

**Crawford Town Forest  
Resource Assessment  
And  
Forest Management Plan  
Royalton, VT**



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## Introduction

This forest management plan was developed for the town of Royalton at the request of the Royalton Conservation commission, by AJ Follensbee the Windsor County Forester. The intention of this plan is to describe the resources of the property, inform residents, the conservation commission and the select board in making decisions about the management of the property. This assessment starts with a broad overview of the landscape level resources and then examines specific details about the property. The plan also will serve as a guide to forest management activities on the property. Before management activities are implemented, input from the community should be gathered. A licensed forester should be involved during forest management activities that take place on the property.

## Location

The Crawford Town Forest is north of the village of South Royalton. The property is 173ac +/- in size. It is one of Royalton's 2 town forests. Accessing this property is not a problem. There are two main ways to access the property. The first is from the town offices off of route 14. After parking at the towns office there is a road that heads north through the agricultural fields. The road turns into a trail. This trail is the main forest trail that runs through the heart of the property. A second access point is off Mill Rd, at an old landing. Parking here is possible, but could be enlarged for more cars to park. Right now, 2 cars can comfortably fit in the turn-off. From the landing, there are some rarely used trails that gain access to northern parts of the property.

The property is mostly forested. With the only exception being the agricultural field and sand pit in the southern part of the property. Currently, there are many trails on the property. Most are not well maintained and rarely used. The main trail runs from the access road north. This trail continues through the southern half of the property and ends at the height of land near the western boundary of stand 1. Nearly all the trails need maintenance. Most trails do not have any drainages installed or installed drainages have been damaged by ATV or dirt bike use.

Dirt bike and ATV use on the property is widespread, with most of the use in the north. I would recommend discouraging the use of motorized vehicles on the property to protect the trails, water quality and soil quality. Hanging signs and blocking off certain trails would be good places to start.

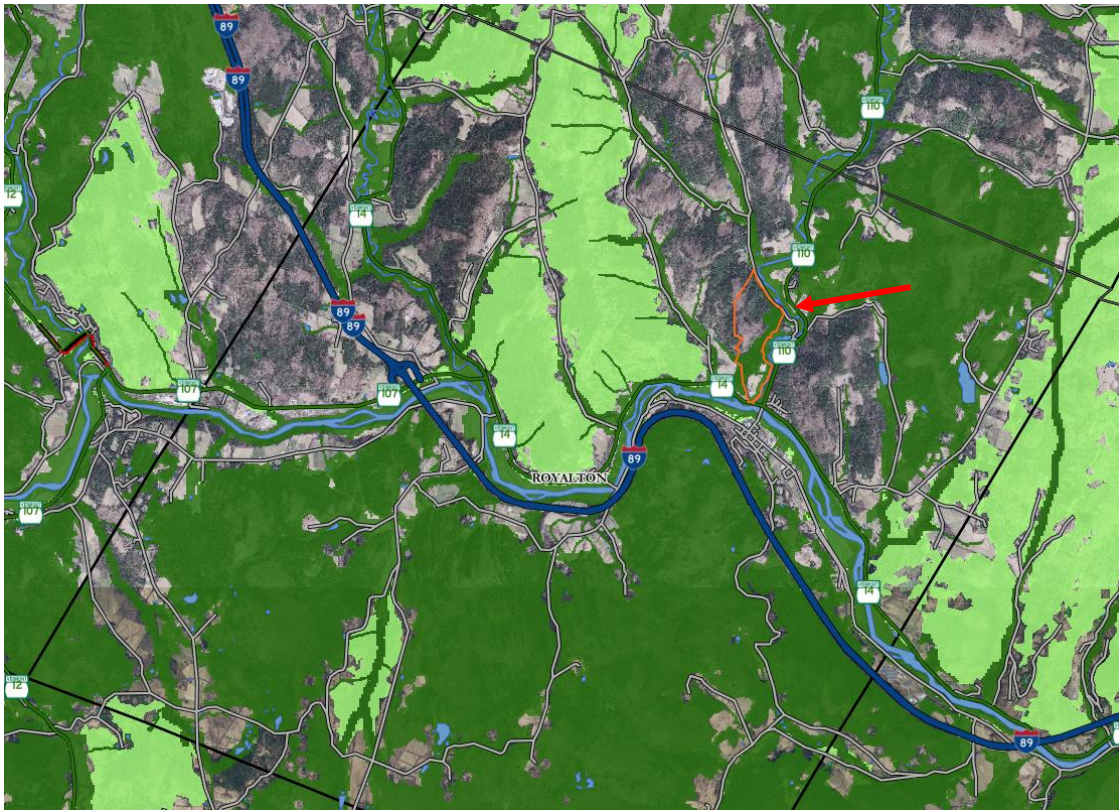
Current known uses of the property include hiking, observing wildlife, educational hikes, sand extraction, farming and water quality protection. The town municipal offices are on the property. Along with a storage barn used by the fire department. Sand is actively being removed from the sand pit by the town for use on town roads.

The Property is located in Vermont's Southern Piedmont Biophysical Region. This is an area described in Wetland, Woodland, Wildland A guide to the Natural Communities of Vermont as: *A region of low rolling foothills, streams and rivers. It is mostly forested, with small agricultural areas in the fertile river valleys and hills. The soils are generally rich and support northern hardwoods forest, oak hickory in the river valleys and pine-oak forest on dryer sites. The Connecticut River is the most dramatic feature in*

*this region. The climate is variable, warmer near the river valleys and colder in the hills. Common animals found in the northern hardwood forest of this region include white-tailed deer, eastern cottontail, porcupine, wild turkey, gray squirrels and forest songbirds.*

Crawford Town Forest is located in the White River watershed. This watershed is one of the few unimpeded watersheds in Vermont. It drains more than 700 square miles and is Vermont's 4<sup>th</sup> largest water shed. The White River travels 56 miles from the Ripton in Addison County to White River Junction where it drains into the Connecticut River. The White River is a favorite fishing spot for anglers

## Forest Block



(Map of forest blocks in the town of Bethel. Light green blocks are priority blocks, dark green blocks are high priority)

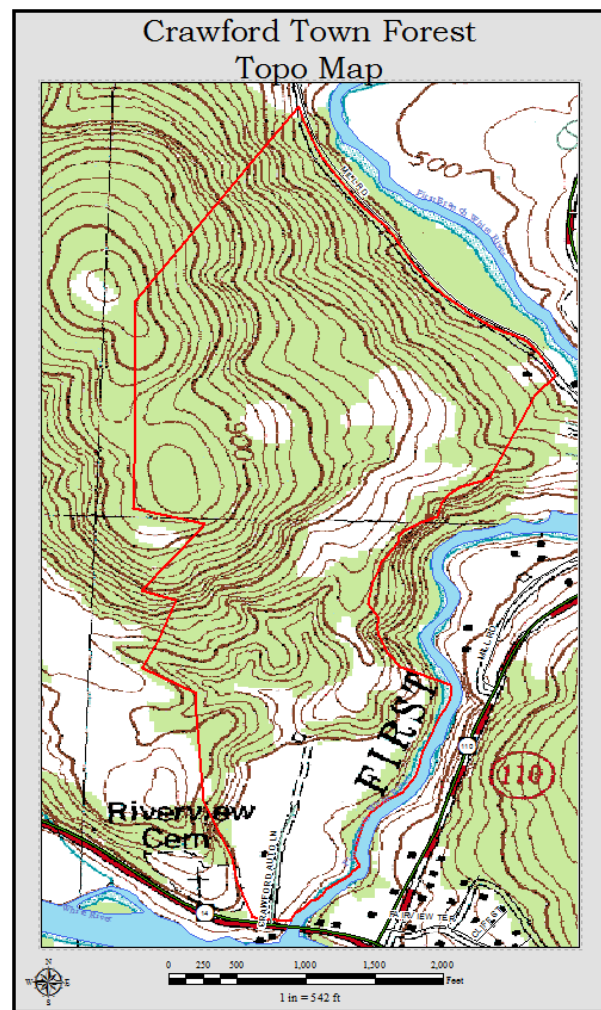
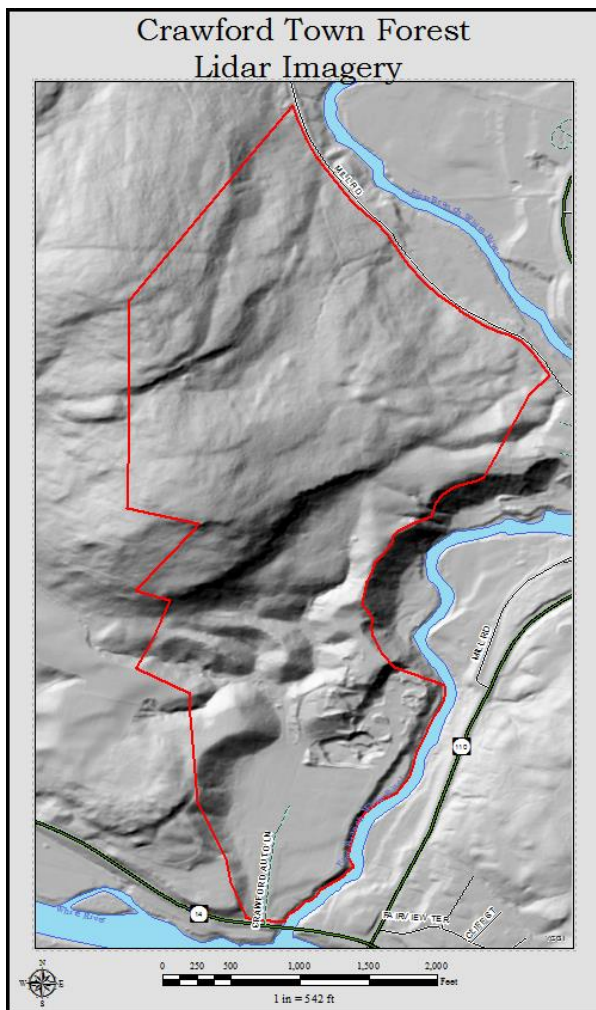
Crawford Town Forest is part of a roughly 595ac unfragmented wooded forest block. The forest block is bounded by rt 14 to the south, Happy Hollow Rd rd. to the west and Rix and Mill street to the east. Although this block is not mapped as critical by VT BioFinder, a biological diversity tool, this block is providing interior forest habitat. An interior forest habitat block provides suitable conditions to support a variety of native plant and animal species. Animals with large ranges depend on these interior forest blocks. Animals such as black bear, moose, white tail deer, bobcat and American martin. It is important to keep these large blocks unfragmented. A road, house, agricultural fields or other development splits these forest blocks up into smaller and smaller pieces. The smaller a block gets, the less beneficial they are. Every parcel in the forest block matters. Crawford Town forest is an important piece of a larger block. More information on forest blocks can be found at [Vermont Bio Finder](#).

