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Silviculture Prescription
Brookline Road

Massachusetts Department of Conservation and Recreation
Bureau of Forestry

Northeast District
Townsend State Forest
Townsend, MA

Prepared by:

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Approved by:

Management Forestry
Program Supervisor  Date: January 13, 2017

William N. Hill, CF

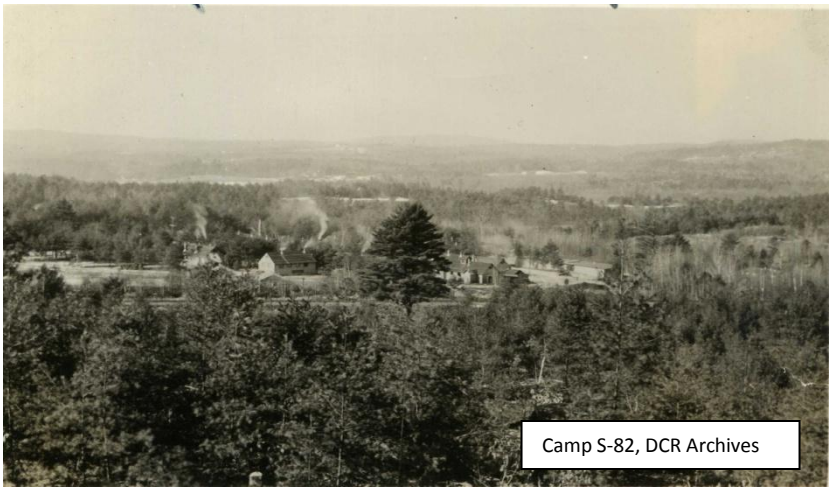
Site Data:

Cultural and Historical:

The Townsend State Forest is located in the north central section of the Town of Townsend, Middlesex County, Massachusetts. The project areas are located along the East (3 stands covering approximately 30 acres) and West (2 stands covering approximately 60 acres) sides of Brookline Road (Route 13) (Appendix Maps 1 and 2). This area of Townsend State Forest is part of approximately 1700 acres deeded to the Commonwealth in the 1930's by the Fessenden Companies based in Townsend. These lands, along with other acquisitions, were consolidated into what is now Townsend State Forest (Appendix Map 3).

Previous land use of this area was subsistence farming, livestock grazing and timber extraction. Evidence of previous land use prior to state ownership can be seen in the stone walls and old cellar holes found within and around the project areas. At the time of acquisition these properties were heavily cut over to provide the raw material necessary for the manufacture of barrels and other lumber products. Cutting was focused on trees that could provide the material necessary for industry and little focus was placed on promoting the long term viability of the forest. Extractive cutting of these forest lands left them in a degraded condition subject to outbreaks of wildfire as occurred in 1927 burning 28 square miles in Massachusetts and New Hampshire.

In the mid 1930's the Civilian Conservation Corps established camp S-82 in Townsend as part of Franklin D. Roosevelt's "New Deal." The young men who worked in this camp gained much needed employment and improved job skills for when economic conditions improved. As part of the Corps conservation and reforestation efforts many thousands of softwood seedlings (e.g. pine and spruce) were planted in this area.



Camp S-82, DCR Archives

Townsend State Forest has been actively managed since acquisition by the state. Many commercial and non commercial projects have taken place over the years and guided forest composition and structure as it appears today. The last such forestry project conducted by the Department of Conservation and Recreation (DCR) in this area was in 1995.[1]

The 2012 Landscape Designations for DCR Parks and Forest: Selection Criteria and Management Guidelines document states, in part. "*Forest management will also play a role in the ecological restoration of areas that have been significantly altered by past land use and management practices such as plantations of non-native species and high-grading*."[2] Within the project areas are white pine (*Pinus strobus*) and non-native red pine (*Pinus resinosa*) plantations along with naturally developed mixed hardwood and pine stands that established after the forest fire.

Geology and Soils:

This area of Middlesex County has, in general, relatively thin soils, rocky outcrops, with the underlying bedrock close to the surface. The soils in this area generally fall into the glaciofluvial (glacial outwash) and glacial till types derived from gneiss and granite. The soils in this area formed as a result of deposits left from the Wisconsin Glacier retreating several thousand years ago leaving behind boulders, stones and soil deposits in its wake.[3]

Elevations within the project area range from approximately 350 feet in the southerly and easterly portions of the project areas and rise approximately 450 feet in the northerly and westerly sections. The topography can be described as generally rolling (0%-10% slope) in nature interrupted by short steep rocky outcrops (15%-25% slope) with an easterly and southerly aspect.

The soils of the Brookline East portion of the project fall primarily into the Canton and Hinckley series of soils (Appendix Map 4), covering approximately 75% of the project area. The remainder of the project area is made up of the Scarboro, Freetown, and Wareham series of soils. The common theme among these soils is a sandy-loamy-stony nature due glacial origin. Soil productivity is moderate to good on these soils with site indexes of 61 for eastern white pine and 49 for northern red oak (*Quercus rubra*) for the Hinckley soil series.[4]

The soils of the Brookline West (Appendix Map 5) portion of the project are dominated by Hinckley and Windsor series of soils, covering approximately 90% of the project area. The remaining areas being made up with the Canton and Rock outcrop-Hollis Complex soil series. As with the eastern portion of the project area soil productivity is moderate to good. Site indexes for the Windsor series being 61 for eastern white pine and 49 for northern red oak respectively.

Soil formation and structure are drivers of both forest development and productivity. Soils in the project areas, in general, are moderately to well drained, with the exception of the muck soils. These types of soils have a tendency towards droughtiness as moisture drains rather quickly through the soil strata thus limiting availability for uptake by plant roots. These moderate to low productivity soils lend themselves to forests that are dominated by eastern white pine and oak forest types, since these trees species are more adapted to xeric soil conditions. Low to moderately productive soils lend themselves to

both even and un-even aged management strategies. Soil productivity will be protected by seasonally restricting operations to fall/winter when conditions are dry or frozen.

DCR Management Guidelines of 2012 state that "*Forests stands will be classed on a continuum and considered for silvicultural treatments that generally fit their productivity, structural complexity (or potential thereof) and diversity."* Analyzing the site productivity and complexity using Geographical Information System (GIS) data layers of prime forest soils, potential vegetation complexity, late successional potential, forest diversity, early successional potential, continuous forest inventory (CFI) site index, and CFI stand structure verifies the low to moderate productivity of these forest stands.[5]

Climate:

The weather in this area of Massachusetts is typical with seasonally changing conditions. According to the National Oceanic and Atmospheric Administration data set this area has an annual average precipitation of 34.5" and a mean annual temperature of 44.8°F.[6]

Major episodic weather events (i.e. hurricanes, ice, etc.) are major factors in forest development throughout New England. The 2008 ice storm and October 2010 snow storm caused significant damage to established regeneration within portions of the project area. Mature trees were not spared either as both hardwood and softwood trees were damaged by these events.

Ice Damage - 2008

Variable weather events are not uncommon for the area and effect forest development over time with wind being the most significant driver of forest development over time. These winds, in general, originate from the south and southwest during warmer months, and north and northwest during cooler periods of the year.

Hydrology and Watershed:

The Brookline Road project area has several intermittent streams, vernal pools (certified and potential) and associated wetlands (see detail maps) and is part of the Nashua River Watershed. As rainfall and snowmelt are introduced into the project areas they drain through several small intermittent streams and drainages into "Wolf Swamp". This discharge flows southward towards Townsend center and the Squannacook River, which discharges into the Nashua River approximately 9 miles to the

southeast. The closest public water supply is approximately ½ mile south of the eastern portion of the project area.

Beaver (*Castor canadensis*) activity over time has expanded Wolf Swamp due to dam building and subsequent flooding of previously forested areas. This flooding has improved habitat for wetland dependant species of flora and fauna.

The project areas are located within the Squannassit Area of Critical Environmental Concern (ACEC). ACEC areas provide protection to public and private groundwater supplies, provide flood control, and protect valuable fisheries and important wildlife habitat. In order to minimize any site impacts there will be no cutting within 50 feet of streams, wetlands, or vernal pool areas with the exception of trees that need to be removed at an approved stream crossing or hazard trees along existing forest roads.

Resource areas will be buffered in the field with flagging and paint. These areas will be mapped in accordance with regulations found within the most recent edition of the Massachusetts Forestry, Best Management Practices Manual.[7] There are no wetland crossings in the project areas, and all stream crossings (other than existing culverts along forest roads) will be made with temporary bridges that will be removed at close of operations.

Archeological Features:

Located within the project areas is evidence of prior ownership and land use. Prior to State ownership these properties were used for livestock grazing, subsistence farming and timber extraction. The remains of old stone walls, a cellar hole and an old well are found within the western portion of the project area. The eastern section of the project contains the remains of a few old stone walls. Existing breaches in the stone walls will be used for access by equipment.

A review conducted by the DCR Archeologist of the project areas indicates that there are no known

pre-contact sites recorded, within or adjacent to the project. Known features will be protected with flagging and paint prior to project implementation.

