Forest Management Plan

For the

Indian Brook
Town Conservation Area

Town of Essex

Chittenden County, Vermont

2018

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Vermont Department of Forests, Parks and Recreation

In Conjunction with the Essex Conservation and Trails Committee

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Introduction

The purpose of this Forest Management Plan (FMP) is to supplement the January 2011 "Indian Brook Town Conservation Area Management Plan" (henceforth referred to as "2011 MP"). This FMP will seek to replace Appendix 3 of the 2011 MP. All management recommendations in this FMP will be in accordance with goals, objectives, and action items put forth in the 2011 MP. Specifically, this management plan will satisfy Action 2 of Goal 4.1.4: "work with a forester to establish timber management plan, including a Roadside Firewood Project". This FMP is intended to provide detailed, specific management recommendations for forested areas of the Indian Brook Town Conservation Area (henceforth referred to as "Indian Brook" or "Indian Brook Forest"), using detailed forest inventory data and a scientific process. This FMP provides no binding recommendations or mandates; however all the management recommendations in this document are intended to satisfy the goals and objectives put forth in Indian Brook's 2011 MP, in addition to best practices with regards to responsible, sustainable forest management, wildlife habitat creation and maintenance, forest health maintenance and enhancement, and climate chance resilience. These recommendations are described in detail and are meant to be applied in the field by a licensed forester utilizing best practices with regards to forest management and operations and complying with all pertinent laws. All of the treatments prescribed here should also be accompanied by public outreach and education before, during, and after their implementation. In addition to managing a healthy, vibrant forest, demonstrating thoughtful, responsible forest management should be considered an important goal of this management plan.

History

The history of Indian Brook, as it is currently owned and managed, is addressed in the 2011 MP, starting in the 1950's, when the Village of Essex Junction purchased Indian Brook and constructed the dam to create a water source for their growing municipality.

Prior to the 1950's, the lands which now constitute Indian Brook were used agriculturally in several capacities: as pasture and tilled land, orchards, sugarbush, and homestead sites. The property was probably cleared almost entirely for sheep pasture in the early-mid 1800's, and steeper and rockier areas were allowed to partially succeed to forest in the late 1800's-early 1900's. Aerial photos from 1937, when the area now covered by the reservoir was managed as open pasture or hayland, show four apparent homesteads on the property: one near the northern boundary, off of Brigham Hill Lane; a second off the present-day end of McGee Road; a third near the present-day end of Indian Brook Road; and a fourth north of this one, near the historic junction of McGee Road and Brigham Hill Lane. This last homestead site is now under water, in the central-eastern portion of the reservoir. Boundaries between these historic homesteads are extremely apparent in this 1937 photo, where it is clear how these landowners managed their lands differently. In general, southwestern portions of the property, in addition to areas along the eastern boundary, were forested at this time, whereas areas in the north and far southeast were open. A 1962 aerial photo of the property shows the reservoir in place, and all areas succeeding to forest.

Accordingly, the forests now present at Indian Brook are a combination of stands which established in the late 1800's – early 1900's (those areas forested in the 1937 photo), and areas which were planted and which have reforested naturally since the property was purchased by the Village of Essex Junction. The difference in composition between these two areas is stark. In general, areas which have more recently succeeded from agricultural land to forest are poorer in quality, dominated by unhealthy white pine of poor form and overall condition. Areas which were allowed to succeed to forest in the more distant past are generally healthier, and support the growth of native forest types rather than field-origin stands.

Since the property became public land (and including its brief stint as a privately-owned parcel in the late 1970's and early 1980's), the property has been partially harvested on several occasions. While records of harvesting are incomplete, it is known that the western half of the property was harvested in the mid/late 1970's, and a small area in the southwest of the property was thinned in 2002. Most areas of Indian Brook feature old stumps, skid trails and other signs of timber extraction.

Management Priorities (not in order of importance).

- **Diversity and Resiliency.**
- **Connectivity.**
- **Wildlife Habitat.**
- **Timber Production.**
- **Recreation and Aesthetics.**

Diversity and Resiliency

The encouragement of diversity as being at the core of forest management of this property, in addition to being part of any responsible forest management plan, is defined in the 2011 MP in Goal 4.1.3, Action 2: "Maintain health and vigor of the forest trees through…encouraging diversity of tree species and sizes", and in Goal 4.2.2: "Forest Areas – Encourage a variety of habitats."

In forest management the terms "diversity" and "resiliency" are intertwined.

The concept of encouraging **diversity** in a forest has its roots in a number of different concepts (again, not in order of importance):

i. From a *wildlife management* perspective, creating the largest number of habitat conditions provides habitat for the widest array of wildlife species. This includes species diversity within a given area ("alpha diversity"), diversity between different types of sites ("beta diversity") and the diversity of age and canopy classes ("structural diversity"). Simply put, allowing the widest range of tree species and habitat conditions to occur in a given area is the best way to accommodate for the most wildlife species.

ii. From a *timber management* perspective, encouraging a diversity of different age classes of trees provides the greatest opportunity for the periodic output of timber from a given area; for example, a forest with a single age class of trees may usually only be harvested all at once, with a long time period between harvests. Forests with a diversity of age classes can provide landowners with income and forest products more frequently, as different age classes periodically mature and require treatment at different times. They also afford landowners interested in timber management the ability to conduct high-frequency, low intensity treatments, lowering the impact of each individual entry.

iii. From an *ecological* perspective, studies have shown that old-growth forests often consist of a variety of age classes of trees present in a given area (usually at least 3). Encouraging a variety of different age classes and habitat conditions more closely mimics what would occur in unmanaged forest, allowing us to harness to forest's natural regenerative capacity to keep itself healthy, vibrant and productive. It also protects the forest against disturbance events that may target a single species, or trees in a single canopy position, disproportionately. This is especially important given unknown future effects of climate change and the increasing threat of invasive exotic pathogens and species.

