (sugar maple, yellow birch, American beech). Overall, regeneration is at moderate levels, but in the northeast portion of the stand the mixed regeneration is somewhat overstocked and would benefit from a light cleaning operation.

Overstory Stocking Level: moderately well-stocked
BA per Acre: 95 sq ft
Trees Per Acre: 295 (AGS- 205)
Quadratic Mean Stand Diameter: 7.7" (AGS- 6.5")
Canopy cover: closed
AGS BA per Acre: 68 sq ft (72%)

Per Acre Volume By Species and Product (live stems over 4"dbh)

Group	Species	% BA	Veneer (bf)	Sawlog (bf)	Pulp (cds)	Cull (cds)	Total Cords	AGS Saw
Hardwood	*Sugar Maple*	20.8%	0	888	4.5	0.7	6.8	813
	Yellow Birch	15.6%	0	0	2.4	0.1	2.5	0
	Red Maple	10.4%	0	0	1.2	0	1.2	0
	Paper Birch	10.4%	0	0	0.8	0	0.8	0
	American Beech	6.5%	0	235	1.6	0	2.1	235
	Black Cherry	2.6%	0	0	0.2	0	0.2	0
	Other Hardwoods	6.5%	0	0	0	0	0	0
Hardwood Total		**72.7%**	**0**	**1,123**	**11**	**0.8**	**14**	**1,048**
Softwood	*Balsam Fir*	26%	0	798	3.3	0	5.1	798
	Red Spruce	1.3%	0	0	0.1	0	0.1	0
Softwood Total		**27.3%**	**0**	**798**	**3**	**0**	**5**	**798**
Grand Total		**100%**	**0**	**1,921**	**14**	**0.8**	**19**	**1,846**

Stand Health/ Quality:

- *Tree form and health:* Good.
- *Disease/Damage:* Some beech bark disease and porcupine feeding damage on sugar maple.
- *Other:* Some moose barking noted on red maple and balsam fir windthrow.

Access: Fair to poor. Although the stand's soils are well-suited to equipment access in dry or frozen ground conditions, the distance to the nearest possible landing (NorthWoods upper meadow) is at minimum a half mile – and over ¾ mile from the farthest corner of the stand. Transport via the Echo

Lake Connector trail to the meadow also requires crossing two log bridges and a neighboring property. Only high value or much needed timber will be economical to remove from the stand and a forwarder system would help to address these difficulties.

Ecological and Social Values:

Downed Woody Debris: Not sampled. Based on field observations, downed woody debris is insufficient, particularly in the >12" diameter sizes.

Snags Per Acre: *(goal is at least two stems 12-18" and two stems >18")*

	<12"dbh	12-18"dbh	>18"dbh	Total
Hardwood	27	3	0	30
Softwood	9	3	0	12
Total:	**36**	**6**	**0**	**42**

Unique and/or Fragile Natural Communities: In the west central part of the stand, less than 200 feet north of the ski trail is a large vernal pool, impounded by two parallel bedrock outcrops. Based on surveys conducted by NorthWoods staff, this is the largest and most productive natural breeding pool for amphibians on the 3,000 forested acres surrounding the NorthWoods facility. Wood frogs and spotted salamanders breed here in large numbers each spring, with 300 spotted salamander egg masses not uncommon. To protect the breeding pool and maintain intact adjacent upland habitat, a no-cut buffer of 100 feet from the vernal pool will be maintained in future management entries. In a second band extending 100 to 300 feet from the pool, no more than 25% of basal area will be removed in each entry, downed woody debris will be retained intact, and equipment will be used with caution to avoid rutting and compaction.

Plants: Understory plant diversity and percent cover are both low in the stand due to the closed canopy. Scattered shrubs include red-berried elder, hobblebush, and American honeysuckle. The most widespread forbs include intermediate wood fern, hayscented fern, New York fern, wild oat, whorled aster, Jack-in-the-pulpit, purple trillium, and starflower. The stand also harbors more spring ephemeral wildflowers than any other on the property. These include dwarf ginseng, spring beauty, and trout lily.