Recreation:

This area is most widely used for passive recreation. Hunting, hiking, bird-watching, geocaching and mountain biking are the most prevalent activities in this forest. Illegal all-terrain vehicle use is an issue, but confined mostly to the main forest roads.

There is one hiking trail located in the western portion of the project area that bisects Stands 1 and 2. All other trails in the project areas are the existing forest roads. The harvest area will be posted to alert constituents to program activities and closed during operational hours.

Existing legal trails within the project areas will be utilized to access the project areas. No slash will remain within 25' of trails, and slash will be treated to promote rapid decomposition and a light appearance. As noted in the management guidelines document forest management activities occurring within trail corridors will focus on retaining larger diameter, healthy trees and promote a safe experience for recreational users. Forest management activity will help to reduce the number of dead and dying trees located along forest trails and roads to meet that goal.

Wildlife:

The Brookline Road project area is used by a variety of native wildlife species. Beaver activity in the eastern portion of the project area has been the driver of ecological development for the site. Dam building has resulted in several acres of flooded snags. These snags provide habitat for invertebrates and the avian species that feed on them. These snags also provide perches for raptor species present in the area for hunting.

There is evidence of ungulate species (white tail deer (*Odocoileus viginianus*) and moose (*Alces alces*)), but generally the project area is used by large animals to pass through to other feeding and bedding areas. It is therefore anticipated that these animals will make minimal impact on regeneration. Other animal species that have been noted in the project area are; black bear (*Ursus americanus*), bobcat (*Lynx rufus*), coyote (*Canis latruns*), opossum (*Didelphis virginiana*), along with a variety of avian species

The proposed activity for the Brookline Road project area will provide positive benefits to wildlife by increasing species diversity and vertical structure of the forest. Establishment of regeneration will be a benefit to animals that utilize younger forests as part of their life cycle. Creation of gaps within the forest will provide an "edge" effect that is attractive to many bird species for nesting and foraging. These gaps will also stimulate the herbaceous and shrub vegetation due to increased sunlight penetration to the forest floor benefitting foraging animal species.

Retention of large (>18"DBH) known cavity trees, snag trees, and course woody material on the forest floor will benefit invertebrates, amphibians, and small mammal species that depend on them for their life cycles. Retention and release of large mast producing species (oak and cherry) will benefit native wildlife through the increased production of nuts and fruits. Reserving areas from management (wetlands and vernal pools) will benefit species that require these features for parts or all of their life cycles.

Rare and Endangered Species:

Review of the 13th edition of the Massachusetts Natural Heritage Atlas shows that the project areas do not fall within priority habitats for rare and endangered species. [8]


Gypsy moth larvae – USFS photo

Insects and pathogens:

This area of the forest was subject to Gypsy moth (*Lymantria dispar*) outbreaks in the early 1980's. The spring of 2016 has seen a resurgence of this forest pest as a result of environmental conditions beneficial to population growth of this introduced pest in other areas of Massachusetts. A small number of caterpillars were observed during the course of stand examination, but no significant amount of defoliation was observed. Oak species are preferred by this destructive pest, and repeated defoliation can lead to crown dieback and eventual mortality affecting the diversity of the forest.[9]


Emerald ash borer adult and larvae – USFS photo

Emerald ash borer (*Agrilus planipennis*) is another introduced pest on the horizon for the forests of New England. Although occasional ash trees were inventoried within the project it does not make up a major component of the forest in this area. Trees infested by this pest experience rapid mortality. This can lead to changes in forest structure and affect overall diversity as a result of species loss.[10]

Dead red pine due to red pine scale. Paul Gregory DCR Management Forester Photo

Also found within the project area is a red pine-white pine plantation (Stand 3 Brookline Road East). Unfortunately, the red pine found on this site are susceptible to the fungal pathogen diplodia blight (*Diplodia pinea*), and red pine scale (*Matsucoccus resinosae*). Red pine infected by these pathogens can experience rapid decline in vigor leading to extensive mortality.[1112]

Caliciopsis canker (*Caliciopsis pinea*) is another concern for white pine forests in New England. The native fungus damages the thin bark of pine trees causing trees to ooze pitch profusely. Trees affected by this can suffer reduced crown density and reduced vigor. Over the long term these weakened trees may become more susceptible to secondary attacks eventually leading to mortality. Caliciposis can be found in high density stands of white pine on sandy well drained soils. Management strategies that allows for greater temperature and sunlight may decrease risks to white pine.[13]

Caliciopsis canker. Jennifer Fish-DCR Service Forestry Photo

Current and Potential Vegetation:

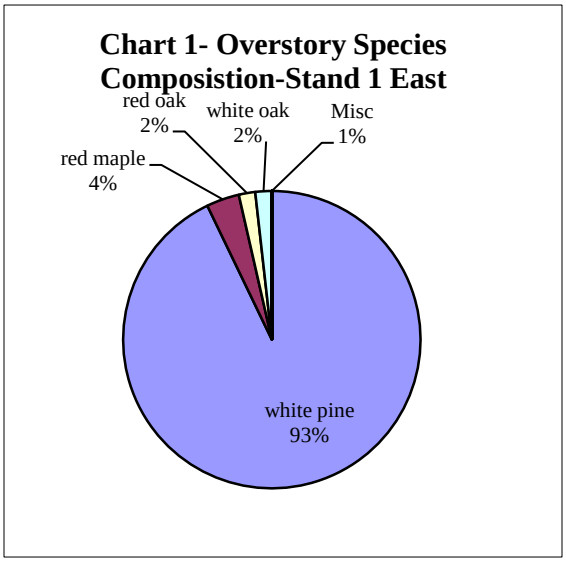
Methodology:

A GIS grid was developed in order to conduct a thorough stand exam of the project areas. Two phase or "Big BAF" sampling was conducted at 89 inventory plots collecting attributes on the overstory and understory of the project. New Hampshire Forests and Lands, Fox DS Cruiser version 2007.2 was used to process the overstory data. Understory vegetation was sampled at each inventory plot using standards set forth in the DCR Manual for Continuous Forest Inventory for regeneration plots (1/300th acre plot size).[14] One hundred foot course woody material transects were conducted from each inventory plot.

Evaluating data gathered during stand examination helps inform the decision making process and provides a basis to guide vegetation management. Foresters use basal area, relative density, trees per acre and other data to recommend a course of action (prescription) for forested landscapes.

Stocking charts developed over many years of research help foresters determine if forest stands are over stocked (A-Level), fully stocked (B-Level), or under stocked (C-Level) by graphically comparing the variables: basal area per acre, trees per acre, and mean stand diameter. The use of relative density is helpful as it describes where current stands fall within these stocking guidelines, (i.e. relative density of 75% means a forest stand is stocked within 75% of full stocking or the maximum of the A - level).

Results-Brookline Road East:



The section of the project area consists of 3 stands of native and non native vegetation. Stand 1 (8 acres) is an even aged white pine stand that was thinned back in 1983 and 1995.[15] The forest canopy of this stand consists of (in decreasing order of dominance) eastern white pine, red maple (*Acer rubrum*), equal proportions of northern red oak (*Quercus rubra*) and white oak (*Quercus alba*), and miscellaneous species such as black birch (*Betula nigra*) and paper birch (*Betula paparifera*) making up the remainder of the stand (Chart 1, Appendix Tables 1 & 2).

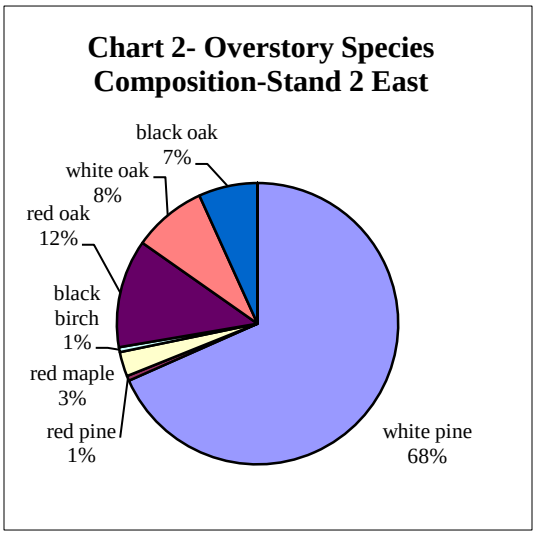
The forest canopy of this area is almost pure white pine suggesting that this may have been planted by the CCC crews in the 1930's. However, no definitive records as to these trees being planted were discovered during research for this project. The trees are generally even aged saw log sized with a median stand diameter of 13.8". The majority of the white pine is either in a dominant or co-dominant canopy position, while the other species observed within the stand occupy the lower intermediate and suppressed size classes. The stand contains approximately 124 square feet of basal area, 277 trees per acre with white pine dominating the species composition. The stand is moderately stocked with an estimated relative density of 53.1.

The understory and potential vegetation of Stand 1 is comprised of native tree and shrub species. White oak, white pine, and red maple were most commonly found in the understory along with lesser amounts of red oak, black birch and American chestnut (*Castanea dentata*) trees (Appendix Table 3). Some larger chestnut trees (<5" DBH) were observed in the stand but because of chestnut blight (*Cryphonectria parasitica*) the trees never reach maturity. No invasive species were noted in this stand during the course of field work.