The ability of a forest to respond to, and maintain its health during, disturbance is known as **resiliency**. Research has shown that forests, in addition to being comprised of myriad independent species, have evolved as systems in many ways. These systematic adaptations allow forests to efficiently respond to disturbance, stabilizing nutrients and soil and creating conditions suitable to the growth of subsequent generations of species. These adaptations require the presence of a variety of species, growing in a variety of ways. While forests today encounter regular natural disturbance events, the largest sources of disturbance are, and will be

into the indefinite future, human-related. In long-term forest management planning it is prudent to manage forests for resiliency in the face of an unstable climate, aggressive invasive species and pathogens, and many other attendant problems. Practically, this means managing for species and structural diversity at all times.

For all the reasons listed above, the encouragement of all types of diversity should be paramount in the management of the Indian Brook Forest.

Connectivity

In addition to Indian Brook's value as an area of vibrant wildlife habitat, it has the added benefit of being part of an approximately 3,000-acre block of relatively un-fragmented forest, connecting to Colchester Pond and blocks of habitat around Brigham Hill. This is one of the largest blocks of intact forest in this area of Chittenden County.

Forest fragmentation can be defined as the process by which blocks of intact forest are divided by human settlement and infrastructure. The fragmentation of forest habitat by roads, homes, and development has a number of serious effects on wildlife habitat and ecosystem function.

For most wildlife species, forest fragmentation limits their ability to move through the landscape and access different habitats, which can affect their ability to hunt, forage, find cover, reproduce, and ultimately remain genetically "fit" as a species. In the case of some "interior dependent" species, such as black bear, shrinking habitat can drastically alter their behavior and ability to occupy a given area.

Forest fragmentation also contributes to a host of other problems, including altering forest vegetation and creating greater opportunities for the establishment and spread of invasive species. It is in the interest of Indian Brook's wildlife habitat objectives, in addition to overall forest health, to engage only in forest management activities which allow the Indian Brook Forest to maintain its utility as a wildlife corridor and interior habitat block.

In general, responsible forest management (timber harvesting) is not seen to contribute to forest fragmentation. To the contrary, forest management is considered an asset to forest connectivity, providing different habitat conditions and opportunities within forest blocks.

Wildlife Habitat

Wildlife habitat management is guided by Goals 4.2.1 and 4.2.2 of the 2011 MP, which provide specific and general guidance on wildlife management priorities.

As is discussed extensively above, the management of forests for wildlife is intertwined with other objectives of the Indian Brook Forest. Accordingly, the management of wildlife should be part of a whole-system approach to forest management, which seeks to preserve intact forested ecosystems rather than individual resources. The establishment and protection of wildlife habitat with this approach serves both to encourage the charismatic wildlife species with which we are familiar, such as neotropical songbirds, white-tailed deer, moose, bobcat, black bear, and coyote, but also to support all species of native biota.

It should be noted that winter browse by white-tailed deer presents a serious impediment to the establishment of successful regeneration of desired, native species in the Indian Brook Forest. Deer are in high populations in the Champlain Valley, and can devastate stands of very young trees, especially of desired species such as red and white oak, white pine, and sugar maple. There is evidence of extensive deer browse in the Indian Brook Forest, which has

virtually eliminated the aforementioned tree species from the understory of the forest, encouraging the growth of near-monocultures of less preferred species (for deer and for humans) such as American beech and witch hazel. While the maintenance of a healthy white-tailed deer population in the Indian Brook Forest, and the maintenance of deer wintering areas, is a stated objective in the 2011 MP, it is recommended that deer hunting in some form is encouraged in the forest as a part of a holistic forest management approach. If deer hunting with rifles is considered an unacceptable use, given other management considerations at Indian Brook, other methods of hunting, such as shotgun, bow, and muzzleloader could be considered.

In the course of forest management activities action should be taken to limit browsing by deer, such as leaving uncut tops of trees and logging slash in the woods, especially in areas to be regenerated.

Timber Production

In the 2011 MP, many goals in the forest management section (4.1 "Forest Management", and 4.2 "Wildlife Habitat Management") with regards to maintaining and establishing aesthetic properties, wildlife habitat, forest health and community services (the mandate to establish a Roadside Firewood Project, to allow residents to cheaply access firewood) in Indian Brook rely on timber management, directly or indirectly, in order to be carried out.

In the course of a normal timber harvest, choices of which trees to retain and which to harvest are guided by a combination of ecological principles (which tree is "healthier," which trees are in use, or may be used, by wildlife), human desires (what our management objectives are for a property) and economic ideas (which tree is of a more valuable species or may produce a more valuable product in the future).

Through harvesting, the growth potential of the forest is concentrated on the specific trees that exhibit value in order to grow these individuals more efficiently, or redirected from trees that have maximized their potential value to new regeneration or existing immature trees. The forest is fully capable of executing this selective process on its own, through competition and natural mortality events, but it will not necessarily do so in a way that supports our goals. In this context "our goals" should also include our desire for a healthy, diverse forest which provides habitat for wildlife, carbon sequestration and recreational opportunities.

The harvesting of timber, while it utilizes means which are not entirely equivalent to natural, ecological processes, is a practice which supports a number of forces which are positive for the health of the forest, in addition to broader environmental concerns. Forest products are a local resource which requires virtually no inputs, and which can be sustainably extracted while preserving or enhancing wildlife habitat and other ecological benefits. It is one of the only such resources available to humans, and provides fuel for heat and electricity, fiber for paper products, and timber for the construction of structures.

Harvesting timber also provides periodic income to forest landowners, helping lower development and subdivision pressure on forested lands. Timber sale proceeds also can allow landowners to engage in non-lucrative stewardship activities, including ecosystem restoration.