## Terrain

The terrain on the Crawford town forest is moderate to steep. The elevation ranges from 500' to 900'. There is a beautiful series of cliffs on the property. The first and most dramatic cliff is in the center of the property. The main trail runs parallel to this cliff. The second cliff is not quite as impressive. This cliff is in the north western part of the property. The second cliff make access to the north west difficult.

The terrain in the southern part of the property is made up of eskers. An esker is a ridge of stratified sand or gravel. They can be quite long in length and steep. Eskers were formed during the time of the glaciers. There are a number of these throughout stand 2.

Below are two maps. The one on the right is the topo map of the property. The one on the left is a LIDAR imagery map. LIDAR imagery strips the ground of vegetation showing what the ground conditions look like. The two cliffs show up well on this map, along with the eskers in the south.



## Boundary Lines

The boundary lines of the property are generally well marked, meaning there is some evidence marking a line. The boundary evidence includes blazes, stone walls and wire fencing. All lines need to be remarked so that they can be easily seen. In areas where no boundary evidence can be found a surveyor should be hired to locate the missing lines. Having well marked boundaries help to protect against timber theft or other unwanted uses of the property.



(Yellow blazes and wire fencing indicating boundary line in stand 2)

## Wildlife

The property is full of mast bearing trees. Mast trees are trees like red oak, beech, black cherry and hickory. They provide a source of food to birds and mammals. Mast bearing trees are important food sources for wildlife. Maintaining a diverse variety of the mast bearing tree species throughout the forest will increase the amount of wildlife on the property that rely on this food source.



(Cavity tree in stand 1)

There are several old large trees on the property. Many of these older trees have holes and cracks. These cavity trees are very important to different species of birds and mammals. Northern Long Eared bat, a federally listed threatened species rely on trees with cracks and cavities. These bats will roost in these trees during the summer months. Bears are also known to use these trees to hibernate.

There are parts of the forest with thick hemlock and pine cover. Areas with dense soft wood cover are used by deer to sleep and spend time in during the coldest winter months. The Vermont Fish and Wildlife Dept. does not have any part of Crawford mapped as a deer wintering area. This does not mean the forest is not being used by deer. Stand 2 has a high amount of dense hemlock cover. Deer use is prevalent throughout the property. Deer brows was seen in most of the forest.



(Example of winter deer beds)



Interior song birds can be heard throughout the spring and summer. Interior forest song birds rely on larger forest blocks in Vermont for breeding. Song birds such as oven birds, red eyed vireos, black throated green and black throated blues warblers and scarlet tanagers are just some of the birds that would use a forest such as Crawford. Some of Vermont's forest song birds are threatened due to habitat loss in their winter Range. Making sure their summer breeding habitat is the best it can be is an important way to help these species. Improvements to forest structure, removal of invasive plants and reducing forest fragmentation are just some of the ways to help our forest song birds. More information on forest song birds can be found at [Vermont Audubon](#)

## Invasive Plants

There are non-native invasive plants found on the property. These are plants not native to the ecology of an ecosystem. They were generally brought in to Vermont from Europe or Asia and used as ornamental plants. These plants do not have any of their native competitors or pathogens here, so they grow well. They can quickly outcompete native plants species for sun light and nutrients. Some can even alter the soil chemistry of an area making it impossible for other plants to grow. This can create a monoculture.

Invasive plants found in the Crawford forest are, common buckthorn, Asiatic barberry, common barberry and shrub honeysuckles. These were the plants found during the inventory, there may be more species with in the forest. The invasive plants are mostly located in the southern part of the property near the trail entrance and agricultural fields. Stand 3 has the highest amount of invasive plants. Stands 1 and 2 have light infestations of mostly barberry. More detail about invasive coverage is in the stand descriptions

Controlling invasive plants can be tough, it can take a lot of time and resources. Control does not always mean eradication of invasive plants. Control can be reducing the invasive plants enough to give the native vegetation a chance to compete. Restoring the natural balance of native plants in an infested forest can have huge benefits. It is important not to take on something that will drain time and resources and have little impact. Being methodical and strategic about where and when invasive control is going to take place will help to do the greatest good with limited resources.

## Forest Health

Overall, the Crawford forest is healthy. There were some common forest health issues that occur throughout Vermont found in the forest. The following is a list of the forest health issues found in the Crawford forest.

### [Beech Bark Disease](#)

Beech Bark Disease is unfortunately a common occurrence in the forests of Vermont. It was introduced in Nova Scotia in the early 1900's from Europe. It has worked its way west from there. The pathogen affects the vigor of beech and will eventually lead to mortality. Beech Bark Disease is an attack of a beech scale insect and a fungus in the *nectria* genus. Beech trees infected with Beech Bark Disease will have cankers on the bark. Some beech trees are resistant to this disease and should be protected and managed for. Genetic resistance is the best way to manage for this disease.

### [Ash Yellows and Ash Decline](#)

Ash trees in the region are experiencing decline. The decline is due to ash yellows and to some extent site and environmental issues. Ash yellows is a disease caused by *Candidatus Phytoplasma fraxini*, a microorganism. This disease can kill infected ash trees within 5-10 years, some trees can survive the disease with only their growth being affected. Decline in ash can also come from environmental factors such as drought, poor soils, fungus and other factors.

### [Red Rot](#)

Red rot is a fungal disease caused by *Phellinus pini*. Red rot is a common disease in temperate forests, affecting softwood trees. This disease leads to decay within the stem of a tree. The fungus is introduced through wounds or dead stems. It can greatly affect the quality of trees when they are sold for lumber. Highly stocked stands are more susceptible due to competition for resources. Reducing the density of white pine stands is one way to manage for this pathogen.

### [White Pine Needle cast](#)

White pine needle cast is a relatively new pathogen. This disease was first noticed throughout the north east in 2010 and has been affecting white pines year after year since. This is a fungal pathogen caused by three different fungi. These fungi affect the second-year needles of pine. Turning the needles brown in June, then these needles are dropped. This decreases the growth and vigor of trees affected.

### [White pine weevil](#)

White pine weevil is an insect *Pissodes strobi* that attacks the top leaders of conifers. It lays its eggs in the previous year's leader. Once the eggs hatch the grubs tunnel inwards towards the center of the leader, feeding on it. The leader is eventually girdled by the feeding of the grubs, killing the leader. The response of the tree is to develop multiple leaders to replace the dead leader. This ruins the form and quality of the attacked tree and gives the tree a bush like appearance. A weevil infestation rarely results in mortality. Norway spruce, Colorado blue spruce, jack pine, red pine, Scotch pine, mugho pine and native spruces are susceptible to white pine weevil.

## Regional forest health problems

The following forest health issues are issues currently found in the state but were **not** found in the Crawford town forest. These are significant issues that should be monitored for. If found in Crawford, their impact will be significant.

### [Emerald ash borer](#)

Emerald ash borer (EAB) is a beetle native to northern Asia. This insect was first discovered in Detroit in 2002. It has spread rapidly east since then, mostly being moved by humans. EAB will kill infected ash trees by effectively girdling the tree. The larva of EAB feed over the winter in the cambium layer of ash trees. Infested trees will normally die within 5 years. EAB kills 95-99% of the trees it infects. Native ash trees have very little resistance. EAB was found in Vermont in February of 2018 in the town of Orange. It has since been discovered in 3 other counties, Grand Isle, Washington and Bennington Counties. On its own, EAB can move 2 miles a year. If it is not moved by humans through firewood or other contaminated wood, the town of Royalton has some time to prepare.