Herbaceous vegetation found in this stand is comprised of native species with eastern teaberry (*Gaultheria procumbens*), and low bush blueberry (*Vaccinimum angustifolium*) being the most commonly observed species (Appendix Table 4). Other species noted in the stand include dewberry (*Rubus flagellaris*), unidentified grasses, sheep laurel (*Kalmia angustifolia*), cinnamon fern *(Osmunda cinnamomea*), arbutus (*Arbutus sp*), high bush blueberry (*Vaccinium corymbosum*), Mt. laurel (*Kalmia latifolia*), partridgeberry (*Mitchella repens*), and American witch hazel (*Hamamelis virginiana*).

Course wood material (CWM) and snags are found throughout the stand. It is estimated there is 511 cubic feet of CWM and 24 (<12"DBH, all softwood) snags per acre within the stand. Part of this stand

was partially flooded due to beaver activity causing some mortality to the stand, thus increasing the amount of CWM and snags found in this stand. Management guidelines recommend maintaining a minimum of 256 cubic feet per acre of CWM and a minimum of 5 dead snags (> 10" DBH) per acre.



Analyzing the data of Stand 1 points to a condition where the trees are experiencing slow to moderate growth due to a competition for resources (soil moisture, light and nutrients). The current basal area of 124 ft², and 277 trees per acre show the stand stocked above the "B line" according to stocking charts for white pine stands.[16]

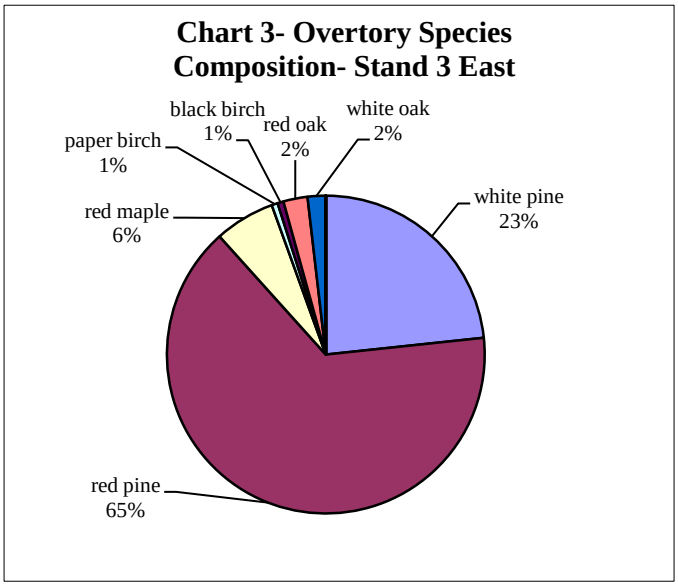
The management for this stand is to introduce a new cohort of trees within it by using an irregular shelterwood regeneration system. With this system small gaps are made in the canopy to stimulate the regeneration process. Over time these gaps are expanded giving rise to different age classes within the stand. Trees outside of the gaps are thinned to promote increment and canopy growth. Over time trees of various heights and ages give the stand an "irregular" structure that is more complex vertically and horizontally.

Stand 2 (15 acres) is an even aged mixed white pine-hardwood stand that was partially thinned (west of the brook) in the 1990's along with Stand 1. The trees are approximately 80-90 years old and no records indicate that this portion of the project (other than the interface with Stand 3) was part of the CCC planting efforts. Therefore, the forest that exists is one that naturally grew up from the surrounding seed bank save a few red pine.

The majority of the stand is made up of small saw log and pole sized white pine and oak species with lesser amounts of red maple, black birch, and a few red pine (Chart 2, Appendix Tables 5 & 6). The stand contains approximately 126 square feet of basal area, with approximately 309 trees per acre, with white pine making up the bulk of the overstory. The stand is well stocked with an estimated relative density of 74.4.

The understory and potential vegetation of Stand 2 is comprised of native tree and shrub species (Appendix Table 7). The most common understory trees are white oak and white pine along with similar species as found in Stand 1. In addition to those species black cherry (*Prunus serotina*), and black oak (*Quercus velutina*) were also inventoried in this stand. The herbaceous species found in this stand are similar to those found in Stand 1, with the addition of club moss (*Lycopodium sp.*)(Appendix Table 8). No invasive species were noted in this stand.

Located within this stand are approximately 31 snags per acre with the majority being less than 12" DBH, derived from white pine and a few (5) hardwood species. The stand also contains approximately 391 cubic feet of course woody material on the forest floor. This material is both of softwood and hardwood species and consists of both sound and decayed types.



Analysis of Stand 2 data shows the stand approaching an over stocked condition with a relative density of approximately 74% and basal area of 126 ft² according to stocking charts for white pine and oak forest types.[17] A commercial thinning of this stand reducing the basal area approximately 20-40% is recommended to increase tree vigor, stimulate increment, and allow for canopy expansion.

Stand 3 (8 acres) is an even aged red pine-white pine plantation with scattered hardwood trees found throughout the stand. The trees are approximately ±80 years old and have never had any silvicultural treatments since planting and are small saw log and pole sized. The majority of the stand is made up of red and white pine (Chart 3, Appendix Tables 9 & 10). There is an estimated 163 ft² of basal area and 344 trees per acre. The stand is approaching and over stocked (A-line) condition with an estimated relative density of 86%.

The regeneration vegetation found in this stand is composed of a variety of native tree species consisting mainly of white pine and black birch, with lesser amounts of red maple, white and red oak and a few eastern hemlock (*Tsuga canadensis*) seedlings (Appendix Table 11). The vast majority of these trees are in category 1 (>3"-<12") with very few larger seedlings and saplings observed in the stand due to a closed canopy condition.

The herbaceous component of this stand is composed mainly of lowbush blueberry and eastern teaberry. This stand contains similar herbaceous species as Stands 1 and 2, but, a few maple leaf viburnum (*Viburnum acerifolium*) were inventoried in this stand (Appendix Table 12). No invasive species were noted in this stand.

Another species of note in this stand, but did not fall into any inventory plots, is green briar *(Smilax sp.*). Although not invasive, it can be a nuisance species because of its aggressive growth habit. It is a source of browse for wildlife and also a source of cover for wildlife. Very few of these plants were observed and confined mostly to the south eastern portion of the stand.

Course woody material is found throughout this stand and is estimated at 250 cubic feet per acre. This material is made up of mostly red pine trees that have died as a result of competition within this

stand. This project will be conducted with a cut to length harvester and forwarder which leaves course woody material behind, therefore additional material will be added to the stand when the project is implemented more than exceeding the recommended threshold of 256 cubic feet per acre.

Standing snags are scattered throughout the stand and are estimated at 41 per acre. All standing snag observations were less than 12" DBH and made up mostly of red pine. Since the stand is highly stocked this is no surprise as competition for sunlight and moisture has caused less vigorous and suppressed trees to die.

Analyzing the data of Stand 3 shows the forest approaching an overstocked condition with an estimated relative density of 86% and basal area of 163 ft². Red pine plantations with these kinds of conditions tend to have low live crown ratios, limited diameter growth, and low vigor since the trees are competing for a dominant canopy position and scarce resources (water, sunlight, etc.).

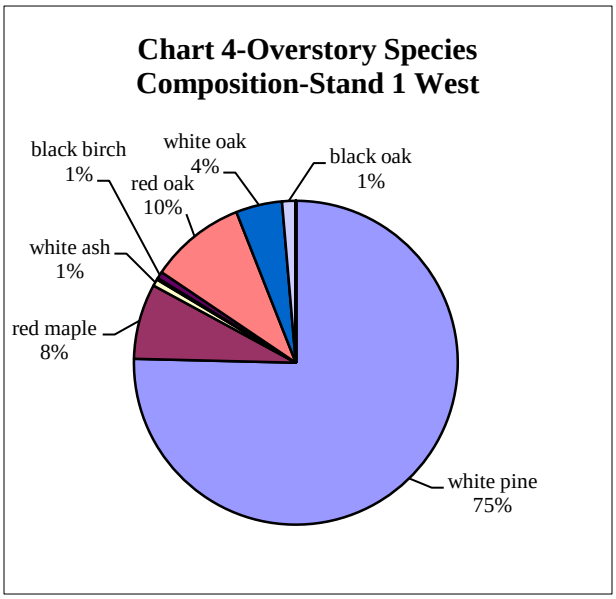
This stand will be treated similarly to Stand 1 with an irregular shelterwood system. The goal to using this type of system is to replace the red pine component of the stand over time with native white pine and hardwood species. Canopy gaps (not exceeding 1/3 acre) will be made focusing on retention of superior hardwood and white pine as seed sources for regeneration. Thinning will occur outside of these gaps to promote stand vigor by removing suppressed, diseased trees, and low quality stems. This will allow for increased diameter and crown growth on future crop and reserve trees.

Results-Brookline Road-West:

This portion of the project area consists of 2 stands of native and non native species. Stand 1(54 acres) is an even aged white pine plantation that was treated with a pulpwood harvest in 1991 removing low grade trees.[18] There are a few scattered red pine found in this stand, but overall this species makes up very little of the stand composition. The trees are approximately ±85 years old.