Wildlife: Located southeast of the vernal pool and south of the ski trail is a hardwood ridge well stocked with American beech, including several over 12" dbh. Seasonal mammal surveys since 1999 have recorded regular use of this area by black bear for fall forage. Although small in size, it is one of the few remaining concentrated sources of beech mast in the surrounding 3,000 acres and should be managed in part to promote healthy individuals of this species. Other large mammals that frequently traverse the stand include coyote, deer, moose, and fisher. Bird species associated with mixed interior forest and/or snags are among the ten most abundant, including ovenbird, black-throated green warbler, hermit thrush, red-eyed vireo, black-throated blue warbler, and hairy and downy woodpeckers. Other birds noted in this stand have included barred owl, scarlet tanager, and Swainson's thrush.

Recreation: The Echo Lake Connector trail crosses the stand. This trail is maintained by NorthWoods, mostly as a cross-country ski trail, for free public use and educational use. Hunters and other nature enthusiasts also access the area through the trail. Management activities will need to be coordinated with trail use to minimize conflict, and aesthetics should be factored into management

decisions along the trail corridor.

Water Quality/ Wetlands: None besides the vernal pool (described above).

Special Considerations: As noted above, the best access to the stand is via the existing ski trail, which requires a roughly 800-foot crossing of a neighboring property. The current landowner allows for recreational use of this land, but special permission for forestry access, or preferably a deeded right of way, would be needed prior to management activities requiring large equipment.

Silvicultural Plan:

Management Age Class System: Uneven **Cutting Cycle:** 15 years

Diameter Objectives:

12-16"dbh ----- balsam fir
14-18"dbh ----- red maple, and red spruce
16-18"dbh ----- beech, white ash
18-20"dbh ----- sugar maple, yellow birch, hemlock

Long Range Goals: The primary goal for this stand is the sustained production of high quality sawlogs in a manner that maintains long-term forest health. Other specific goals include protecting and preserving wildlife habitat values of the vernal pool and beech ridge, supporting recreational trail values, and supporting educational activities. This will be achieved by gradually converting the stand to an uneven-aged structure while simultaneously improving stem quality and species composition. Management will employ the single tree and small group selection systems, with group sizes of up to one quarter acre. Marking will promote well-formed commercial shade tolerant/ mid-tolerant species (sugar maple, yellow birch and white ash), as well as healthy beech. Red spruce in all age classes will be promoted over balsam fir in an effort to reverse the relative proportions of these two species. The structural goal is q=1.4, though several cutting cycles will be needed to reach this.

Planned Management Practices: The stand has suitable quality for uneven-aged management, but stocking is still too low in the upper size classes to warrant a stand-wide entry. To begin moving the stand's structure from its current q=1.7 toward a goal of q=1.4, a small-scale improvement thinning could be done, particularly in the slightly overstocked regeneration areas north of the trail. An appropriate timeline for this work is within the next 3-6 years (2011-2014). This entry will focus on the low grade and small diameter wood and will likely yield only fuelwood for extractable product. Marking should promote well formed individuals of the commercial species listed above and should use the following stocking and structural guidelines.

Size class	remove (TPA)	residual (TPA)	residual (BA)
Under 5"dbh		350+	
5-7"dbh	35	130	19.9
8-10"dbh	0	57	24.6
11-15"dbh	4	41	35.5
16+dbh	0	0	0
	39	256	80.0 sq ft

Appendix A: Sampling Methods

Silvicultural and ecological data for this plan were gathered through parcel-wide permanent plot surveys conducted during the summer and fall of 2005 by Conservation Science and Land Management staff of the NorthWoods Stewardship Center. Stand boundaries for the east parcel were transferred from the 2003 management plan, and west parcel boundaries were drawn from GPS boundary data (CMT MarchII unit) and drafted in the office using 1999 black and white and 2003 true color aerial orthophotography and ArcView 3.2 software. Plots were initially laid out on a 100 meter grid and then stratified by stand by systematically removing plots until reaching the criteria of a minimum of 5 plots per stand and a minimum of one plot per 3.75 acres. Additional plots were added in stand 1 prior to the commercial thinnings in 2006-2007.