### [Hemlock Woolly Adelgid](#)

Hemlock Woolly Adelgid (HWA) is an introduced insect from Asia. It was first found in the Pacific Northwest in the 1920's, then found in northern Virginia in the 1950's. It is currently in southern Vermont, slowly spreading north. HWA can be identified by the cotton like frass at the bottom of hemlock trees. HWA feeds on the young twigs causing needles to dry out and fall of the tree prematurely. If infested, a hemlock tree can die within 4 to 6 years. Some trees can survive but have reduced crowns making the tree less valuable to wildlife that depend on hemlock.

## History

The property was purchased by the town on June 6<sup>th</sup>, 2013 from Herb Crawford Autoland. The Crawford family had owned the property since 1967. The Crawford's purchased the property from George Goodrich on December 27<sup>th</sup>, 1967. The Goodrich's bought the property from Leon and Delia Skinner on September 27<sup>th</sup>, 1932. Leon Skinner who lived in Boston, had inherited the property from his father's Anson Skinner's estate. Anson Skinner had been farming the property before his death.

The property is described in the 1932 deed as *"It being the Anson P. Skinner farm so called, situated on the First Branch of the White River, near the Village of South Royalton, Vermont, and comprising one hundred and seventy three acres of land more or less... Anson P Skinner estate the same being situated on the northerly side of the State highway leading from the iron bridge across White River in South Royalton, the Village of Royalton. It being all the land that is listed to said Leon A. Skinner in said Town of Royalton or the Piece land and Waldo Pasture"*

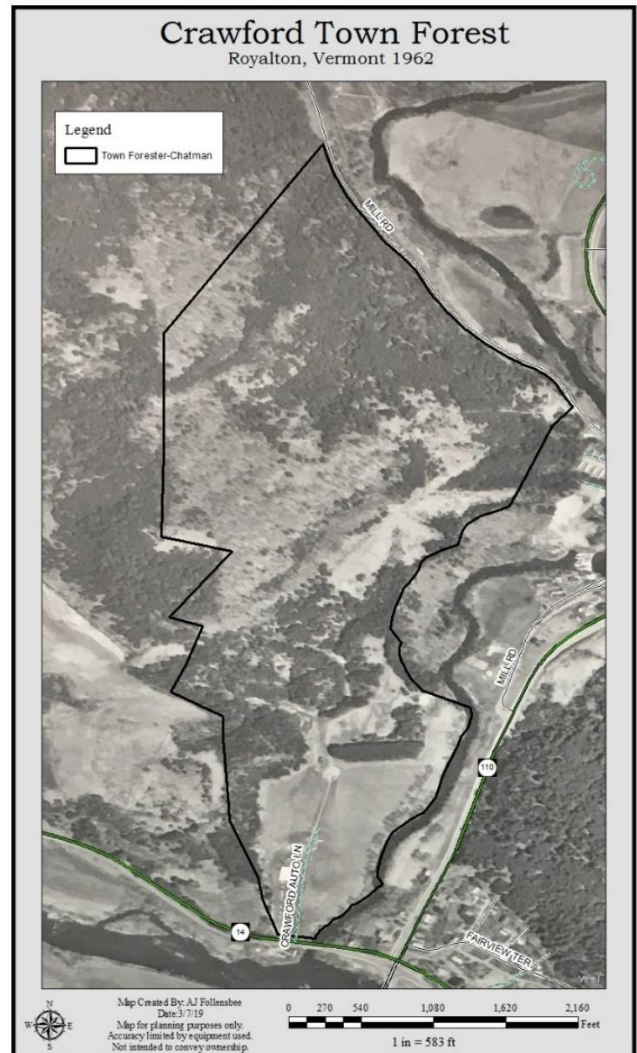
When the property was sold to the Crawford family in 1967 spring and aqueduct rights were conveyed to Wendell and Norma Eaton and to another person, M. Bostwick. The M. Bostwick conveyance was not recorded in a deed. No maps or descriptions were found describing the location of these conveyances. More research could be done on neighboring properties. Their deeds might describe where the water rights were granted.

During the 1967 transaction a right of way was granted to Central Vermont Public Service Corp. Another ROW was granted to New England Telephone and Telegram Company.

No previous forest management plan is known to exist. Whether the property was enrolled in the Current Use program prior to town ownership is also uncertain. Very little evidence of past timber management was noticed during the field examination.

Understanding the historic land use of a forests is an important thing to consider when thinking about how a forest got to its current condition. Forests regenerate differently depending on what the past use of the land was. Older aerial photos can be a tool to try and piece together past land uses. I was able to find a 1939 aerial photo of Royalton. This photo indicates much of the property was cleared of trees. The only exception being the western center of the property and the part of the property along the Mill rd. By 1962 much of the property has regenerated back to forest, with some of the areas still in patchy open land.

These two maps show the area of Crawford town forest in 1939 and 1962. Lighter spots on the maps are open fields, darker gray and black spots are trees.



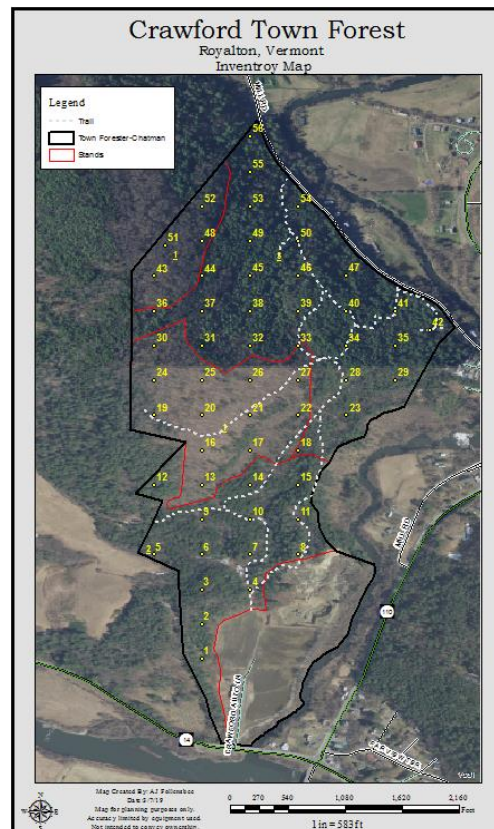
## Goals

The goals for this property have not yet been defined. This will be an important discussion to have with members of the community, the Royalton Conservation Commission and Select Board. There are resources available that can help to facilitate the discussion between the Conservation Commission and the public, to shape the goals for the property.

## Resources

The forests on the property have been split up into stands. Stands are groups of trees. These trees normally have something in common. Things like species composition, age, topography. Lumping groups of trees together makes it easier to assess the forest and make management decisions. The Crawford Town Forest has been split into 3 different stands.

A forest resource inventory was done in the summer of 2018, by AJ Follensbee and Brian Refro. A total of 56 randomly assigned points were taken using a big BAF cruising system, using 20 factor and 40 factor prisms. Density, diameters, merchantable heights, regeneration coverage, species and coarse woody debris information were gathered at each point. The data was then run in the State of Vermont's forest system. The following is an assessment of the 3 forest stands



(Cruise map developed for summer of 2018 cruise)

## Stand 1

40 acres

### **Description**

Stand 1 is the only hardwood stand on the property, it is a beautiful northern hardwood stand. It is composed mostly of sugar maple, white ash and beech. There are inclusions of hemlock mostly on the periphery of the stand. Other species found in the stand include red oak, yellow birch, basswood, and white pine. The highlight of this area are the large sugar maples through out the stand. They have large diameters and are tall. The white ash in this stand are also large. There seems to be some dieback in the crowns of some large sugar maples. This looks to be from old storm damage.



(maiden hair fern in stand 1)

This stand has developed on rich fertile soils. Throughout the stand there are rich site indicators. A rich site indicator are plants and trees that require good productive soils to grow. This would be a great area for wildflowers in the spring. Some of the plants found during the inventory were maiden hair fern, Christmas fern, wild ginger and blue cohosh, among others. A more thorough examination of plants should be done here during the spring or early summer. This could be a good project for high school students in the future.

The main trail ends at the height of land in the west of this stand. At trails end, the stand opens to an understory made up of sedges. This area is likely a dry oak-hickory natural community normally found in western Vermont but with out hickory. This is a unique feature that should be protected during management activity. The area is roughly 1-2ac in size.

### **Terrain**

The terrain in this stand is generally gently rolling and accessible. There are two sections of this stand separated by steep cliffs. The northern section of the stand cannot be easily accessed from the property. It would have to be accessed from the neighboring property. The composition of the two areas is very similar. Management in the southern section of stand 1 will not be inhibited by the terrain. This section is accessed from the main trail that runs through the property.