The western portion of Stand 2 has more hardwood trees mixed in as this is the transition between the plantation and naturally seeded surrounding forest. The trees in this stand are small saw log and pole sized class with some larger (>18" DBH) scattered throughout. Also located within this stand is a small wetlands complex and a certified vernal pool (See detail map). This portion of the stand is excluded from the prescription as natural processes will be allowed to dictate forest composition in this area.

The canopy of this area is almost pure white pine making up approximately 75% of the overstory, followed by red oak, red maple, white oak, black birch, and white ash (*Fraxinus americana*) (Chart 4, Appendix Tables 13 & 14). There is an estimated 117 ft² of basal area and the stand is moderately well stocked with an estimated relative density of 61%.



The understory and potential vegetation of this stand is composed of native vegetation, the majority being white pine, red oak and white oak species. Other species of note are red maple, black birch, gray birch (*Betula populifolia*), and hophornbeam (*Ostrya virginiana*) (Appendix Table 15).

The herbacious species found in this stand are consistant with other stands in the project area with the addition of several other plants. These plants being bracken fern (*Pterdium sp*.), Canada mayflower (*Maianthemum canadense*), sweet fern (*Comptonia peregrina*), huckleberry (*Gaylussacia sp*.), goldenrod (*Solidago sp*.), star flower (*Trientalis borealis*), and a few glossy buckthorn (*Frangula alnus*) plants (Appendix Table 16).

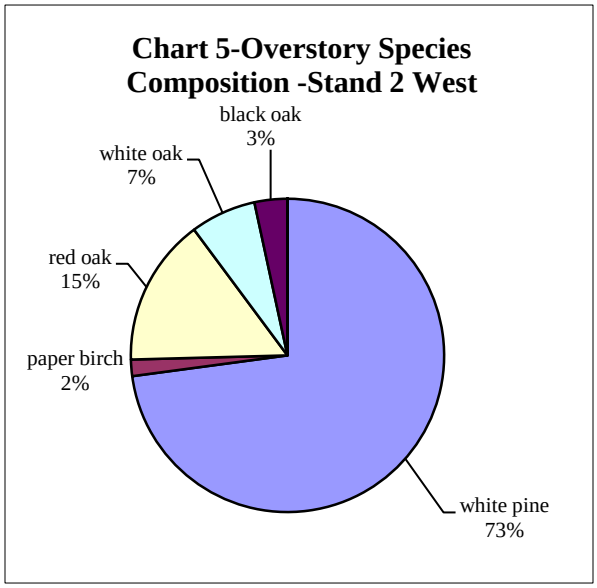
Glossy buckthorn is an invasive plant that readily outcompetes native vegetation. Left unchecked this plant will dominate the understory and replace native tree and shrub vegetation within a forest stand. All plants that were observed during stand examination were mechanically pulled, and follow up treatments (mechanically pulling any additional plants found during marking and post harvest monitoring) will be made to minimize impacts from this plant.

Course woody material is found throughout this stand and is estimated at 266 cubic feet per acre. The majority of this material being derived from white pine and oak species and ranges from small (<3”) to larger (>12”) pieces as a result of natural mortaility and damage caused by the 2008 ice storm. Standing snags are found throughout the stand and are estimated at 17 stems per acre.

Analysis of the data for this stand shows it in a fully stocked (B-line) condition. Previous silvicultural treatments (pulpwood thinning) left a stand of healthy trees and introduced a regeneration component to this stand. The 2008 ice storm, and subsequent early fall 2010 snow storm caused significant damage to this regeneration and also caused damage to the overstory component of this stand (mainly broken tops). A group selection silvicultural system is recommended for this stand to break up the monotypic overstory and introduce a new cohort of trees to replace those previously lost to episodic weather events.

Stand 2 (3 acres) is a mixed white pine-hardwood stand that was partially treated with a home fuelwood project back in the early 1990’s.[19]The trees are generally even aged in pole to small sawlog size

with ocaasionally larger specimens (>18" DBH) found within it. The stand contains approximately 98 square feet of basal area with approximately 280 trees per acre with white pine dominating the overstory (Chart 5, Appendix Tables 17 & 18)). The stand is moderatly stocked with a relative density of approximatley 53%.



The understory and potential vegetation found of this stand is comprised of native tree and shrub species(Appendix Table 19). The most common tree species found in the understory is red maple estimated at 225 stems per acre along with lesser amounts of white pine, white oak and black birch stems. The shrub vegetation species composition in this stand are similar to other stands in the project area. Mountain laurel covers the largest portion of the stand and is inhibiting with other plant species from becoming established (Appendix Table 20). No invasive species were noted in this stand.

Located within this stand are approximately 46 snags per acre with the majority being less than 12" DBH. The stand also contains approximately 244 cubic feet per acre of course woody material. This material is consists of both hardwood and softwood species and is of sound and decayed varieties.

Analysis of the data for this stand shows a moderatley stocked condition with a relative density of 53%. A commercial thinning reducing relative density to approximatley 40% is recommended to improve vigor of trees and allow canopy expansion of the remaining stand. Removals would target damaged, diseased and suppressed trees of low vigor.

Silvicultural Prescription:

Objectives:

This area of Townsend State Forest is designated a Woodland. As noted in the Landscape Designations for DCR Parks and Forests: Selection Criteria and Management Guidelines- Management Approach for Woodlands, this project fulfills the ecosystem services that Woodlands provide. Woodlands provide a range of ecosystem services such as, but not limited to, clean water, wildlife habitat, recreation opportunities and sustainable production of renewable wood products.

The Brookline Road Project objectives are:

- Demonstrate silvicultural systems that regenerate native softwood and hardwood species in place of non-native plantations that are highly susceptible to disease and insect infestations.

- Demonstrate biologically and economically sustainable forestry practices.
- Increase public safety by removing hazard trees along roads and trails within the project areas.
- Improve access for recreational users and first responders.
- Improve growth and vigor of residual trees.
- Provide habitat and food sources that benefit native wildlife.
- Produce sustainable wood products to be used in local economies

Brookline Road-East: Stands 1 and 3:

These stands will be treated using an irregular shelterwood system. Trees will be individually marked for removal (cut tree marked) using DCR standard marking regime. Cutting boundaries will be triple marked with 45 degree slashes to denote cutting areas. Fifty foot no cut buffers will be located along Brookline road to minimize aesthetic impacts. Potential vernal pools and wetlands will be buffered minimum of 50 feet and no principal skid trails (except existing forest roads) will be located within 100 feet of these features. Fifty foot no cut filter strips will be placed along streams and no trees will be removed in these filter strips except those required for equipment access at an approved stream crossings. All features will be marked with paint and identified as required by law when filing a Ma Ch132 Forest Cutting Plan with the Bureau of Forestry and the local conservation commission.

Standing snags, cavity trees and wildlife trees will be retained with the exception of those that present a danger to public safety. If these trees need to be cut, they will be left on site as course woody material.

As part of this silvicultural system gaps will be made in the existing canopy and expanded over several entries to regenerate the forest stands to native white pine and hardwoods and replace non native red pine. Using this type of system will increase the horizontal and vertical complexity of these stands as new age classes of trees become established and mature. Gaps not exceeding 1/3 acre will be randomly scattered across these stands with the intent of regenerating approximately 3 acres (approximately 20%) of these stands. Between these gaps trees will be thinned to promote vigor and increment growth. Follow up treatments every 15-20 years will focus on expanding those gaps thereby regenerating these stands over approximately a 100 year period.

Recommended harvest levels:

Brookline Road East	Current BA Ft^2	Current Rel Density	Target Residual BA Ft^2	Target Residual Rel Density
Stand 1	124.4	53	94.0	41
Stand 3	163.0	86	114.0	55

Post treatment these stands will have a more open appearance as more sunlight will penetrate to the forest floor. Average diameter distribution across the project area will be composed of larger diameter specimens of all species. Non native species will still be present, but will make up less of the residual overstory species composition. Increased light penetration will stimulate the shrub and herbaceous plants and allowing both to increase in abundance. The regeneration that is currently present in areas within the stands will be released to increase in height and caliper due to increased availability of scarce resources. In areas of these stands where regeneration is limited it can be expected that white pine and oak will readily occupy these areas within 2-5 years.

Brookline Road-East: Stand 2:

This stand will be treated using a commerical thinning. Trees to be removed will be individually marked using DCR standard marking regime. Cutting boundaries, setbacks, buffers and filter strips will receive the same treatment as stands 1 and 3. Similar standards for snags, cavity and wildlife trees as mentioned above will also be followed.

Thinning is a method of improving future growth by regulating stand density.[20] Thinning trees within these stands will focus on removing poor quality, low vigor and non native specimens while releasing larger diameter individuals to provide food and habitat for wildlife and also provide a seed bank for the future forest. Thinning these trees will improve their ability to withstand stressors and improve the sawtimber quality of the remaining trees.