To facilitate periodic resampling, permanent plot markers were installed using 1-2" diameter white pvc tubes, extending 8-18" above the ground surface and labeled with the plot number. We used fixed radius (24 feet) plots, measuring all standing trees (including snags) greater than 4" dbh and assigning product classes by 8-foot logs. A single healthy dominant or co-dominant tree was cored at or near each plot to provide site index information, or in the case of a history of suppression and release, land use history data. Saplings less than 4"dbh but greater than 12" tall were tallied by number, species, and 1"size classes in four 48"x48" subplots, located inside the outer periphery of the 24 foot radius main plot area. Presence of shrub and herb species was also noted both within the main plot and within each of the four subplots (to allow for rough relative abundance estimates).

A range of other data were also gathered at each plot, including land use history evidence, slope, aspect, soil drainage, surface rock coverage, canopy density, biological and other natural disturbances, exotic plant abundance, and tree health. Digital photographs were taken from each plot center of the canopy and eye-level view in each of the cardinal directions. These data were entered into a Microsoft Access- based forestry database (Assisi Resource) or otherwise archived at the NorthWoods Stewardship Center offices.

Downed woody debris (stand 1 only) was sampled in 2007 at each permanent plot using the Perpendicular Distance Sampling method. Like prism cruising, this method combines distance and diameter to define whether a stem is tallied. We used a volume factor of 200 and a maximum distance of 66 feet.

Other wildlife data used in the plan was gathered between 1999 and 2007 through a variety of sampling methods including bird point count surveys, mammal track and sign transect surveys, and small mammal live trapping using Sherman traps.

Appendix B: Notes on Silvicultural Information Section

Stand Type: Example- H2/3B.
Refers to broad forest type, canopy size class, and stocking level.

broad cover types	*size classes*	*stocking levels*
H=>74% of canopy hardwood	1= 1-4.5"dbh	A, B or C *(based upon*
S=>74% of canopy softwood	2= 4.6-9.5"dbh	*applicable forest type*
HS= mixed forest with hardwood	3= 9.6-14.5"dbh	*stocking chart)*
dominant, but < 75% of canopy	4= >14.6"dbh	
SH= mixed forest with softwood		
dominant, but <75% of canopy		

Site Index/Species: A measure of site quality- height that this species would reach on this site in 50 years. Derived from tree cores collected from healthy dominant or codominant trees at each plot and plotted on species-specific site index charts.

Cruise Intensity: Total # of plots sampled in the stand (and # acres per plot).

Age Class Distribution: Even= two or less distinct classes of trees separated by at least 25 years in age, Uneven= at least three distinct classes of trees separated by at least 25 years in age.

Regeneration: Refers to stems 0-3.9"dbh and >12" in height.

Stocking Level: A measure of stand density relative to a desirable goal. Stocking is based on Basal Area, Trees Per Acre and mean tree diameter, plotted on a chart specific to forest type. Stands falling above the A-line on these charts are considered overstocked and in need of thinning to achieve maximum tree growth and development. Stands between the A and B line are considered well stocked, while those below the C-line are understocked.

Canopy cover: Characterized broadly as closed, patchy or open.

BA per Acre: Basal Area is the cumulative cross-sectional surface area of all trees at 4'6". Value given here excludes suppressed trees (following Use Value Appraisal management plan guidelines).

Trees Per Acre: Value given is for all trees within the plots down to 4" dbh (commercial and non-commercial species, acceptable and unacceptable growing stock).

AGS BA per Acre: Acceptable Growing Stock refers in this plan to all healthy stems that are capable of eventually producing a minimum of one 12-foot sawlog or two 8-foot sawlogs. AGS BA per acre is given in square feet (along with the percent of total basal area that AGS represents).

Quadratic Mean Stand Diameter: The diameter of the tree of average basal area in the area unit of interest, for our purposes the stand.

Total % Basal Area and Volumes per Acre by Species (table): This table reports % basal area and volumes per acre of all species, commercial and non-commercial. Sawtimber is rounded to the nearest whole number, while other values are given to the nearest tenth if necessary.