## **History**

There is very little evidence of past forest management in this stand. This stand has been forested for a while. On the 1939 photo this area appears to be forested. Prior to that it was most likely cleared during the sheep boom in the 1800's for pasture. No evidence of past tapping can be clearly seen, but it is likely that these trees have been tapped in the past. There appears to be some ice storm damage in the crowns of some of the trees. This damage could be from the 1998 ice storm. The trees in this stand are roughly 120 years old.

## **Soils**

The soils in this stand are productive based on the height of the trees and the types of plants growing in the stand. The soil found in this stand is Vershire Dummerston complex, 8 to 15% and 26 to 60% slope, rocky. These soils are deep well drained soils. These soils are productive soils for northern hardwoods species. The site class of these soils is a 1 out of 4, with 1 being the most productive and 4 the least productive. (see soil report for more details)

## **Forest Health**

Beech bark disease is affecting some of the beech in this stand. There are some beech in this stand that are showing signs of resistance to the disease. Trees showing resistance should be managed for and promoted in the stand. Releasing the crowns of these trees is a great way to increase their vigor and growth. Promoting genetically resistance beech is the best way to combat beech bark disease. There was mortality noticed from occasional blow downs. No other major health issues were found in the stand.

This stand has a fair amount of white ash. The stand is made up of 11% white ash. This makes the stand vulnerable to emerald ash borer (EAB). Reducing the amount of ash in this stand would be a way to reduce the impact of EAB in this stand. Ash should not be completely removed from this stand, as that has been shown to not make a difference in the spread of EAB in a forest. There also might be genetically resistance ash in the stand and removing all the ash would also remove these trees from the forest. Removing trees of value, trees 14" or larger and trees near trails is a good place to start. Not all trees 14" and greater should be removed. Ash retained should have large healthy crowns

## **Invasive plants**

There are some scattered bushes of Asiatic barberry and honeysuckle in both sections of the stand. The coverage of the plants is generally light. The plants on average are medium to small. These plants should be removed before or directly following any forest management.

## **Regeneration**

Tree regeneration in this stand is generally lacking. The present regen is made up of beech saplings. Little other hardwood or softwood regeneration was found. There are pieces of coarse woody debris found in the stand, from occasional blowdown. Coarse woody debris are large pieces of trees. These pieces are very important for wildlife, erosion control, carbon retention and soil health. It also helps to protect tree regeneration. Coarse woody debris is an important feature of forests. The level of coarse woody debris in this stand is generally high, which is a good thing!



**Stand statistics**

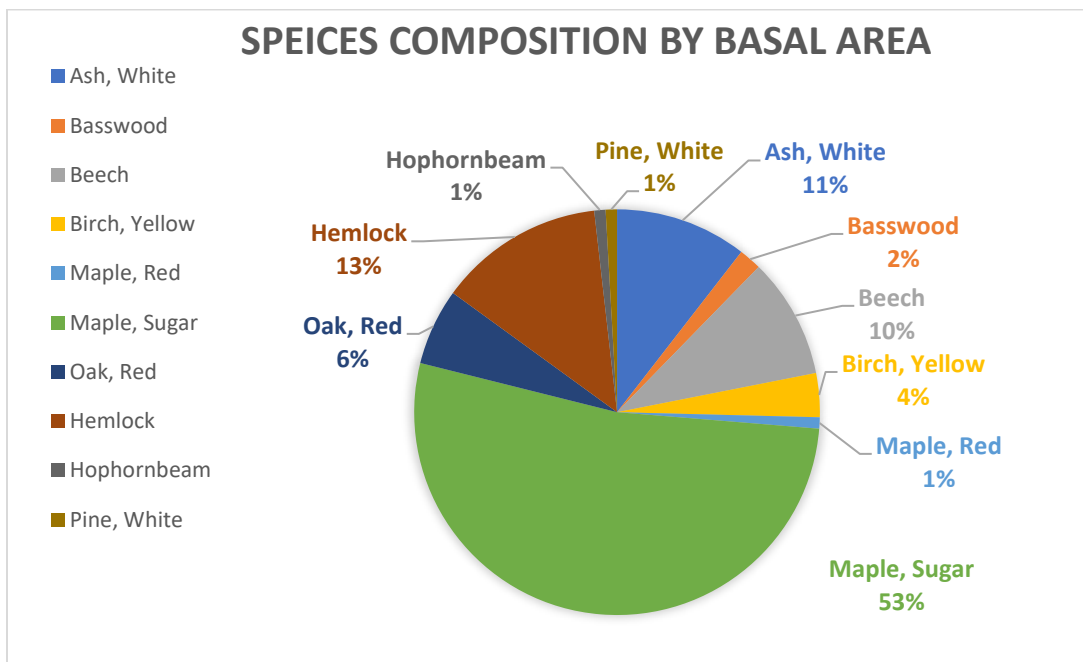
**Quadratic Mean stand Diameter 15.7"**

**Basal area 134ft<sup>2</sup>      AGS BA 84ft<sup>2</sup>      UGS BA 50ft<sup>2</sup>**

This stand is generally made up of large saw log sized trees. Roughly a third of the stands volume is made up of poor-quality trees.

**Species composition**

The stand is a northern hardwood stand. The most common tree species in this stand is sugar maple followed by hemlock, white ash, beech and red oak.

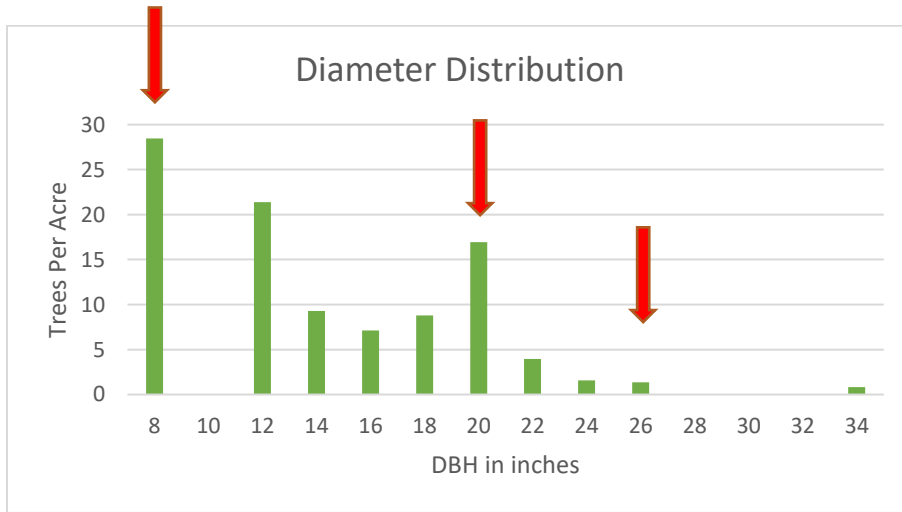


### Species Composition and Volume Table

Species	Trees / Acre	Basal Area	%BA	QMD	Rel Density	%AGS	Sawlog Board ft/Acre	Pulp Cord/Acre	Mean Ht Sawlogs
Ash, White	26.82	14.12	10.5	9.82	11.76	91.7	753.18	0.7	1
Basswood		2.35	1.8			0			
Beech	9.91	12.94	9.6	15.47	10.14	0	0	2.2	1.5
Birch, Yellow		4.71	3.5			50			
Maple, Red		1.18	0.9			0			
Maple, Sugar	49.98	70.59	52.6	16.09	55.27	75	5,627.06	5	1.694
Oak, Red	12.48	8.24	6.1	11	7.47	71.4	0	0.4	1.5
Hemlock		17.65	13.2		8.4	53.3	0	2.8	1
Hophornbeam		1.18	0.9			0			
Pine, White	0.49	1.18	0.9	21.01	0.41	100	260.91	0	3.5
<b>TOTAL</b>	<b>99.68</b>	<b>134.14 ft<sup>2</sup></b>	<b>100</b>	<b>15.71"</b>	<b>93.46</b>	<b>63.12%</b>	<b>6,641ft<sup>3</sup></b>	<b>11.1</b>	

### Stand Structure

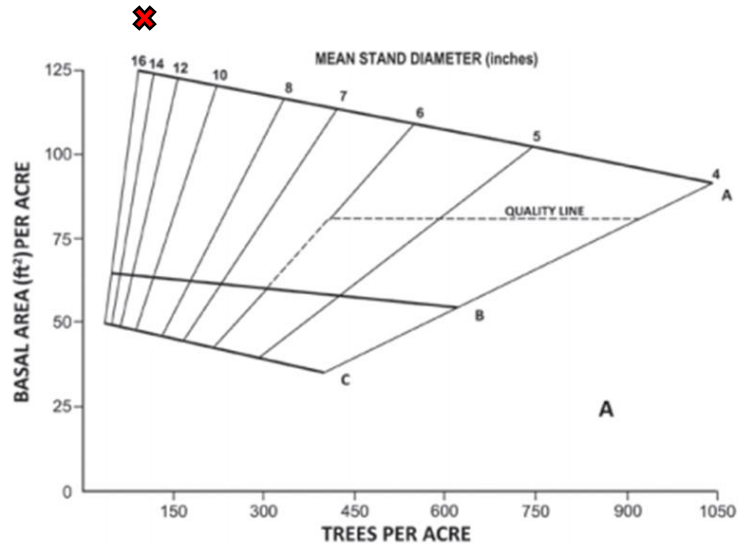
This stand is trending towards an uneven aged stand. Meaning it almost has three distinct age classes



(arrows indicate different age classes)

### Stand density

Based on the basal area and size of the trees in the stand, the stand density is above the A line of the northern hardwoods stocking guide. The B-line of the stocking chart is the suggested residual stocking for optimal growth. The C-line of the stocking chart is minimum preferred stocking of a stand. The A-line of the stocking guide is a fully stocked stand. The chart below shows the stand as overstocked. Overstocked stands tend to have slower growth rates and more mortality due to competition for resource and health and disease problems.