Recommended harvest levels:

Brookline Road East	Current BA Ft^2	Current Rel Density	Target Residual BA Ft^2	Target Residual Rel Density
Stand 2	126.4	74	80.0	48

Post harvest this stand will appear to be more open and sunlight will penetrate to the forest floor. There will be a reduction in the relative density of this stand and the residual stand will be composed of trees in the dominant and co-dominant canopy positions. Non native species will be removed from this stand to be replaced by white pine and hardwoods seedlings. Follow up treatments in 15 to 20 years should focus on releasing regeneration within this stand using an irregular shelterwood system similar to stands 1 and 3 if appropriate.

Brookline Road-West: Stand 1:

This stand will be treated using a group selection silvicultural system. Trees will be individually marked for removal using standard DCR marking regime. Cutting boundaries, setbacks to roads, buffers to wetlands/vernal pools, and filter strips will receive the same treatment as other stands. Similar standards for snags, cavity and wildlife trees as mentioned in previous sections will also be followed.

With this type of silvicultural system randomly selected groups (not exceeding 1/3 acre) are harvested within the stand. Unlike the irregular shelterwood system previously described future treatments may or may not expand the groups, but rather more random groups are established in the stand. Future openings to the forest canopy may or may not be located near each other. Outside of the groups the stand is thinned to improve increment and vigor. Over time this gives rise to a forest stand that is structurally more complex and conisits of multiple tree species and age classes scattered temporaly and spatially across the landscape. This type of treatment simulates the episodic weather events (wind, snow, ice, etc.) that occur throughout New England forests.

It is recommended that up to 33 ≤1/3 acre openings be created within the stand. This will begin the regeneration of approximately 20% of this stand with planned follow up treatments on a 15-20 year cycle regenerating the stand over a 100 year period. Within those openings all trees over 4" DBH will be harvested.

Openings will focus on areas of the stand that:

- Have low vigor and/or crown damage from periodic events.
- Are adjacent to superior dominant trees as a seed source
- Presence of advance regeneration that can be released,.

Recommended harvest levels:

Brookline Road West	Current BA Ft^2	Current Rel Density	Target Residual BA Ft^2	Target Residual Rel Density
Stand 1	117.0	61	85.0	42

Post treatment these stands will have a more open appearance as more sunlight will penetrate to the forest floor. Increased light penetration will stimulate the shrub and herbaceous plants and allow them to increase in abundance. The regeneration that is currently present in areas within the stands will be released to increase in height and caliper due increase availability of scarce resources. In areas of these stands where regeneration is limited it can be expected that mid shade tolerant (white pine and oak), and some shade intolerant species (birch and cherry) will readily occupy these areas within 2-5 years.

Brookline Road: West-Stand 2:

This stand will be treated using a commerical thinning. Trees to be removed will be individually marked using DCR standard marking regime. Cutting boundaries, buffers and filter strips will receive the same treatment as other stands. Similar standards for snags, cavity and wildlife trees as mentioned above will also be followed.

Thinning trees within this stand will focus on removing poor quality, low vigor specimens while releasing larger diameter individuals to provide food and habitat for wildlife. Large dominant specimens (hardwood and softwood) will be retained as seed source for the future forest.

Recommended harvest levels:

Brookline Road West	Current BA Ft^2	Current Rel Density	Target Residual BA Ft^2	Target Residual Rel Density
Stand 2	98.3	53	74.0	40

Post harvest this stand will appear more open as sunlight will penetrate to the forest floor. There will be a reduction in the relative density of this stand and the residual stand will be composed of trees in the dominant and co-dominant canopy positions. Follow up treatments in 15 to 20 years should focus on releasing established regeneration within this stand using an irregular shelterwood system if appropriate.

Harvesting System and Project Layout:

A cut-to-length logging system employing a harvester and forwarder will be utilized to harvest the forest stands. This system of operation processes trees at the stump retaining woody material throughout the site providing nutrient retention and short term carbon sequestration. Forwarding processed trees out of the project area will minimize soil disturbance because logs are carried out on the machine, and not skidded along the ground. Soil compaction is minimized since the equipment is working on a mat of woody material. Log landings are small and highly organized into different products to be trucked to market.

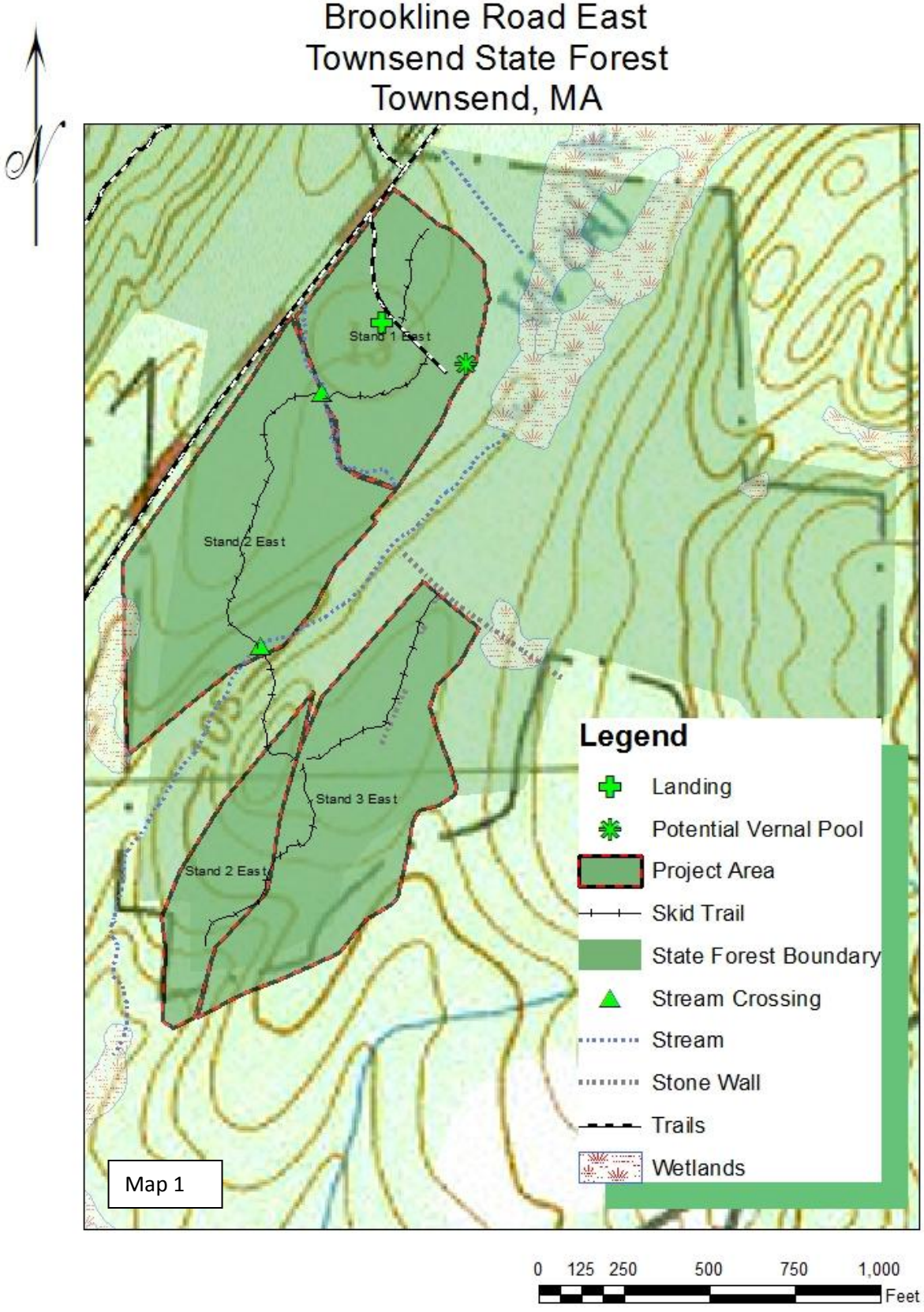
Access to the project area is excellent due to the proximity to Brookline Road. Existing roads and skid trails and landings will be re-used during operations to minimize site impacts. Clean crushed stone will be brought in to improve truck road conditions for future forestry projects, recreational users and first responders. The landing area in the eastern portion of the project area will be moved closer to Brookline Road from its previous location due to its proximity to wetland resources. Stream crossings within the project are permanent existing culverts along forest roads or temporary bridges that will be removed at project completion.

At project completion the landing areas will be seeded and straw mulched to rapidly vegetate the area. Access roads (other than gated fire road) will be blocked with boulders to prevent illegal access. Main skid trails will have waterbars installed as a best management practice as necessary to mitigate any site impacts. Project will be timed to take advantage of winter conditions (dry/frozen) to minimize impacts to this site.