The timber harvesting regimes prescribed in this management plan are extremely progressive, based on the best available science, and have the opportunity to demonstrate responsible forestry to residents of Essex and the surrounding area. In the course of any timber harvesting, care will be taken to include the public in the process, giving them many chances to see and understand this work from planning to execution, to ask questions and to understand the reasoning behind these activities. In this way, timber harvesting at Indian Brook will not only

benefit this one property, but will also give landowners and citizens tools to understand and encourage responsible, sustainable forest management in the broader landscape.

It is further recommended that all proceeds from timber harvesting at Indian Brook be used towards the maintenance of the park, its forest, and its recreational opportunities. It is recommended that at least 25% of proceeds be specifically dedicated towards further improving the health of the forest, including non-commercial forest stand improvement work and invasive species control.

Recreation and Aesthetics

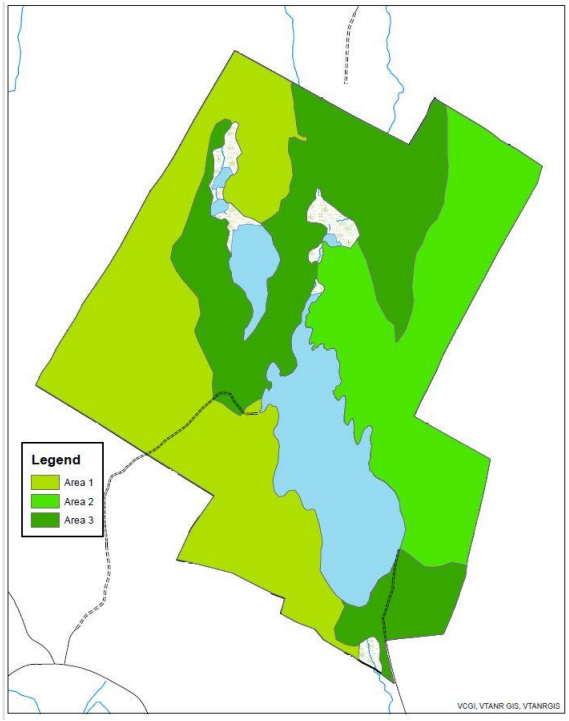
The importance of the preservation of the qualities of the Indian Brook Forest that make it such an important cultural resource for residents of Essex and beyond cannot be overstated. The property is much-loved for its aesthetic benefits, the access to nature that it provides, its recreational offerings, and its symbolism as a healthy, vibrant block of forestland in an increasingly developed and fragmented landscape. While all of the management priorities listed in this FMP are in some way framed by human benefits, it should also be said that the recreational usage of Indian Brook is an important part of its mission. Management activities should seek to maintain or enhance the human benefits of the property, and if possible, to strengthen the connection between residents of Essex to this parcel of land, its management, and its function as an important community resource. This should include taking steps to make all timber harvesting and forest management inclusive processes to interested people, and trying to disrupt the recreational usage of the reservoir property as little as possible. In the course of any work on this property prescribed in this FMP, the Essex Parks and Recreation Department should be consulted to make sure that recreational usage of Indian Brook is disrupted as little as possible.

Some sections of trail may need to be closed for safety reasons during forest management activities. Steps should be taken to minimize the disruption to trail usage as much as possible, and to minimize physical disruption to trails caused by logging equipment. The use of interpretive signage at every step of the implementation of the activities prescribed in this plan is strongly recommended.

Overview of Forest Conditions

Overall, the Indian Brook Forest is a diverse, vibrant forest. There are a variety of different tree species, natural communities, and ecosystems of value present in the forest. Due to differing land use histories, forest stands in a variety of developmental stages are present, though very young, or *early successional* and old, or *late successional* forest types are generally not represented. The presence of uncommon and diverse natural communities in the Indian Brook Forest provides unique habitat opportunities for a wide spectrum of wildlife species.

For descriptive purposes, forest conditions for the Indian Brook reservoir can be divided into three Areas: one encompassing Stands 1-7 and 9, in the west and southwest of the property (Area 1); another in Stands 12 and 13, in the east of the property (Area 2); and a third in all remaining stands west of the reservoir (Area 3). These areas differ in terms of site qualities, forest composition, history and structural condition.



Area 1 features forest dominated by mature oak, hemlock and white pine. This area was harvested in the 1970's, a harvest which appears to have targeted large, mature white pine, according to field evidence. This action resulted in the release of red and white oak, mixed hardwoods, and hemlock, present in the understory and midstory at the time of the harvest. The trees released in this harvest are now healthy, large and mature, with a dense canopy. This area features soils which are slightly enriched, though in places are thin and/or excessively drained, and in places are wet, with many vernal pool and seeps in western areas. In general wet and steep portions of Area 1 favor the growth of hemlock, moist soils support the growth of rich-site northern hardwoods such as sugar maple, American basswood and white ash, and mesic to dry soils are dominated by red and white oak, with occasional white pine. The majority of pine present in this area is field-origin, though it is expected that white pine would be a minor component in more mature forests of this type.

Area 2 was managed as a sugarbush for at least the last 200 years, as evidenced by the ancient scattered sugar maple trees found throughout the stand. This area was likely simultaneously managed as pasture for sheep and then cows, which were probably allowed to graze around these open-grown trees. The likely release event, which allowed this Area to revert to forest, was when grazing ended. This allowed a cohort of white pine to grow up around the scattered sugar maple sugarbush trees. Much of this pine was apparently harvested sometime in the middle to late 1900's,. This harvest was variable, with some areas appearing to be nearly clear cut. This allowed oak (mainly red) and hardwoods, present in the understory and midstory, to be released, and established pockets of new regeneration. As in Area 1, these oak and other hardwoods have since matured in many areas. The main difference in composition between Area 2 and Area 1 is the presence of much more large, remnant white pine, in addition to the scattered sugarbush trees. This area also features small pockets of planted red and white pine. This stand is very steep and rocky in places. Soils in this Area are similar to those in Area 1.