The "X" shows where the stand density charts out on the hardwood stocking guide according to Silvicultural Guide for Northern Hardwood Types in the Northeast, USFS NE-603

## **Silvicultural management**

This stand is special. It has large beautiful trees growing with in it. Along with many unique plants. There are reasons to do some forest management in this stand. The stand is overstocked. Trees here are competing for resources and mortality and decline is visible throughout the stand due to the high density of trees. There is a fair number of poor-quality trees taking up growing space. Roughly one third of the stand is made up of poor-quality trees. Removing these trees will give the better-quality trees more growing space, increasing their vigor and growth rates. There is a lack of regeneration throughout the stand. The young trees that will replace the overstory trees are lacking. The tree regeneration that is present is made up of beech, which due to its vulnerability to beech bark disease is undesirable. Changes can be made to the overstory to get more sunlight to the understory. Making the growing conditions more favorable to desirable hardwoods species. Another reason to do some management is to reduce the amount of white ash in the stand. This will reduce the impact of EAB in the stand once the pest arrives.

## **Treatment**

### Single tree and group selection -2025

Within the next 5 years implement a single tree and groups selection cut. This treatment will help move the stand further toward an uneven aged state. The groups should be no larger then 1ac in size, with most groups falling within .25ac to .5ac. No more than 15% of the stand should be in groups. These groups should be in areas of poor quality or to release established desirable regeneration. In-between the groups, implement a selection harvest that will reduce basal area to 90-80ft<sup>2</sup>. The selection cut should focus on the release of desirable growing stock and remove poor quality trees. Removal of saw log white ash should also be a focus of the selection cut. Primary trees to be managed for in this stand are sugar maple, red oak, yellow birch, resistant beech and white ash, though all species should be considered for retention to promote species diversity.

The diameter objectives for this stand should be Sugar maple, red oak, white pine: 22"-24", Hemlock, yellow birch, red maple: 18", white ash 14". The cutting cycle in the stand should be 15- 20 years.

Due to the fragile state of some parts of this stand I would recommend a careful operator with small equipment. This treatment should be done with the up most care to protect the sedge area. This stand should only be operated in frozen conditions or in dry summer months. Any timber management should include the treatment of the invasive plants in the stand.

## **Non-timber management**

### Trail maintenance-annual

The trails in this stand can be expanded and improved. The main trail that runs through the stand can be expanded through the proposed timber sale. A loop trail can be created that can run through most of the stand.

### Vista Expansion - 2020

There are opportunities to have some vistas looking south down the White River valley towards the village. These vista openings can be part of a larger timber sale or a separate work day for the community. This vista can already be seen with leaves off at the height of land in stand 1. This area could be developed in to a nice picnic area.

### Plant inventory 2019

Inventory the plant community in the stand. This would be a great chance to get the high school involved with the property. It will give the town an opportunity to know what plants are growing in this rich stand and give students a hands on learning opportunity.

### Sugaring - 2019

Pursue a lease agreement to tap the norther part of the stand. The neighboring property has an extensive sugaring operation. This part of the stand is too steep and inaccessible for timber operations. The owners of the neighboring property might be interested in tapping this section of the stand. This would give the town an annual income from tapping. The town can expect around \$1.00 per tap paid annually. A more thorough look into potential number of taps in this area should be done, but roughly 500 taps could be expected in this area. Tapping should follow the latest science and tapping guides to ensure the health of the trees tapped.

## Stand 2

**34 acres**

### **Description**

Stand 2 is a hemlock- white pine stand with inclusions of hardwoods. The hardwoods present in the stand include white ash, beech, red oak, sugar maple, red maple, and yellow birch. The hemlock growing in this stand are providing great cover for deer. During the inventory sign of deer use was evident throughout.



(Trail on top of esker in stand 2)

The highlight of this stand is the topography. There are multiple eskers through out the stand. These eskers provide a cathedral like entrance to the town forest. The entrance to the main trail runs through the base of two eskers. It will be important to know what the plan is for sand extraction. Protecting the feel of this special area will be important. If the expansion of the pit is north, then this area is not in danger. If the pit is expanded west then the eastern esker could potentially be removed, damaging the special feel of the entrance of this stand. There are multiple trails already in place that are at the top of the eskers. These could be enhanced and expanded. Small vistas could be cut to increase the view of the White River in some spots. These geological features provide a great learning opportunity for school kids.

## **Terrain**

Access to the stand is not a problem. The main trail runs through the heart of this stand. The operability of this stand is very difficult due to the eskers, described above. The eskers are very steep in most places.

## **History**

There are no signs of recent activity from harvesting. The 1939 aerial photo shows some parts of this stand as forested. Most of the stand in the 1939 photo is open. By the time the 1962 photo was taken much of the stand was reverting to forest. This means the age of most of the trees in this stand is roughly 70-80 years old.



(Junk car in stand 2)

An old tire dump can be found in this stand. This tire dump is near the fire departments storage shed. Another remnant of past use are the junk cars scattered in this stand. There is a total of 5 junk cars found in the stand. One is along the main trail. The other 4 are at the top of one of the eskers on the eastern boundary of the stand and property. The eastern most trail runs through this area.

## **Soils**

The soils found in this stand are Hitchcock silt loam, 3 to 8 percent slopes. These soils are deep, and excessively to well drained. They are also erodible. This soil is very productive. The other soil type occurring in this stand is Windsor loamy sand, %25- 60 slopes. These soils are excessively drained and moderately productive. The soils give this stand a forest site class of 1 to 2 out of 4, with 1 being the best and 4 being the poorest. (see soil report for more details)

### Forest Health

Some common health issues were found. Those health issues included white pine weevil, beech bark disease, ash decline and red rot in the white pines. This stand should be monitored for hemlock wooly adelgid due to the high amount hemlock in the stand.

### Invasive plants

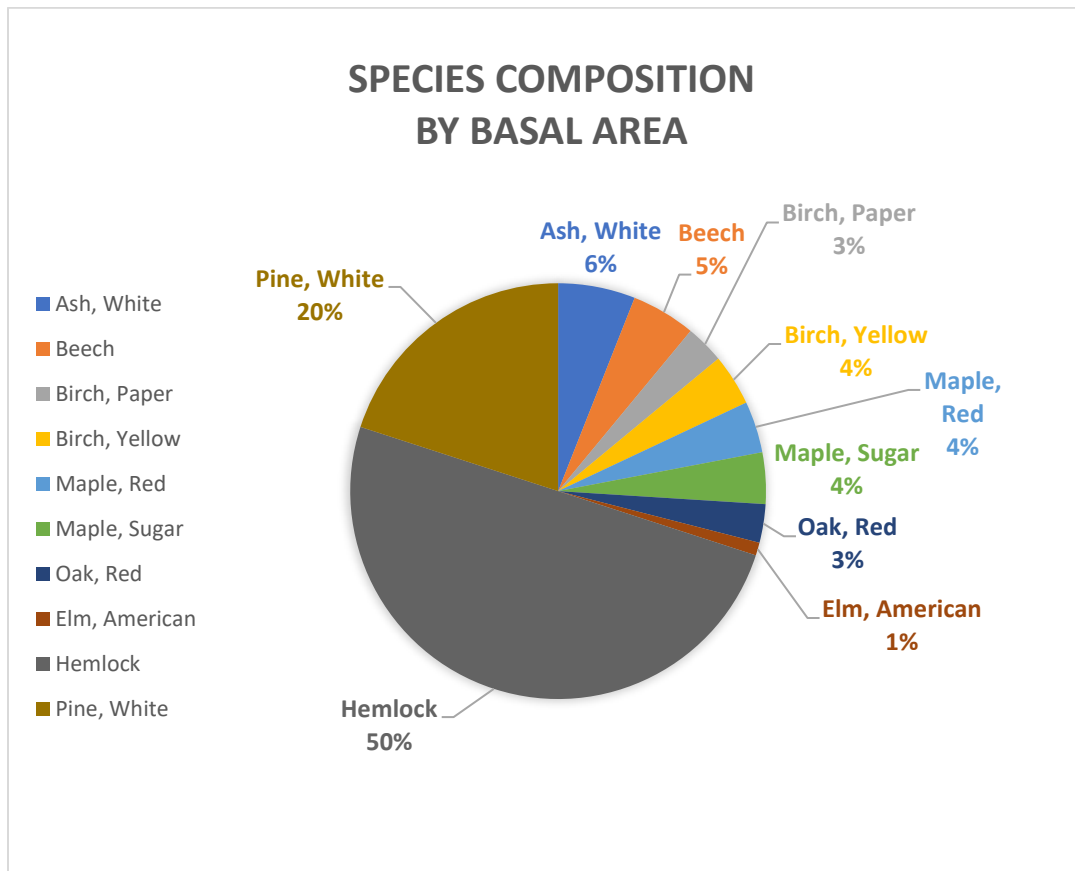
The periphery of the stand has some invasive plants present. Near the fire department shed and at the trail head there is a moderate amount of honey suckle, buckthorn and barberry. The interior of the stand is mostly invasive free due to the crown closure of the hemlock shading out the understory.