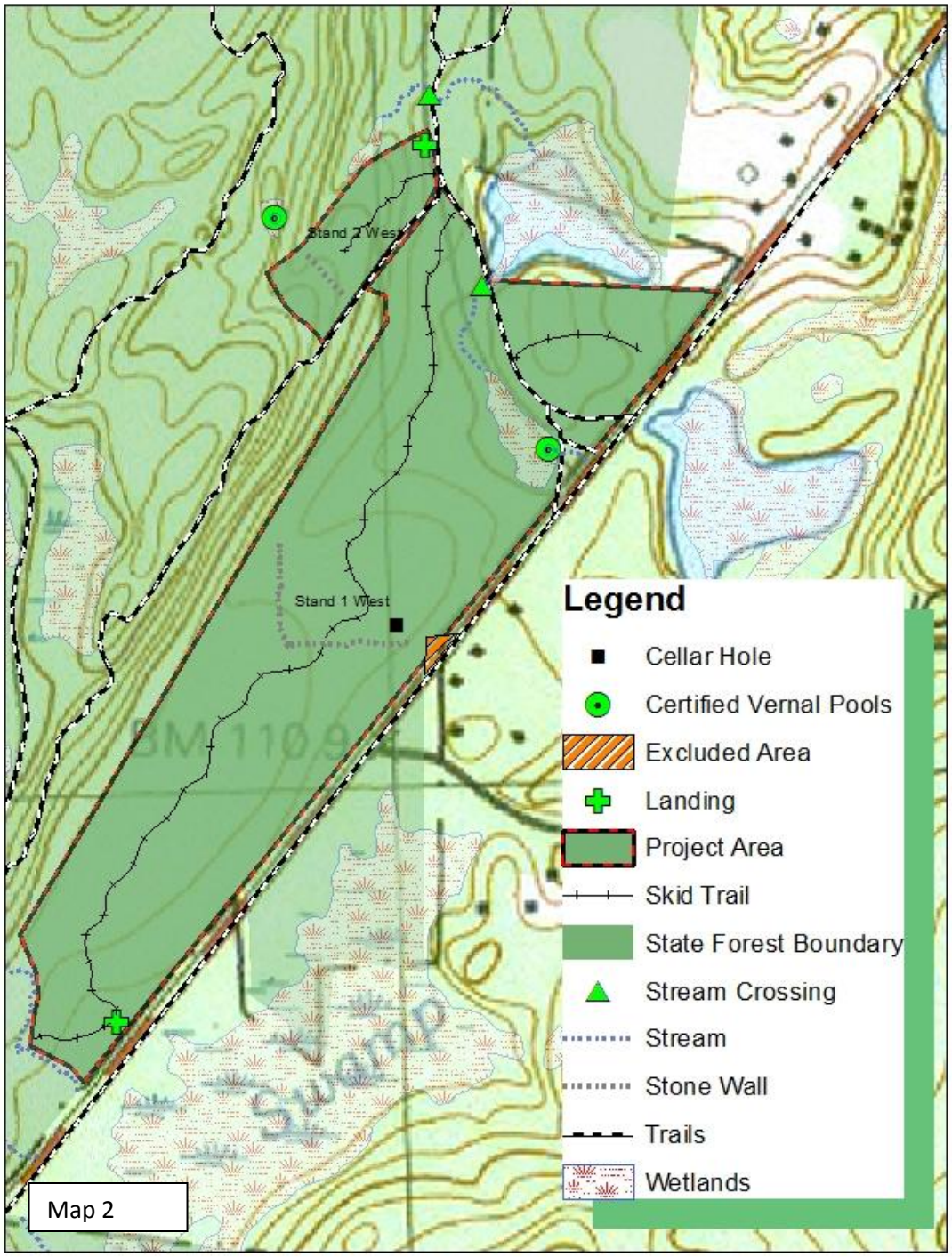
A MGL Ch 132 Forest Cutting Plan will be filed with the Massachusetts Department of Conservation and Recreation Service Forestry Division and local conservation commission prior to harvesting operations.

Mandatory best management practices, as required by law, will be implemented to safeguard important ecological features (wetlands, vernal pools, streams, etc).

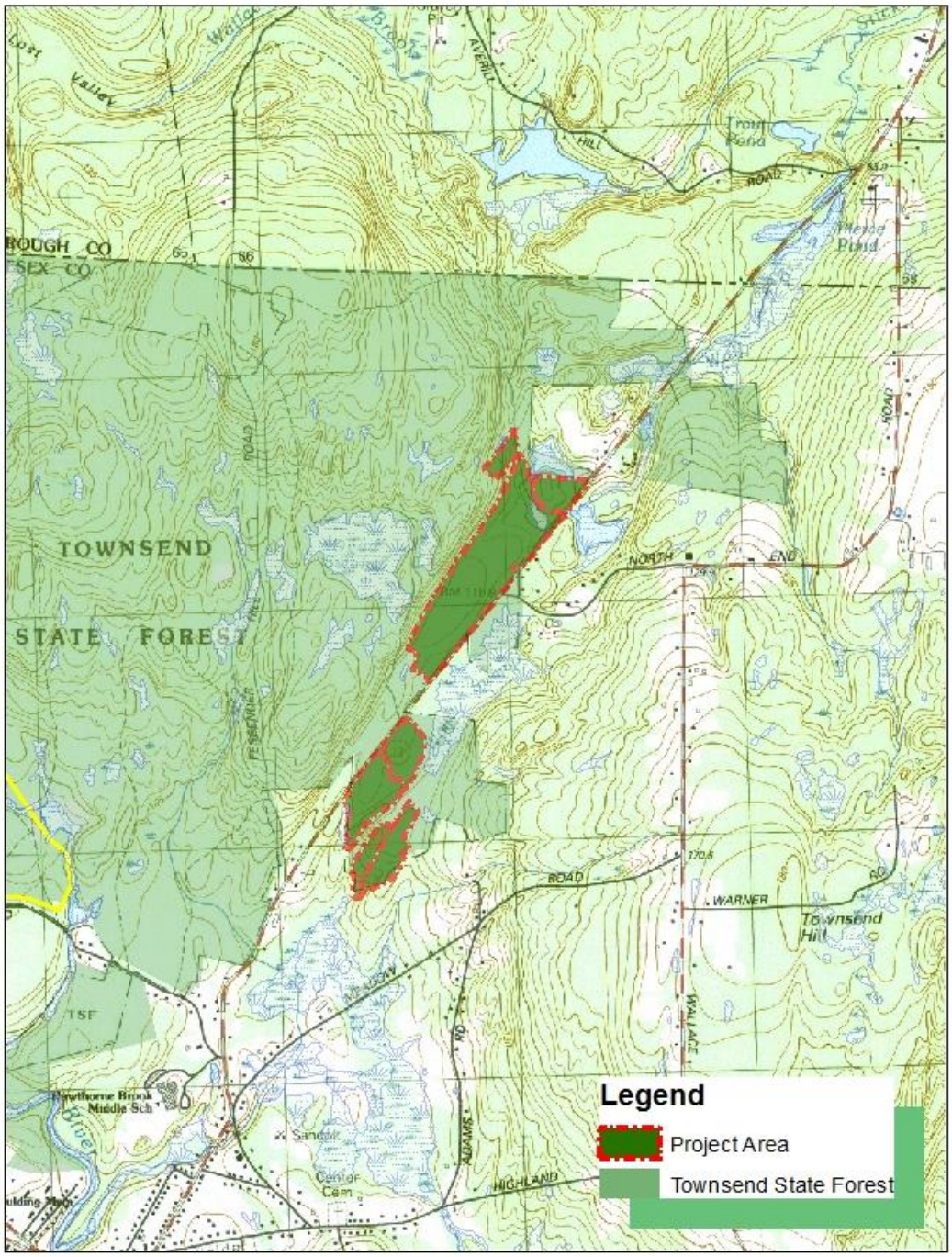
Brookline Road East
Townsend State Forest
Townsend, MA