Area 3 is defined by the presence of young, field-origin stands. These stands are dominated by immature, unhealthy white pine of poor form and overall condition, though there are pockets of northern hardwood, mainly sugar maple, poles in evidence. These stands were managed as open land until the property was purchased by the Village of Essex Junction in 1950 or later, placing their age around 50-65 years. Despite their young age, these stands have already begun to decline and succumb to natural mortality in most areas due to a combination of stresses, including blister rust and white pine weevil damage. In many areas this has led to an understory dense with regeneration, dominated by sugar maple seedlings, saplings and poles. These stands also support invasive species populations in their understories, mainly common buckthorn (*Rhamnus cathartica*) and shrub honeysuckle (*Lonicera* spp.). In general, species and structural diversity in this Area is the lowest on the property. Area 3 is relatively flat and soils are generally the most productive on the property, which is probably why this Area was managed as agricultural land for longer than other Areas.

While representation of many species and several age classes of trees is present across the forest, the Indian Brook Forest is generally *even-aged*: consisting of groups of trees which are all generally the same age and size. In the youngest forests, located in Area 3, virtually all trees are in the same height and diameter range. In Areas 1 and 2, even-aged field-origin stands dominated by white pine have given way, through harvesting and natural mortality events, to areas which are generally *two-aged*, with a second generation of trees overtopped by, or interspersed with, remnant white pine, sugarbush, or open grown hardwood "wolf trees". This second generation is generally large and mature, with a closed, high canopy. While preferable to purely even-aged stands, these latter areas still generally lack structure, especially in the understory.

As described above, the structural condition of these stands is the result of common origin (i.e. agricultural fields), in addition to the lack of significant disturbance in the forest's recent past. This is a common condition for first and second-generation forests, following agricultural abandonment, which have not been actively managed. Areas of Indian Brook which feature the highest level of structural diversity are the areas which were harvested in 2002 (Stands 1 and 2). One can generally equate structural diversity to species diversity, as areas with the highest number of structural conditions generally support the greatest diversity of tree, shrub, and vegetation species.

Research on disturbance dynamics in the northern forest suggests that most forests in even-aged and two-aged conditions in this region will eventually assume a more structurally diverse condition through natural disturbance events. However, it should be noted that for this transition to occur without intervention it may take multiple additional generations of trees.

Forest Management Priorities

The Management priorities outlined above, and in the 2011 MP, give the framework for management actions that will occur in the Indian Brook Forest. However, this framework must be translated into action on the ground. Specifically, the prescriptions in this management plan will:

1. Act to remove and control invasive exotic plant species in the Indian Brook Forest.
2. Release hard and soft mast trees for wildlife.
3. Create pockets of regeneration to increase structural and species diversity in the forest, increase wildlife browse and habitat opportunities, and increase the resilience of the forest.
4. Begin to transition all areas from even to uneven-aged structures, enhancing species and structural diversity in the course of all management activities.
5. Use harvesting to transition poor-quality field-origin stands to stands comprised of healthy, native species.
6. Use harvesting to favor the efficient growth of healthy high-quality trees of all native species.
7. Protect water resources and protect and enhance wildlife opportunities in wetland habitats.
8. Protect cultural resources on the property.
9. Encourage practices that enhance the Indian Brook Forest's resilience to climate change and carbon storage capacity.
10. Use harvesting to capture value in mature and low-quality trees, in order to pursue other stewardship projects in the Indian Brook Forest, such as invasive species treatment, improved recreational access and infrastructure development, and ecosystem restoration.

Wildlife Habitat Management Priorities

Wildlife habitat management is guided by Goals 4.2.1 and 4.2.2 of the 2011 MP, which provide specific and general guidance on wildlife management priorities. As discussed earlier in this FMP, wildlife habitat is a critical component of forest management on this property, and one that will be encouraged by the promotion of species and structural diversity in the forest, the maintenance of this area as interior forest as part of a large block of habitat, and the control of exotic invasive plant species. The goal will be to provide the most habitat for the widest array of species, but also to provide habitat for any rare or endemic species or natural communities present. The priorities laid out in the 2011 MP will be implemented by:

1. Taking steps to control and remove invasive exotic plant species.
2. Protecting and enhancing deer wintering areas where they are present, particularly in the west of the property (Stand 6). In these areas maintain a closed canopy, and attempt to recruit and release softwood regeneration. All management should seek to improve habitat for white-tailed deer in these areas. No new recreational trails should be installed in areas of deer wintering habitat.
3. Releasing and recruiting hard and soft mast species, including apple trees, oaks, cherries and hickories.
4. Regenerating areas to encourage a diversity of age classes and species and increase browse availability.
5. Buffering sensitive features, and features of great habitat significance, such as vernal pools, den sites, cliffs, talus slopes, streams, wetlands and active wildlife travel corridors. Depending on best practices for maintaining the integrity of certain features, activity within for the buffers will be determined.

Water Management

The original purpose of this property was to provide a dependable, clean water supply for the Village of Essex Junction. It served this purpose for approximately 20 years, between 1952 and 1973. While the priorities of this forest have shifted, its hydrological features are still important in that they provide wildlife habitat for aquatic, amphibious, reptilian, and mammalian species and their predators. They also provide recreational opportunities, aesthetic values, and contribute to the water quality in the Lake Champlain Basin. Any forest management activities should take the utmost care to preserve and enhance water quality in the reservoir and the other water bodies on the Indian Brook property.