### Regeneration

Tree regeneration in this stand is lacking. Due to dense shade from overstory. What regen is present is made up of hemlock, beech, sugar maple or oak. The level of coarse woody debris in this stand is generally moderate.

### Species composition

This stand is a softwood stand with the most common tree species being hemlock and pine. Hardwoods make up a third of the stand's composition.



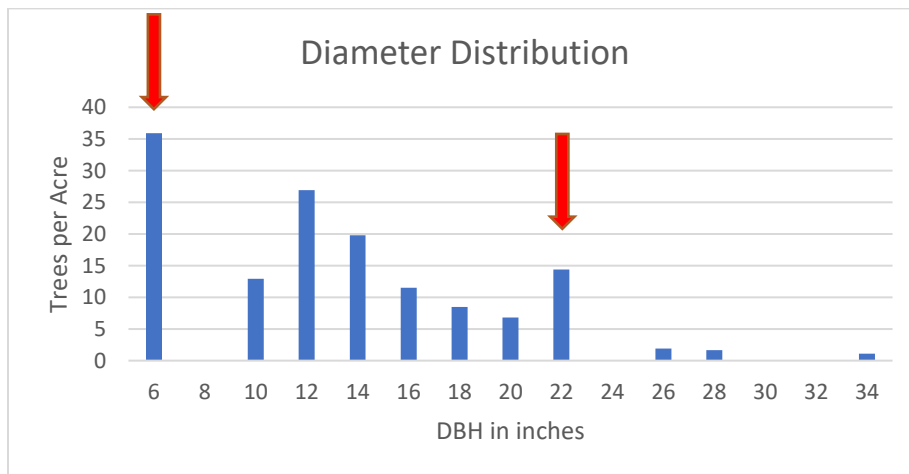


**Species Composition and Volume Table**

Species	Trees / Acre	Basal Area	%BA	QMD	Rel Density	%AGS	Sawlog Board ft/Acre	Pulp Cord/Acre	Mean Ht Sawlogs
Ash, White	2.96	10.91	6	26	8.2	83.3	0	2	2.5
Beech	5.15	9.09	5	17.99	7.04	0	0	2.5	2
Birch, Paper		5.45	3			0			
Birch, Yellow	6.81	7.27	4	13.99	5.78	75	366.22	1	1.5
Maple, Red	3.69	7.27	4	19.01	5.6	100	0	1.2	2
Maple, Sugar		7.27	4			75			
Oak, Red	2.07	5.45	3	21.97	4.64	66.7	402.03	0.4	1.5
Elm, American		1.82	1			100			
Hemlock	107.36	90.91	50	12.46	42.91	36	3,094.75	15.4	2.231
Pine, White	13.42	36.36	20	22.29	12.4	60	5,312.60	5.5	4.333
<b>TOTAL</b>	<b>141.45</b>	<b><u>181.8ft<sup>2</sup></u></b>	<b>100</b>	<b><u>15.35"</u></b>	<b>86.57</b>	<b>48</b>	<b>9,175ft<sup>3</sup></b>	<b>27.9</b>	

**Stand Structure**

This stand is two aged. Which means stand 2 has two distinct age classes. The large overstory trees are one of the age classes and the smaller pole sized trees are another age class. This stand will eventually move towards an uneven aged forest. This will happen as new tree regeneration becomes established and overstory trees fall out of the canopy.



(arrows indicate different age classes)

## Stand statistics

Quadratic Mean stand Diameter 15.35"

Basal area 181ft<sup>2</sup>

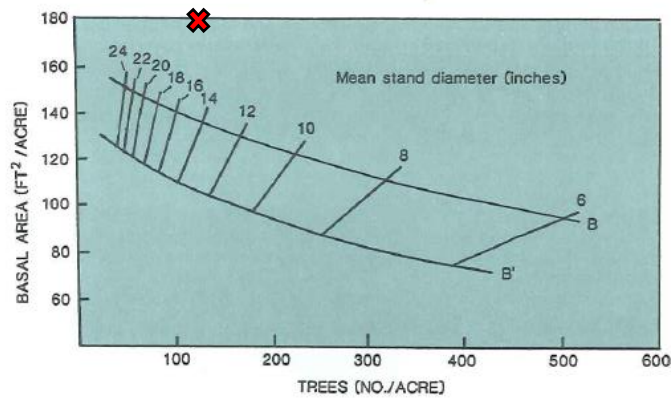
AGS BA 87.4ft<sup>2</sup>

UGS BA 94.6ft<sup>2</sup>

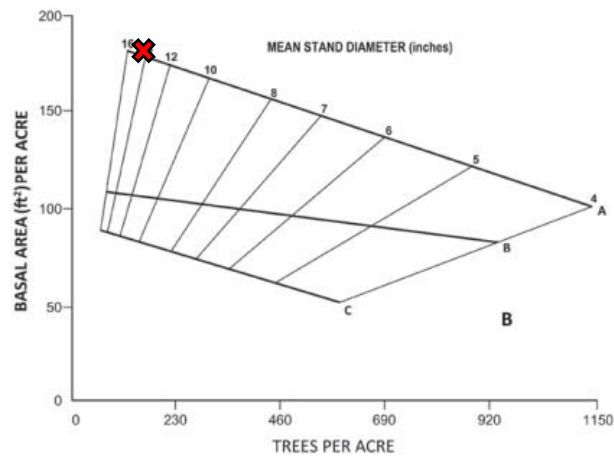
The stand is made up of saw log sized trees. The quality of the stems is poor. Many of the hemlocks in this stand have poor form or other defects. The white pine in this stand have poor form do to white pine weevil. There are some promising hardwood poles and smalls logs sized trees scattered throughout the stand.

## Stand density

There are two ways to look at the density of the stand and it depends on how it will be managed. If the stand is to be managed as a hemlock stand and a deer wintering area the hemlock guide should be used. If the stand is to be managed as a mixedwood stand, managed for all species then the mixedwood stocking guide should be used. Both are provided below.



The "X" show where the stand density charted out on the hemlock stocking guide. This is according to Management guide for Deer Wintering areas in Vermont. Hemlock can grow well in a overstocked condition and it is why this chart does not have an A-line for a fully stocked stand.



The "X" show where the stand density charted out on the mixedwood stocking guide according to Silvicultural Guide for Northern Hardwood Types in the Northeast. If charted out in using this guide the stand is considered overstocked.

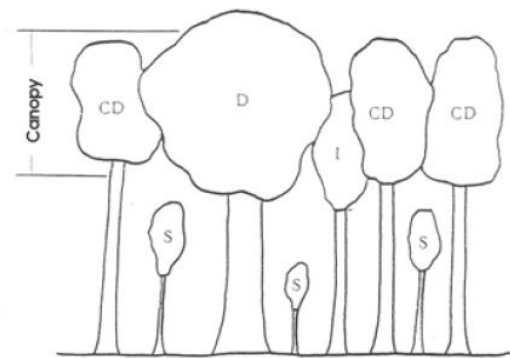
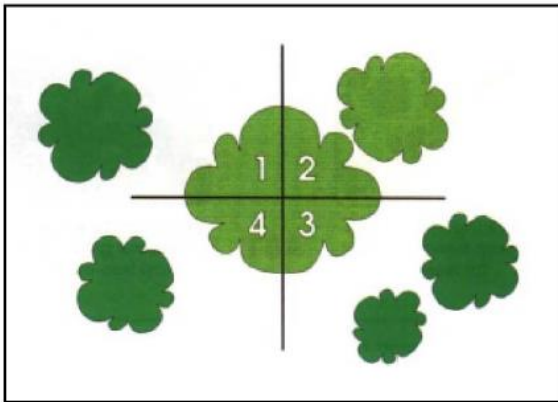
## Silvicultural management

This stand is not a good stand to manage timber in. The terrain is very tough and in spots inoperable. Treatments in this stand should be for wildlife, recreation and preservation of the unique geological areas. There are a few non-commercial treatments that could be done in this stand that would be beneficial.

### Treatment

#### Mast tree release - annual

The mast bearing hardwoods in this stand could be released. Target red oak, healthy beech, yellow birch and hickory for release. Release the trees on 3-4 sides. Tree to be removed from the canopy of the mast trees should be co-dominates. The two figures below show examples of the four sides of a crown and what dominant and co-dominant trees are in an overstory.