Brookline Road West
Townsend State Forest
Townsend, MA

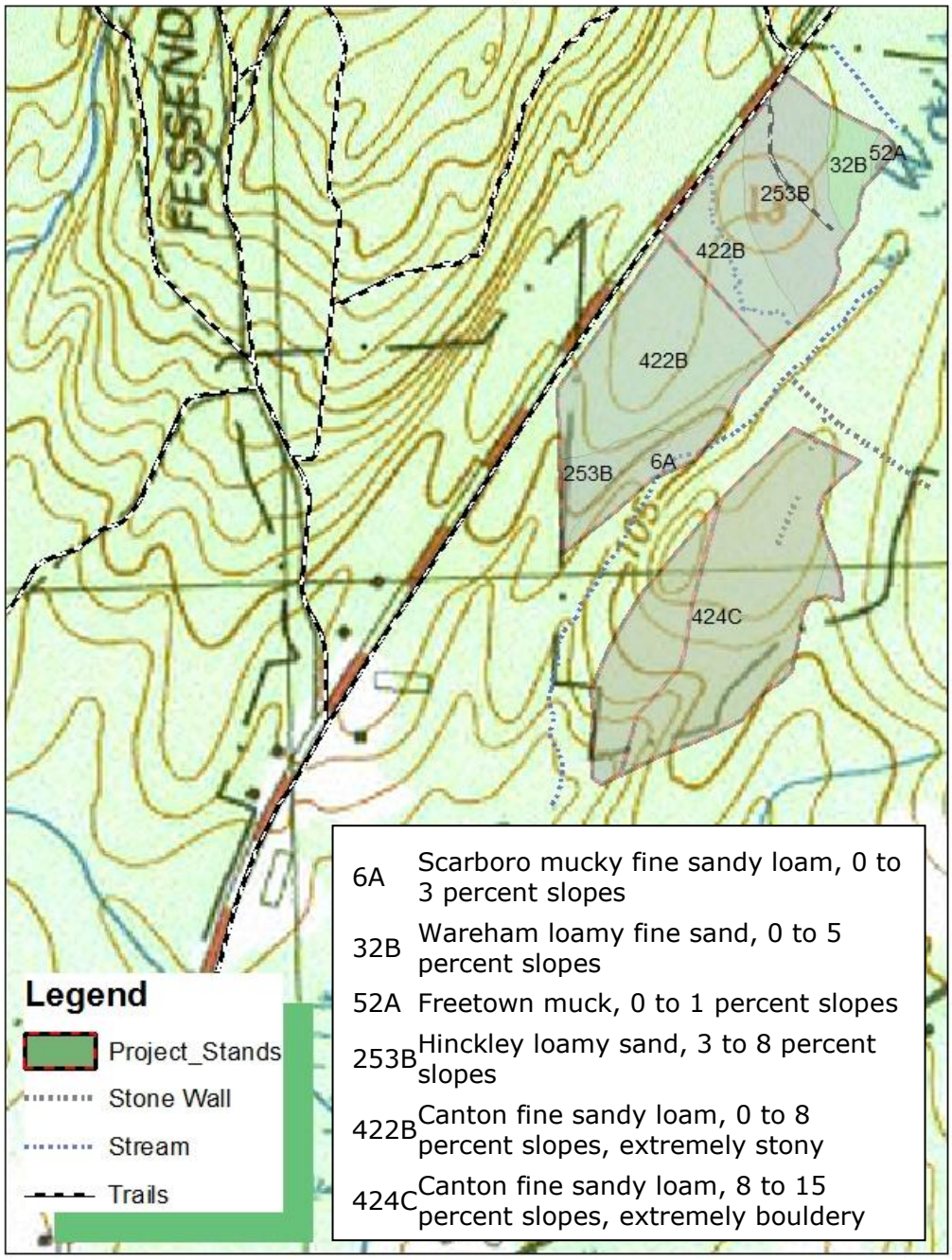


Brookline Road Project Locus Map
Townsend State Forest
Townsend, MA



Map 3

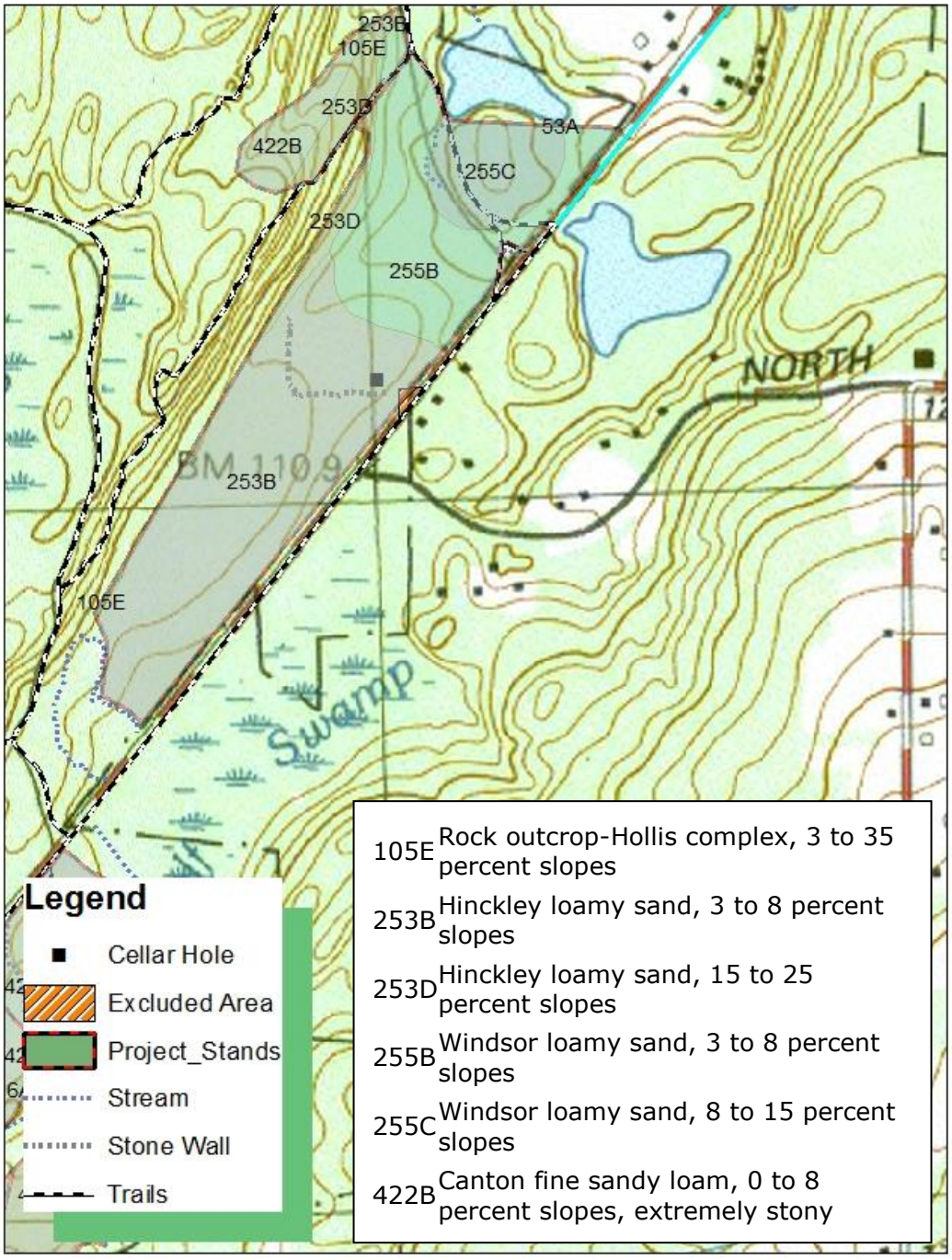
Soils Map-Brookline Road East
Townsend State Forest
Townsend, MA



Map 4

0 170 340 680 1,020 1,360
Feet

Soils Map-Brookline Road West
Townsend State Forest
Townsend, MA



105E	Rock outcrop-Hollis complex, 3 to 35 percent slopes
253B	Hinckley loamy sand, 3 to 8 percent slopes
253D	Hinckley loamy sand, 15 to 25 percent slopes
255B	Windsor loamy sand, 3 to 8 percent slopes
255C	Windsor loamy sand, 8 to 15 percent slopes
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony

Map 5

0 225 450 900 1,350 1,800
Feet

Stand 1 East-Overstory & Understory Data

Table 1	Volume		Sawtimber	Total	Total	Topwood
	Sawlog	Pulp	Mean	Bf	Cords	Cords
Species	Bf/Acre	Cords/Acre	Ht (logs)	(Stand)	(Stand)	(Stand)
white pine	20599.9	6.4	3.8	164799.4	51.4	8.1
red maple	0.0	0.0		0.0	0.0	
red oak	0.0	0.4		0.0	3.0	
white oak	0.0	1.2		0.0	9.2	
Total	**20599.9**	**8.0**		**164799.4**	**63.6**	**8.1**

Table 2	Stocking		%			
	Total	Total	BA/ac			
Species	Trees/Acre	BA/Acre	by Spp	QMD	Rel Density	% AGS
white pine	204.5	115.6	92.9%	10.2	45.9	83.7%
red maple	11.8	4.4	3.6%	8.3	0.0	0.0%
red oak	7.0	2.2	1.8%	7.6	2.1	50.0%
white oak	53.9	2.2	1.8%	2.7	3.2	0.0%
Total	**277.2**	**124.4**	**100.0%**	**9.1**	**51.2**	**78.6%**
			Median Stand Diameter ->>	**13.8**	**53.1**	<<- Estimated Relative Density

Table 3		Size	Class		
Species	**1**	**2**	**3**	**4**	**TOTAL**
red maple	0	0	30	180	210
red oak	60	0	60	30	150
American Chestnut	0	0	90	0	90
black birch	0	0	90	30	120
white oak	240	0	330	30	600
white pine	240	60	0	0	300
Estimated total per acre	**540**	**60**	**600**	**270**	**1470**

Table 4 Species	**AVG. % COVER**
low bush blueberry	11.9
eastern teaberry	21.7
dewberry	3.6
grass (unidentified)	5.6
sheep laurel	3.9
cinnamon fern	2.2
arbutus	1.0
high bush blueberry	3.9
Mt laurel	8.9
partridge berry	0.1
witch hazel	1.7
Estimated total percent cover	**64.5**

Stand 2 East-Overstory & Understory Data

Table 5	Volume		Sawtimber	Total	Total	Topwood
	Sawlog	Pulp	Mean	Bf	Cords	Cords
Species	Bf/Acre	Cords/Acre	Ht (logs)	(Stand)	(Stand)	(Stand)
white pine	9677.0	8.1	2.5	145155.2	121.6	31.7
red pine	105.2	0.0		1577.9	0.0	
red maple	0.0	0.8		0.0	11.8	
black birch	0.0	0.0		0.0	0.0	
red oak	946.8	2.7		14201.4	40.3	
white oak	105.2	1.3		1577.9	19.9	
black oak	316.6	1.0	1.2	4748.9	14.5	3.7
Total	**11150.8**	**13.9**		**167261.4**	**208.0**	**35.4**