The reservoir should be protected by 100-foot buffer in which no harvesting will occur, except what is necessary for safety and recreational concerns, what is absolutely necessary for access to other areas, or to accommodate any harvesting that may benefit wildlife and aquatic habitats. **All other areas of open water and streams should be protected with a 50-foot buffer**, under the same restrictions. If harvesting is recommended to improve the quality of wildlife habitat in wetland or aquatic environments, the Vermont Department of Fish and Wildlife should be consulted for its recommendations.

In general, within buffers soil disturbance should be minimized by excluding harvesting equipment. Only light harvesting may occur in these areas, as dictated by the Acceptable Management Practices (AMP's) for maintaining water quality on logging jobs in Vermont. Best practices for maintaining aquatic and riparian habitat, and laws pertaining to the protection of wetland areas should be strictly adhered to in the course of logging.

The 100-foot buffer will also serve as a de-facto buffer to the most widely-used recreational trails on the property. Special consideration should be given to safety and impacts to recreational trails within this buffer, should forest management activities enter this buffer.

Soils

Forest soils are a huge contributing factor to which tree species can be successful in a given location. Along with disturbance history and climatic variables, soils can help us determine which species are likely to be most healthy and productive in a given area. See soils map (attached) for details on the location of individual soil types.

In general, soils in Vermont are influenced by a combination of bedrock, glacial deposits, and lacustrine deposits. The latter influence is of special importance in the Champlain Valley, as this area has been filled two large bodies of water, one an enormous freshwater glacial lake ("Lake Vermont") draining south through the Hudson Valley and the other a brackish, inland sea ("The Champlain Sea"), in the last 20,000 years. These events followed the departure of the Laurentide ice sheet, which retreated from the Champlain Valley about 13,500 years ago. Each of these large bodies of water caused the deposition of soil particles in the Champlain Valley. In general, sandy particles were deposited over most of what is now Essex during this time, as this was where the proto-Winooski river drained into Lake Vermont, and then later into the Champlain Sea. Soils map show Essex as the eastern end of the delta created by the proto-Winooski River at that time.

Accordingly, soils in the Indian Brook Forest are generally sandy and well-drained. Some areas, especially in the eastern portion of the property, feature very thin and rocky soils, but in most areas soils are deep enough to support the productive growth of forestland species.

Species best suited to soils in the Indian Brook Forest include oaks, pines, and hemlock, in addition to many other associated woody and herbaceous species. In areas where soils are more moist or deeper, rich-site hardwood species are present.

The most common soils in the Indian Brook Forest are the Lyman-Marlow complex, which covers 76% of the area. These soils are well-drained and stony sandy loams. This soil type is a combination of Lyman soils, which are somewhat poor and often quite thin and rocky (Site Class II), and Marlow soils, which are deeper and more productive (Site Class I). These soils are well suited to the growth of white pine, red and white oak, and hemlock, in addition to other associated dry-site species. These well-suited tree species are all present and thriving in areas underlain by this soil type. In areas where soils are deeper, these soils support the growth of pockets of rich-site northern hardwood species, such as sugar maple, white ash, bitternut hickory and American basswood.

Also present are Marlow fine sandy loams, which cover 5% of the area. This is a stony but productive well-drained fine sandy loam located in the north and south of the property, in the areas most recently managed as agricultural land. This history speaks to the productivity of this soil type in the growth of both agricultural and forest products. Areas of the Indian Brook Forest with Marlow soils are primarily stocked with early successional, field-origin stands but have the potential to support the growth of a wide variety of tree species, as described above.

Peru fine sandy loams cover about 3.5% of the Indian Brook Forest, present in one area in the northwest of the property. These are deep, stony, well-drained soils, best suited to the growth of dry site species, similar in site characteristics to Marlow fine sandy loam.

Finally, the remainder of the area is covered by Limerick silt loam and Cabot silt loam. Both of these soil types are located in wetland areas, and so are non-productive for the growth of commercial tree species.

Invasive Species

Invasive exotic plants (hereafter called “invasives”) are an enormous threat to the continued health and productivity in the Indian Brook Forest, and to forests world-wide. These species are aggressive competitors which are able to outcompete native plants, especially in agricultural environments, of forest edges, in the understory of disturbed forests and in field-origin, pioneer stands. The result of this is the interruption of ecological processes (such as the natural regeneration of forests), and ecosystem function. From a management perspective, this equates to a loss in productivity, and a diminishment of our ability to grow healthy, productive tree and animal populations.

Controlling invasives is by far the most important management activity prescribed in this management plan, due to the fact that, **in lieu of the removal of these species, no other forest management activities are likely to be successful over the long term.** Failure to control these species will result in further infestation, and the eventual degradation of all ecological and aesthetic benefits of the forest, including recreation, aesthetics, wildlife habitat, climate change resiliency, carbon storage, and water quality.

Most invasive plants, unlike pathogens, fungi, or insects, were introduced to our environment intentionally. Species such as common buckthorn and multi-flora rose were

used as living fences, to eliminate the need to maintain wire fence lines. Invasives such as shrub honeysuckle, Norway maple, and burning bush (*Euonymous*) were popular landscape plants. Autumn olive and Russian olive (*Eleagnus*) were planted by foresters and conservationists as food for wildlife. In each case, these plants spread into forests and other natural environments due to a combination of attributes including, but not limited to:

i. Resilience to disturbance (i.e. ability to survive even while it is cut and pulled).
ii. Vegetative reproduction (the ability to reproduce asexually by sprouting, even from small chunks of root or stem).
iii. Abundant fruiting, often coupled with wildlife dispersion.
iv. Shade tolerance.
v. Allelopathic tendencies (the ability to inhibit the growth or establishment of other species by the use of soil-borne, chemical agents).