*Fig. 1 - Crown Classes (Maryland DNR Image)*

#### Small group selection - annual

Small opening of 4-5 trees could be removed in the overstory to release regeneration. This could be carried out either through girdling or felling trees. The groups should be placed in areas where there is softwood regeneration to be released. This would help to enhance and keep the softwood cover going into the future.

Both activities would be great projects for school students. The release work could be done with axes or saws depending on the ability. This work could be done as part of a Game of Logging class as well. A forester should be involved when selecting the trees to be removed.

### Non-timber management

### Trail enhancement – annual

There are a few nice trails running along the top of the eskers in this stand. These trails could be enhanced. Brushing out some more trails and marking the trails are good first steps. This stand is the entrance to the town forest from the village and should have a kiosk installed with trail maps and other forest related info. There are some good places for a kiosk in this stand.

### Build loop trail -2019

There are enough trails already established in this stand that a small loop trail could be established. A smaller loop trail closer to the entrance would be great for users of the forest looking for smaller 15-30min walk. It would complement the longer trail system that could be established in the rest of the forest.

### Sand pit extraction -annual

Figuring out where the expansion of the sand pit will be important in persevering the cathedral like entrance the forest. If the sand pit expands to the west this could be lost. Expansion north would keep the eastern esker in tack as you enter the forest.

### Removal of tires and junk cars -2019

Cleaning up the junk cars and tire pile in this stand is important. It is part of being a good land steward and is important for soil and water quality protection. If a timber sale is done in other stands it may be possible with the heavy equipment that will be operating in the forest to pull out the junk cars. They could be sold as scrap metal if the cars are accessible with a flatbed truck.

## Stand 3

**64 acres**

### **Description**

Stand 3 is a white pine transitioning to hardwood stand. The understory and mid story of the pine stand has established hardwood saplings and poles throughout. The soils in this stand are the same soils found in stand 1. There are rich site indicators though out the stand, like in stand 1. The pine in this stand are generally poorly formed from white pine weevil. Signs of red rot were found in the pine. In some spots the pine has blown over due to wind. This problem will only get worse as more wind events take place in the stand.

There are some trails established. They tie in to the main trail. There are two access points into this stand from Mill Street. One is from a trail in the northern part of the stand. The other is from a small landing in the eastern part of the stand. This landing has not been used in 10-15 years based on the trees growing in the landing. This landing could be used again in future logging operations. In stand 3 there is evidence of motorized vehicle use on most of the trails. It appears to be from dirt bikes and ATV's.

### **Terrain**

Terrain is generally gently rolling and accessible. There are few steeper sections in the north and south of the stand, generally the stand is operable and accessible. The northern section of the stand is hard to access due to a steep ledge that runs north south. It is possible to establish a hiking trail to access this area but is most likely to steep to establish a skid trail.

### **History**

There are no signs of recent activity from harvesting. In this 1939 aerial photo most of this stand is open. This stand was most likely cleared in some spots in the 1850's during the sheep farming boom and was maintained as open until the 1940's. Since then it has been allowed to grow back to forest. Some areas remained open as late as 1974. These areas have the worst quality pine growing in them. The stand age ranges from 50-70 years old.

### **Soils**

The soil found in the majority of stand is Vershire Dummerston complex, 25% to 60% slope, rocky. These soils are deep well drained soils. These soils are productive soils for northern hardwoods species. The other soil found in the eastern part of the stand is Hitchcock silt loam, 25% to 50% slopes. These soils are deep, and excessively to well drained. They are also erodible. The soil is very productive. The site class of these soils is a 1 out of 4, with 1 being the most productive and 4 the least productive. (see soil report for more details)

### Forest Health

White pine weevil has affected many of the pine growing in this stand. Signs of red rot (*Phellinus pini*) were noticed in some of the white pine in this stand. White pine needle cast is also affecting the pines in this stand. In the center of the stand there is roughly a half to an acre area of blow down. Once a stand like this begins to blow down, the problem does not get better but persists and more of the stand will likely start blowing down. Due to dense growing conditions, the Live Crown Ratio (LCR) of the pines are low, >20%. For white pine to respond to treatment, an LCR of 25% or more is ideal.

### Invasive plants

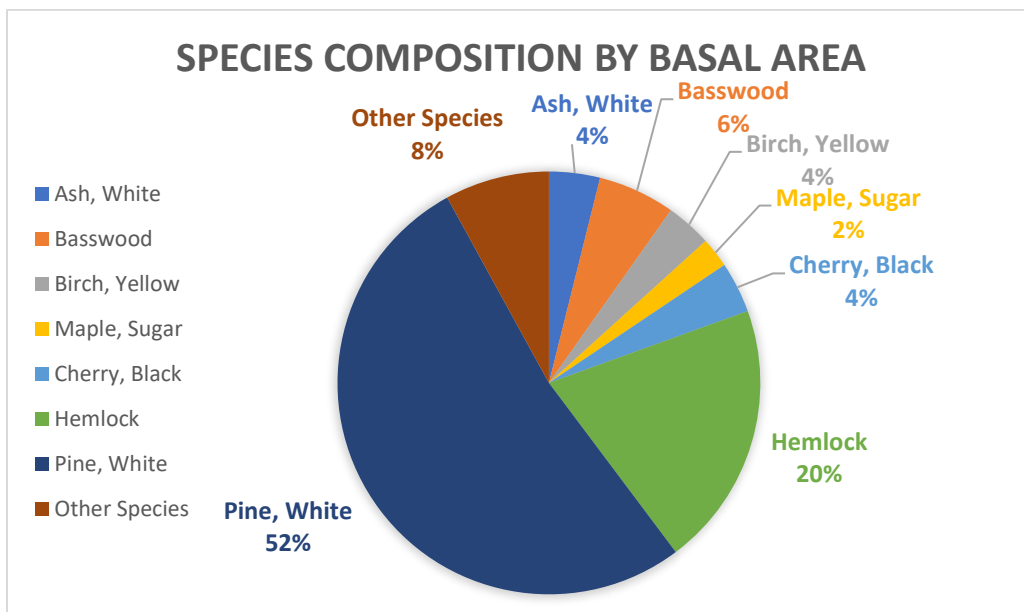
This stand has a light to moderate infestation of invasive plants. The most common invasives found is honeysuckle, also found was barberry and buckthorn. This stand should be treated before or immediately following any timber management. Not doing so will affect the outcome of management and make the infestation worse.

### Regeneration

This stand has well established hardwoods throughout most of the stand. These hardwoods are a mix of sizes from seedling to pole sized trees in the midstory. Some areas that have not been forested as long as the bulk of the stand do not have much regeneration established. There is plenty of course woody debris found throughout this stand, from blowdown and mortality due to competition.

### Species composition

The stand is made up of 50% pine trees. A third of the basal area is made up of hardwoods, roughly 60ft<sup>2</sup>. That would be enough stocking to have an adequately stocked hardwood stand.

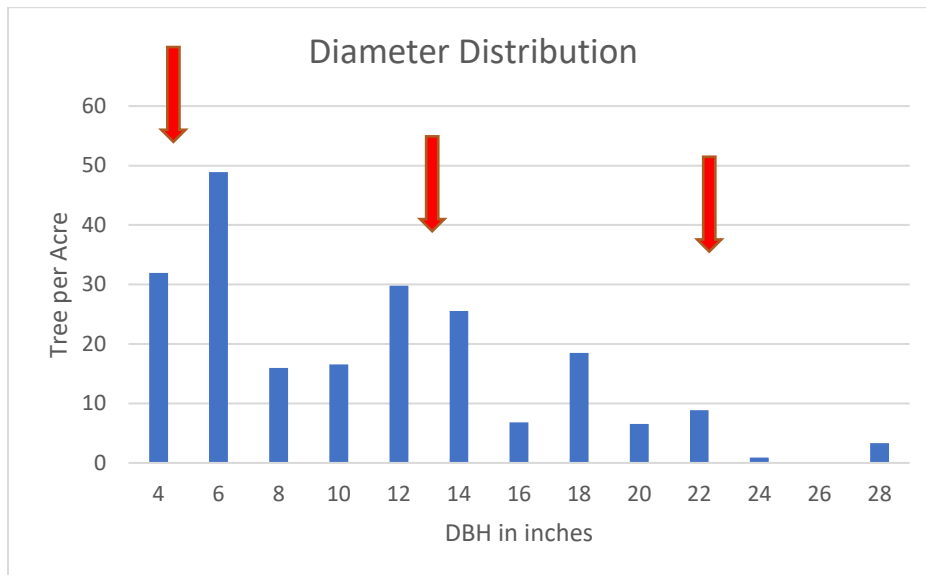


Species composition table and Volume Table

Species	Trees / Acre	Basal Area	%BA	QMD	Rel Density	%AGS	Sawlog Board ft/Acre	Pulp Cord/Acre	Mean Ht Sawlogs
Ash, White	6.04	7.14	3.9	14.72	5.62	100	553.18	0	1.25
Basswood		10.71	5.9			13.3			
Birch, Yellow	5.24	6.43	3.5	15	5.07	88.9	146.34	0	1.5
Maple, Sugar	16.7	4.29	2.3	6.86	3.77	33.3	0	0.1	0.25
Cherry, Black	23.6	7.14	3.9	7.45	6.28	40	0	0.8	1
Hemlock	51.07	37.14	20.3	11.55	17.49	38.5	940.25	5.6	1.654
Pine, White	77.05	95.71	52.3	15.09	37.81	18.7	1,515.08	16	1.744
Other Species		14.28	8						
<b>TOTAL</b>	<b>213.65</b>	<b>183ft<sup>2</sup></b>	<b>100</b>	<b>12.53"</b>	<b>81.64</b>	<b>30.52</b>	<b>3,154ft<sup>3</sup></b>	<b>23.7</b>	

### Stand Structure

This stand is an uneven aged stand. This means that it has three distinct age classes. These age classes were developed at different stages of stand development. The younger age class is made up of seedling and sapling hardwoods. The second age class is made up of small saw log size hardwoods and hemlock. The third age class is made up of larger pine, hemlock. The chart below shows three different groups of trees in different size classes.