MANAGEMENT PLAN SUMMARY FORM (new X revised amendment change of ownership) page 1 of 2 FORM 4

"FP&R COUNTY FORESTER USE ONLY"
Parcel ID For Data Entry (by state)# __ __ __ __ __, __ __ __ __ __ __ — __ __ __ __ __ Year of Entry
Year of Plan 2008 Year of Last Inspection

The following is to be prepared by applicant/agent:

1) Landowner Names (last name first): NorthWoods Stewardship Center
Landowner 2 Signature: _____ *(Walter Medwid, Executive Director)*

2) Landowner Address (Street, PO Box): P.O. Box 220, East Charleston, VT 05833

3) Town(s) Located: Charleston

4) Total Forestry Acres in Parcel 87.7 (both parcels) (Grand list acreage, minus agricultural or non-productive land and exclusions)
5) Plan Preparer (last name first) **Benoit, Jayson – NorthWoods Stewardship Center** ,
6) Previous Owner (last name first) Spitzer, Lydia (west parcel); Manning, William and Pat Moyer (east parcel) ,
7) Date Form Completed: 12/20/2007
8) Ortho Sheet # and Year: #192256 and #196256 (both 1999)

9) Stand information: (this information is for data entry only and does not override what is in actual plan)

Stand #	Acres (Grand List)	Even-aged[1] Uneven-aged[2] (existing)	Predominant Site Class (1, 2, 3 or 4)	Timber Type	M.S.D.	Total BA	AGS BA	Mgmt. Activities	Scheduled Date (± 3 yrs.)
1	8.1	even	1	12	10	150	129	2	2009
2	27.5	even	2	11	7	55	37	1	2010
3	33.8	even	2	11	6	99	76	1	2011
4	25.2	even	2	11	8	95	68	1	2013

10) No activity (identify stand # and reasons): _____

11) Management Activities - other (identify stand #) : _____

12) Timber Types - other (identify stand #): red/white pine and Norway spruce plantation (stand 1); _____

13) Amended prescriptions (identify stand #): _____

DEFINITIONS

ACRES-round off to nearest acre
EVEN-AGED-stands with two or less size classes
UNEVEN-AGED-stands with three or more size classes

TIMBER TYPES	CODE #
aspen and/or white birch	01
white pine, red oak	02
white pine	03
hemlock	04

SITE CLASS-predominant site class as defined by UVA standards
MSD-Mean Stand Diameter to nearest inch
TOTAL BA-basal area to nearest foot^2
AGS BA (acceptable growing stock basal area) to nearest foot^2

sugar maple	05
beech, birch, sugar maple	06
beech, red maple	07
spruce	08
spruce/fir	09
pioneer species	10
mixed wood (25%-65% softwood)	11
other (identify other in section 12)	12

MANAGEMENT ACTIVITY CODES (if one of the following choices reasonably describes the planned management activity, use it. If not, use #13 other and describe the management activity in Section 11. Note these descriptions are for choosing codes only; they are not the silvicultural standards).

A. **EVEN-AGED MANAGEMENT** (Two or less distinct size classes)

CODE

1. Pre-commercial thinning. Thinning in sapling or young pole stands leaving at least three hundred and fifty (350) stems of acceptable growing stock per acre.
2. Intermediate thinning. Reduce stocking to B level, or remove up to 33% of basal area in densely overstocked stands.
3. Shelterwood cut. Stand basal area reduced to between 30 and 70 sq. ft. for hardwoods, 80 to 120 sq. ft. for softwoods.
4. Overstory removal cut. Removing overstory after a new featured stand has become established. This applies to two-aged as well as recently regenerated stands. After harvest, residual stand should have minimum of sixty (60) square feet of acceptable growing stock or 350 stems/acre for stands less than six (6) inches MSD.
5. Clearcut. Stand basal area reduced below thirty (30) square feet.
6. Progressive clearcutting. Removing a portion of a stand in strips or patches, to be followed by similar treatments at predetermined dates until entire area is clearcut. If you choose this option, indicate the total time period from first to last cut (i.e., 30 years) in section 13.