Common buckthorn (*Rhamnus cathartica*) is the most prevalent invasive in the Indian Brook Forest, present in the understory of stands throughout the property, and especially prominent around the edge of the reservoir. This species is extremely difficult to control. Once it is larger than 2-3 feet in height, herbicide, applied to the cut surface of the plant's stump, is generally required to kill it. When smaller, hand pulling of this species is possible, although some sprouting may occur from root fragments.

Shrub honeysuckle (*Lonicera sp.*) is similar to buckthorn, although tends to be slightly less resilient to treatment. This species may also be hand-pulled until it is 2-3 feet in height, and then must often be treated with herbicide.

Japanese Barberry (*Berberis* sp.) is a difficult species to control mechanically by hand-pulling due to its abundant thorns. This species is known to harbor large populations of deer ticks, increasing overall tick populations in forests greatly. Very small plants may be hand-pulled (with gloves), but most plants over 2 foot in height generally must be treated with herbicide.

Japanese Knotweed *(Fallopia japonica*) is only present in one area of the Indian Brook Forest, but its presence is a serious threat to the health and productivity of the forest as a whole. This species is extremely resilient to all methods of control, and will require serious treatment to eradicate. A combination of herbicide and smothering using thick plastic is recommended as the most feasible method of treatment of this species.

Access and Operability

i. **Access**, in a forest management context, refers the ability of logging equipment to reach a property, and to transport any timber harvested on the property to an area where they can be processed, sorted, and loaded onto log trucks. The trails on which logging equipment travels within the property are referred to as "skid trails" or "skid roads." The area where logs are piled, processed, sorted and ultimately loaded onto trucks, is referred to as a "log landing" or "landing". The roads, passable by log trucks, which access the landing, are referred to as "truck roads" or "haul roads."

1. <u>McGee Road</u>
McGee Road is a town-owned Class VIII road where it accesses the boundary to the Indian Brook Property. Most areas west of the reservoir can be most easily accessed via

this road, though 200 - 300 feet of truck road would need to be installed from the end of the town-maintained portion of McGee Road, and a new landing installed. This road would be a simple, gravel drive approximately 10-12 feet wide, and the landing would be an approximately ½ acre area cleared of trees, possibly with some gravel added.

The cost of this work could be borne by the town, or incorporated into a timber sale contract with a logger, where it would be deducted from timber revenue during the course of a timber sale contract. It is estimated that this work would cost no more than $5,000 in materials and labor. In any case, the high value of timber in the area accessed by this infrastructure would easily cover the cost of a high-quality road and landing. It is also recommended that a heavy-duty gate is installed at the property boundary following this work, to limit access to the landing by motorized vehicles in an effort to protect the town's investment in this access infrastructure. Depending on the quality of the gate, its purchase and installation may cost an additional $1,000 - $2,500.

If the town wishes to pursue the development of a Roadside Firewood Program, as suggested in the 2011 MP, the historic course of McGee Road, leading down to the reservoir, could be gradually repaired to afford pickup truck access in the future, though this process would likely be extremely expensive. It is recommended that the town pursue alternative options for this program, some of which are outlined in the Roadside Firewood Program section, below.

2. Indian Brook Road

Stand 2, eastern portions of Stand 1, southern portions of Stand 13, and Stand 14 would likely need to use the southern-most parking area, at the end of Indian Brook Road, as a landing, or else establish a new landing in the southwestern portion of Stand 14. Disturbance to these areas, and the recreational opportunities they afford, can be minimized by harvesting these sections of the forest only in the winter, and using low-impact logging equipment.

3. Brigham Hill Lane

Access to northern and northeastern areas of Indian Brook for forest management could most easily occur via Brigham Hill Lane. Unfortunately, this road's Class IV status ends north of the Indian Brook property boundary, and the town's right of way may only be for non-motorized travel. This right of way should be investigated in the next 10 years, to learn what may or may not be allowable, as far as access improvements. In order to afford forest management access through this road, the unmaintained section would need to be restored or improved for a distance of about 1,000 feet in order to reach the property, or a landing would need to be used on the property of a neighbor to the north. Repairing this road is likely to be expensive, as this access is extremely eroded, requiring a significant amount of material to need to be imported. If access could be achieved through this road, the cost of upgrading Brigham Hill Lane to the boundary of Indian Brook, including the installation of a new landing, is estimated to be around $15,000 - $20,000. This cost could be borne by the Town, incorporated into a timber sale contract with a logger, where it would be deducted from timber sale revenue, or paid for by using proceeds from harvesting elsewhere at Indian Brook. Because of the high cost of this work, and the uncertainty of the Town's right of way, it is recommended that the option of using the landing on a neighbor's property be pursued.

ii. **Operability** refers to the ability of logging equipment to operate within the property. Operability may be limited by steep or rocky ground, natural features such as water bodies, wetlands and cliffs, and a lack of available, appropriate skid trail infrastructure.

Operability in the majority of the Indian Brook Forest is good, with existing skid trails and old farm roads reaching most areas. Some areas in the east, southeast, and southwest of the property are very steep and/or rocky, which will limit the ability of logging equipment to operate somewhat. For the most part, these are areas which would be avoided anyway in accordance with best practices for maintenance of soil qualities and sensitive sites. Areas where soils are very thin should be avoided whenever possible, and only operated on under frozen conditions, when snow cover exists.

The largest operability challenge by far in the Indian Brook Forest are the streams, wetlands, and vernal pools present on the property. While they do not necessarily inhibit harvesting, these features are sensitive, and harvesting must be carefully planned to minimize disturbance to them. The chain of wetlands and open water running from the south of Indian Brook to its northwest corner effectively divides the property, for the purpose of timber harvesting, into halves. As described above, areas west of the mapped wetlands will generally be accessed from McGee Road, and areas to the east will generally be accessed via Brigham Hill Lane. Vermont AMP standards should be met or exceeded whenever harvesting occurs, to protect streams and wetlands.