(arrows indicate different age classes)

**Stand statistics**

**Quadratic Mean stand Diameter 12.5"**

**Basal area 182.8ft<sup>2</sup>**

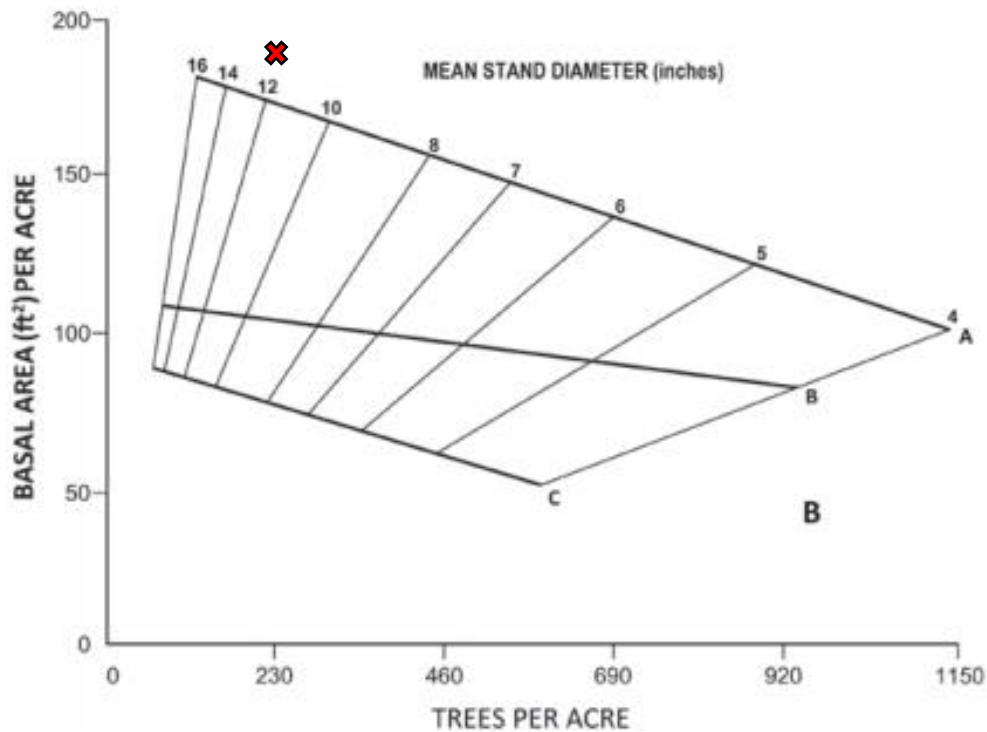
**AGS BA 56.7ft<sup>2</sup>**

**UGS BA 126.1ft<sup>2</sup>**

This is a highly stocked stand. It is stocked mostly with poor-quality trees. Due to the high stocking of this stand the crowns of the pine are small and mortality due to competition is found through out the stand.

**Stand density**

Based on the basal area and size of the trees, the stand is above the A-line of the mixed wood stocking guide. Meaning it is overstocked according to this chart. Trees in this stand would benefit from more growing space. The B- line of the stocking chart is the suggested residual stocking for optimal growth. The C-line of the stocking chart is the minimum preferred stocking of a stand. The A-line of the stocking guide is a fully stocked stand.



The "X" show where the stand density charts out on the mixedwood stocking guide according to Silvicultural Guide for Northern Hardwood Types in the Northeast, NE-603



## **Silvicultural management**

This stand is in transition. It is transitioning from a white pine stand to a northern hardwood stand. This stand has the same soils as in stand 1. Eventually the composition of this stand will be similar to stand 1. This will take time. As the white pine decline and fall out of the canopy they will be replaced by hardwoods. This is already happening in parts of the stand. We can speed this transition up by removing the pine and releasing the already established hardwoods. Targeted removal of declining pine will get this stand to a more productive state. The species mix of the regeneration will greatly benefit from more sun light. Some pine have good form and crowns and seem wind firm. These pines should be promoted where it makes sense to do so. The following prescriptions will work to speed up the transition of this stand from pine to hardwoods, capture declining pines, release hardwood regeneration and promote pine where it makes sense to do so.

## **Treatment**

### **Group Overstory Removal 2019-2020**

In areas where pines are blowing over or in areas of high poor quality, implement a group overstory removal of white pine. These patches will remove all overstory pine. All hardwood in these patches will be retained regardless of quality for seed dispersal and stocking. The size of the patches will be guided by the quality of pines or size of areas vulnerable to wind thrown, they could be as large as 10ac. No more than 3 large patches will be cut. No more than half of the stand will be in these groups or no more than 30ac.

### **Group selection with thinning/shelterwood in-between 2019-2020**

In the areas in between the overstory removal areas a thinning or shelterwood will occur with small groups >.5ac in size. The thinning will target well form pine and hardwood for release. Any red oak will be retained regardless of quality. The residual basal area will vary depending on the composition of the overstory. In areas where the overstory is mixwood the residual basal area will be 90-100ft<sup>2</sup>.

In areas where the overstory is mostly white pine and there is no regeneration the first stage of a shelterwood will be implemented. This will reduce the basal area to 80-90ft<sup>2</sup>. Well form white pine with good LCR will be retained. Once these areas have regenerated, either the second stage of the shelterwood will be implemented, reducing the basal area to 60-50ft<sup>2</sup> or the overstory will be removed.

The small groups will be implemented in areas where hardwood regeneration is well established. No more than 10% of the non-patch OSR area will be in groups or no more than 3.5ac will be in small groups. These groups will be .25ac to .5ac in size

## **Non-timber management**

### **Trail Enhancement - 2020**

A major timber sale is being recommended for this stand. Which means large equipment will be operating in this stand. This will be an opportunity to get some trail work done. Either through upgrading used skid trails or asking the operator to build new hiking trails post-harvest. The details of using a logging operator to enhance trails will have to be worked out in a contract before the work begins. It will also depend on who does the work proposed.

Work can be done to fix up damaged roads without the use of heavy equipment. Water bars and drainages can be reestablished with hand tools. Getting motorized vehicles off the roads will be a big step in reducing the damage being done.

### **Landing / small field development – 2019-2020**

A new landing could be built in this stand. This landing would be roughly an acre in size, located in the east central part of the property, the southernmost part of stand 3. This landing would be serviced by the main trail that runs through the property. Minor improvements to the trail would have to be made to make it passable for logging trucks. The material could be mined from the property itself. When this landing is not being used for forest management it will provide wildlife habitat for birds, deer, bear, hawks and owls and other wildlife that use annually mowed fields. It would also be a place for picnic tables for user of the forest.

### **Invasive plant removal – annual**

Invasive plants should be treated in this stand. Besides the field edges, this stand has the worst invasive plant problem. These plants should be treated as part of any timber sale that is done here either before or after. A treatment with herbicide will get the problem to a more manageable level. After the initial herbicide treatment, control could be done through mechanical methods.

## Summary

The Crawford town forest is a great asset for the community of Royalton and surrounding towns. The forest has seen very little management activity. The past land use of the property went from farming in the early to mid-1900's to primarily being used as an auto repair shop. With the primary use of the auto repair shop being tire and car disposal. The forest has been neglected for some time.

There is potential to do some great work in the forests of Crawford. This property could provide educational opportunities for the local school, recreational opportunities for community members and promote and preserve the natural communities and wildlife habitat of the property. This can all be done while the forest is being managed through periodic timber sales. These timber sales will generate income and more importantly get the forest in a more healthy and productive state. Active management and use of this neglected forest will turn it into a working forest, much like the rest of the forest land in Royalton.

The income generated from these timber sales should be invested back into the property to help fund different projects, like the ones outlined in this plan. These include invasive plant control, trail enhancements and maintenance, waste removal, a kiosk, parking lot enhancements, road improvements and landing/meadow installation. All of these projects will enhance the property and make it more user friendly. The goal being to get more community members to use and enjoy their town forest.