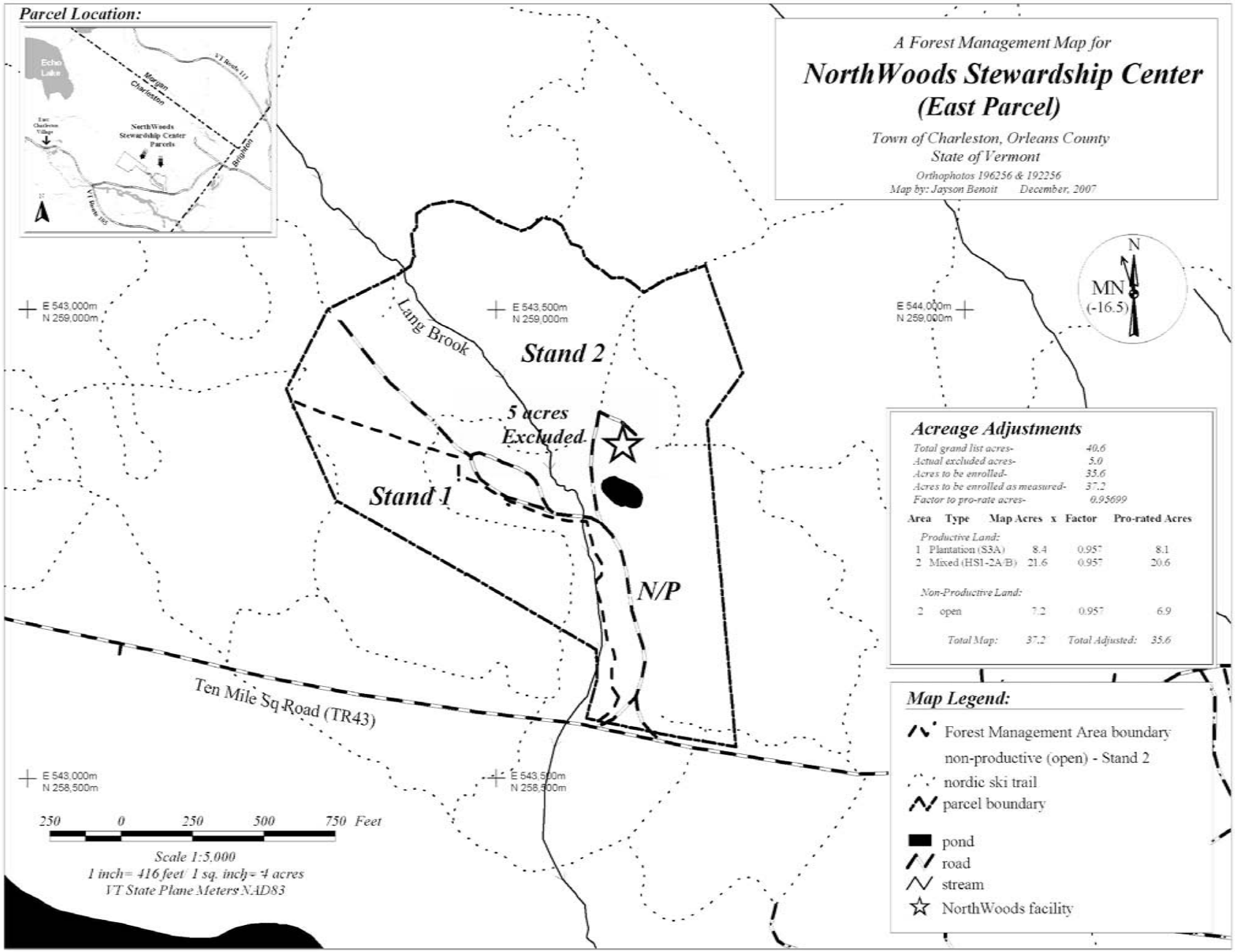
B. **UNEVEN-AGED MANAGEMENT** (Three or more distinct size classes) (NOTE: ratio of AGS to total basal area should be maintained or increased through any management activities.)

7. Thinning. Converting an immature or existing even-aged stand to uneven-aged management. After thinning, residual stand should have a minimum of 60 square feet of acceptable growing stock.
8. Harvest. After cut, residual stand should have sixty (60) feet of acceptable growing stock. Stand should have at least ten (10) square feet of growing stock in each of the sapling, pole, and saw timber size classes.

C. **MISCELLANEOUS CHOICES**

9. Salvage cut. Removing a portion of a stand because of damage or disease. Resulting residual stand may not fit standards in guides.
10. Sugarbush thinning. Cut designed with the sole objective of establishing or improving a sugarbush. Cut should follow sugarbush guides.
11. Species conversion. Cut done usually in a mixed stand to favor certain species. Treatment should not favor species that are "off site".
12. No activity. Indicate reason such as "stand understocked", in section 10.
13. Other. In cases where none of the above choices comes reasonably close to describing the management activity, put your own description in section 11

Forest Management Map- East Parcel



Forest Management Map- West Parcel