A lesser operability challenge is posed by the fact that many recreational trails have been developed on old logging skid trails. In many cases, logging trails cannot be relocated, so these sections of trail will need to be used in forest management activities. Care should be taken not to cause unnecessary damage to these trails, to restore them to a stable condition following the completion of timber harvesting, and to clearly close sections of trail while harvesting is occurring. The Essex Parks and Recreation Department will be consulted with before any use of recreational trails by logging equipment occurs. Whenever possible, the use of recreational trails by logging equipment should be avoided.

Cultural Features

Cultural features are elements of the landscape that speak to its history. Common examples of these are stone walls, the foundations of old homes, historical artifacts, and plant assemblages associated with agricultural use. The importance of preserving these features is identified in the 2011 MP Goal 4.5.2 “Cultural/Historic Resources – Identify sites and avoid disturbance.”

The Indian Brook property has tremendous cultural value to the citizens of Essex as a recreational and community resource. It also features many significant historical features that pre-date the municipal ownership of this property, dating back to when the area was farmed.

The cellar holes of old farmhouses and barns are present where McGee Road, Brigham Hill Lane, and Indian Brook Road enter the property. The Brigham Hill Lane site in particular contains a variety of cultural artifacts and historic features. These roads are also important cultural features, as they are remnants of a time before Indian Brook Reservoir existed, when they met near the northern end of what is now the reservoir.

The Indian Brook Property also features an impressive network of stone walls, especially prominent in northeastern areas. These walls were created from stones pulled from the soil during the clearing process (probably in the early-mid 1800’s) and used as property boundaries

and livestock barriers. In some areas, the presence of small stones in these walls and stone piles means that adjacent areas were likely plowed cropland.

Old sugarbush trees in the east of the Indian Brook Forest, and apple trees around the old homestead site off Brigham Hill Lane, are also cultural features to be protected, as they are remnants of past land use, in addition to valuable features for wildlife.

All cultural features should be buffered and protected during the course of forest management activities. If a stone wall must be crossed, this should be done at a right angle to the direction of the wall, and as few crossings used as possible. A 50-foot-wide buffer should be maintained around all cellar holes and cultural artifacts. All known locations of cultural resources should be surveyed prior to harvesting.

Boundaries

Boundaries of forested properties are usually marked by a combination of wire and stone fence line and trees which are "blazed" (marked with an axe) and/or marked with paint. Corners are usually marked by metal pipes, rebar, metal stakes, cement monuments and stone piles, in addition to blazed "witness trees." Depending on maintenance, these boundaries can be either very clear or virtually non-existent.

Clearly-marked boundaries are essential to the management of forested properties. Vermont law dictates that forest landowners must demarcate boundaries prior to harvesting of timber. Failure to locate or maintain boundaries may result in disputes with neighboring property-owners, and/or expensive surveying costs. For this reason it is recommended that boundaries are walked and maintained continuously, but now less frequently than once every 5 years.

The boundaries of the Indian Brook Forest are defined by a combination of wire fence, stone fence, and blazed and painted boundary trees. Boundaries are most clearly defined in the southern and western boundary lines, where a tall wire fence in good condition has been installed. Boundary marking is poorest on the property's eastern boundary, where some areas feature only occasional barbed wire and blazed boundary trees.

While the tall wire fence in the west of the property clearly marks the location of the boundary, this structure runs counter to the Indian Brook Forest's stated objectives of wildlife habitat and allowing connectivity between forested blocks. This fence in many areas appears capable of preventing the movement of wildlife species through Indian Brook. It is recommended that, in association with the neighboring property owner(s) in this area, periodic openings are installed in this fence line to allow wildlife passage through Indian Brook.

Roadside Firewood Program

A priority expressed in Goal 4.1.4, Action 2 of the 2011 MP, is "establishing a Roadside Firewood Project." The general purpose of Roadside Firewood Projects is to provide a low-cost source of fuelwood for local residents, while conducting needed thinning in forested stands. Programs like this have been a historic management strategy on many town forests. Examples of this include the Hinesburg Town Forest, which historically maintained such a program for the residents of Hinesburg (this program is not currently active).

The model for this type of project is the State of Vermont, which has had a program of this type for many years (this program is also not currently active). 3-cord lots are paid for (each lot is $30), and delineated and marked in the field by a trained forester. Lots may vary in size, depending on how many cords of wood are available to be cut in a given area. The purchasers of

each lot may then cut and haul the marked trees from their designated area, using no draft animals or machinery and obeying a few simple rules. This is usually done by “bucking” up the trees into small chunks in the woods, and carrying them to a pickup truck on an adjacent road by hand.

Unfortunately, the traditional model for Roadside Firewood removal is unlikely to be feasible due to access consideration within this property. This type of program requires a good road system that affords access to the interior of the property with a pickup truck. However, should McGee Road or Brigham Hill Lane be restored and extended onto the property, these areas could support such a program.

In the interim, the objectives of a Roadside Firewood program/project may be met by other means. It would be possible to either:

a. Have a logger reserve a certain amount of log-length firewood on the landing following a harvest. This firewood could be purchased/given to Essex residents and they could buck it to length on the landing and haul it away by the pickup truckload.
b. Offer the opportunity to qualifying Essex residents for the logger to drop off a load (approximately 10-12 cords) or portion of a load of log-length firewood at their home, following a timber sale.
c. Have a local firewood producer process firewood, reserved on the landing following a harvest, and deliver it to qualifying Essex residents at a reduced cost.
d. Hire a logger to come and skid firewood to the landing annually, to be processed and/or delivered as above.