Table 6	Stocking		%			
	Total	Total	BA/ac			
Species	Trees/Acre	BA/Acre	by Spp	QMD	Rel Density	% AGS
white pine	197.4	86.4	68.4%	9.0	38.1	73.6%
red pine	1.8	0.7	0.6%	8.6	0.0	100.0%
red maple	19.7	3.6	2.8%	5.8	3.4	0.0%
black birch	1.8	0.7	0.6%	8.6	0.0	0.0%
red oak	39.4	15.7	12.4%	8.5	14.7	63.6%
white oak	36.7	10.7	8.5%	7.3	10.1	13.3%
black oak	12.8	8.6	6.8%	11.1	7.3	41.7%
Total	**309.6**	**126.4**	**100.0%**	**8.7**	**73.5**	**62.7%**
			Median Stand Diameter ->>	**11.6**	**74.4**	<<- Estimated Relative Density

Table 7		Size	Class		
Species	**1**	**2**	**3**	**4**	**TOTAL**
red oak	0	0	0	23	23
white oak	531	162	69	46	808
white pine	485	138	138	46	807
black cherry	0	46	0	0	46
black birch	46	46	23	0	115
red maple	0	0	69	138	208
American chestnut	23	0	46	0	69
black oak	185	0	0	0	185
Estimated total per acre	**1270**	**392**	**345**	**253**	**2261**

Table 8 Species	**AVG. % COVER**
eastern teaberry	22.5
lowbush blueberry	8.3
grass (unidentified)	3.9
cinnamon fern	3.9
partridge berry	1.1
club moss	0.1
American witchazel	1.3
sheep laurel	0.8
Mt. laurel	1.3
highbush blueberry	1.0
arbutus	0.5
Estimated total percent cover	**44.7**

Stand 3 East-Overstory & Understory Data

Table 9	Volume		Sawtimber	Total	Total	Topwood
	Sawlog	Pulp	Mean	Bf	Cords	Cords
Species	Bf/Acre	Cords/Acre	Ht (logs)	(Stand)	(Stand)	(Stand)
white pine	5766.9	2.1	2.9	46135.6	16.5	6.4
red pine	11884.0	14.4	3.1	95071.6	115.2	10.9
red maple	0.0	2.7		0.0	21.8	
paper birch	0.0	0.0		0.0	0.0	
black birch	0.0	0.0		0.0	0.0	
red oak	346.1	0.1		2768.8	0.9	
white oak	0.0	0.0		0.0	0.0	
Total	**17997.0**	**19.3**		**143975.9**	**154.2**	**17.3**

Table 10	Stocking		%			
	Total	Total	BA/ac			
Spp	Trees/Acre	BA/Acre	by Spp	QMD	Rel Density	% AGS
white pine	61.2	38.0	23.3%	10.7	15.6	86.8%
red pine	250.9	106.0	65.0%	8.8	55.9	90.6%
red maple	18.2	10.0	6.1%	10.0	8.3	0.0%
paper birch	2.1	1.0	0.6%	9.3	0.0	0.0%
black birch	2.1	1.0	0.6%	9.3	0.0	0.0%
red oak	3.8	4.0	2.5%	13.8	3.5	50.0%
white oak	6.3	3.0	1.8%	9.3	0.0	33.3%
Total	**344.7**	**163.0**	**100.0%**	**9.3**	**83.4**	**81.0%**
			Median Stand Diameter ->>	**11.3**	**86.0**	<<- Estimated Relative Density

Table 11		Size	Class		
Species	**1**	**2**	**3**	**4**	**TOTAL**
black birch	267	67	133	33	500
red maple	0	0	0	33	33
white oak	0	67	0	33	100
white pine	867	67	0	0	934
red oak	33	33	0	0	66
Eastern hemlock	33	0	0	0	33
Estimated total per acre	**1200**	**234**	**133**	**99**	**1666**

Table 12 Species	**AVG. % COVER**
sheep laurel	2.5
partridge berry	2.3
arbutus	0.8
club moss	0.9
cinnamon fern	2.7
lowbush blueberry	22.7
eastern teaberry	21.5
maple leaf viburnum	0.1
highbush blueberry	2.6
Mt. laurel	0.2
grass (unidentified)	0.5
Estimated total percent cover	56.8

Stand 1 West-Overstory & Understory Data

Table 13	Volume		Sawtimber	Total	Total	Topwood
	Sawlog	Pulp	Mean	Bf	Cords	Cords
Species	Bf/Acre	Cords/Acre	Ht (logs)	(Stand)	(Stand)	(Stand)
white pine	11276.7	5.6	2.7	608943.8	301.8	109.3
red maple	31.7	1.7		1714.1	92.8	
white ash	95.2	0.0		5142.3	0.0	
black cherry	0.0	0.1		0.0	2.9	
black birch	0.0	0.0		0.0	0.0	
red oak	658.4	0.7	1.4	35552.8	39.1	22.1
white oak	127.0	1.2		6856.3	66.4	
black oak	95.2	0.1		5142.3	6.2	
Total	**12284.3**	**9.4**		**663351.5**	**509.3**	**131.3**

Table 14	Stocking		%			
	Total	Total	BA/ac			
Species	Trees/Acre	BA/Acre	by Spp	QMD	Rel Density	% AGS
white pine	127.6	88.2	75.4%	11.3	35.9	88.4%
red maple	35.9	8.8	7.5%	6.7	8.0	4.5%
white ash	1.2	0.8	0.7%	10.9	0.0	100.0%
black cherry	0.4	0.2	0.2%	9.4	0.2	0.0%
black birch	1.2	0.8	0.7%	10.9	0.0	0.0%
red oak	13.5	11.2	9.6%	12.3	10.1	75.0%
white oak	12.2	5.4	4.6%	9.0	4.9	40.7%
black oak	5.5	1.6	1.4%	7.3	1.6	75.0%
Total	**197.6**	**117.0**	**100.0%**	**10.4**	**60.6**	**77.8%**
			Median Stand Diameter ->>	**12.8**	**61.4**	<<- Estimated Relative Density

Table 15		Size	Class		
Species	**1**	**2**	**3**	**4**	**TOTAL**
white oak	260	23	52	6	341
white pine	427	110	92	23	652
red maple	46	6	115	87	254
red oak	300	23	12	12	347
black birch	29	0	17	6	52
gray birch	17	0	12	0	29
hophornbeam	23	0	0	0	23
Estimated total per acre	**1102**	**162**	**300**	**134**	**1698**

Table 16 Species	**AVG. % COVER**
eastern teaberry	12.0
lowbush blueberry	8.7
grass (unidentified)	8.1
cinnamon fern	2.0
sheep laurel	1.2
club moss	0.8
maple leaf viburnum	0.1
glossy buckthorn	0.0
greenbriar	0.0
braken fern	0.0
dewberry	0.9
partridge berry	0.2
Canada mayflower	0.1
Mt. laurel	10.8
unidentified shrub	0.0
sweetfern	0.0
huckleberry	0.1
goldenrod	0.1
arbutus	0.1
star flower	0.1
highbush blueberry	0.2
Estimated total percent cover	**45.6**

Stand 2 West-Overstory & Understory Data

Table 17			Sawtimber	Total	Total	Topwood
	Sawlog	Pulp	Mean	Bf	Cords	Cords
Species	Bf/Acre	Cords/Acre	Ht (logs)	(Stand)	(Stand)	(Stand)
white pine	7039.1	10.9	2.7	21117.4	32.8	3.9
paper birch	0.0	0.5		0.0	1.4	
red oak	728.2	0.0		2184.6	0.0	
white oak	0.0	1.6		0.0	4.9	
black oak	0.0	1.0		0.0	2.9	
Total	**7767.3**	**14.0**		**23301.9**	**42.1**	**3.9**

Table 18			%			
	Total	Total	BA/ac			
Species	Trees/Acre	BA/Acre	by Spp	QMD	Rel Density	% AGS
white pine	217.3	71.7	72.9%	7.8	34.4	69.8%
paper birch	2.2	1.7	1.7%	11.8	1.6	0.0%
red oak	40.3	15.0	15.3%	8.3	0.0	100.0%
white oak	13.2	6.7	6.8%	9.6	5.9	100.0%
black oak	6.7	3.3	3.4%	9.6	3.0	50.0%
Total	**279.6**	**98.3**	**100.0%**	**8.0**	**44.8**	**74.6%**
			Median Stand Diameter ->>	**10.7**	**52.9**	<<- Estimated Relative Density

Table 19		Size	Class		
Species	**1**	**2**	**3**	**4**	**TOTAL**
white pine	0	75	0	0	75
red maple	75	0	0	150	225
black birch	75	0	0	0	75
white oak	75	0	0	0	75
Estimated total per acre	225	75	0	150	450

Table 20	
Species	**AVG. % COVER**
eastern teaberry	7.5
grass (unidentified)	2.5
lowbush blueberry	7.5
Mt laurel	42.5
Estimated total percent cover	60.0

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