The benefits of establishing a Roadside Firewood Program are clear. It is recommended here that consideration be given to providing fuel wood for Essex residents as a part of any timber sale contract on the Indian Brook Forest.

STAND DESCRIPTIONS

Stand 1

Size: 23 acres

Forest Type: Mixed Softwood

Structure & Composition: This is a two-aged stand of diverse composition and moderate quality. It is primarily comprised of hemlock (45% of the basal area), red oak (15%), and white pine (12%). Black birch, white oak, and other northern hardwoods are present as minor associates. Eastern portions of this area were harvested in 2002, along with Stand 2, a treatment which established and released regeneration in patches throughout the stand. These areas are generally two-aged. Areas not harvested in 2002 are generally even-aged, with little understory vegetation.

General Description: This is a long, thin stand, mostly located on a hillside sloping towards the western side of the Indian Brook Reservoir. The character of this stand is primarily dominated by hemlock, a species which is prevalent throughout. This stand also features scattered pockets of hardwood, dominated by red and white oak, and occasional super-dominant white pine. Harvesting in this stand, primarily in eastern and southern areas, established or released pockets of primarily hardwood regeneration, although white pine and hemlock are also present among this younger age class. In western areas, the understory is sparse, with scattered hemlock, beech and witch hazel

Stand Summary: 4 plots, 10 BAF prism

Total Basal Area/Acre:	156 ft^2
Acceptable Basal Area/Acre:	110 ft^2
Quadratic Mean Stand Diameter:	13 in.
Trees/Acre:	210

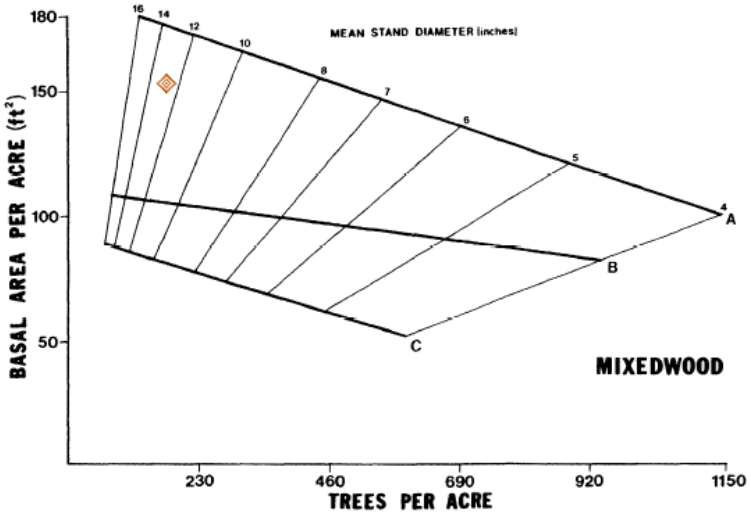


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

Approximate Stand Age: 90 years/ 15 years (younger age class)

Stand Health: In general, hemlock is in poor condition in this stand, with a high probability of interior defects, such as ring-shake. White pine shows slight blister rust and white pine weevil damage on some stems.

Invasive Species: None noted.

Soil Types: Lyman-Marlow Complex

History/Previous Activity: This area was abandoned from agricultural use sometime in the late-1800's to early 1900's. Southern and eastern portions of this stand were harvested in conjunction with Stand 2 in 2002. Western areas appear to have been harvested in the 1970's. Both harvests probably focused on large, mature white pine.

Access and Operability: Eastern portions of this stand, and those sloping to the east, must be accessed via a landing on Indian Brook Road. Western areas may be accessed via a landing at the end of McGee Road (see Stand 3). Operability is good throughout the stands, with the exception of steep areas, where the stand slopes down towards the reservoir.

Management Objectives:

The primary objective for management of this area is the establishment and the maintenance of structural and species diversity, the maintenance of high quality wildlife habitat, the sustained production of forest products using low-impact logging techniques, the continued use of this area for dispersed recreation, and the protection of water resources.

Management in eastern portions of this stand and those sloping eastward, approximately 2/3 the total area of Stand 1, will be focused on preserving their recreational and aesthetic values. These areas are used heavily for recreational purposes in all seasons, and also serve as a buffer for the Indian Brook Reservoir.

There is a small amount of the stand (approximately 1/3 of the stand area) which is relatively flat and can be easily accessed from the west. Uneven-aged management techniques should be used to transition this portion of Stand 1, over time, to a condition which is rich in species diversity, structural diversity, and well-stocked with high-quality timber. This is a condition which is the most beneficial to forest health, wildlife habitat, and the sustained production of forest products.

Management Activities:

Eastern portions of this stand, including all areas sloping down towards the Indian Brook Reservoir, will be not be harvested, except to remove occasional hazard trees and the cutting of occasional trees for aesthetic or recreational purposes.

Western portions of this stand, as described above, will be treated with a single tree and small group selection treatment, scheduled for 2020. The goal of this treatment will be to increase the amount of structural diversity in the stand while capturing the value of poor-quality, declining and mature stems and concentrating growth on the highest quality stems in the stand. If possible, this work should be done in the fall of, or winter following, a red oak, white oak, and/or white pine seed year.

Groups (see Glossary) will be harvested in areas of poor-quality, defective, and declining stems up to ½ acre in size. In these areas all stems will be severed, with the exception of occasional high-quality seed trees, immature growing stock, and desirable regeneration. All snags and cavity trees will be retained within these groups. Groups will be evenly distributed throughout the stand, but will be preferentially placed wherever stocking is poorest in quality or condition and/or where advance regeneration of desirable species exists. Groups will cover about 20% of the harvest area, or approximately 1.5 acres in total. The goal of these groups will be to establish a suite of all native species well-suited to this site, though red and white oak, hemlock and white pine are the targeted commercial species to regenerate.

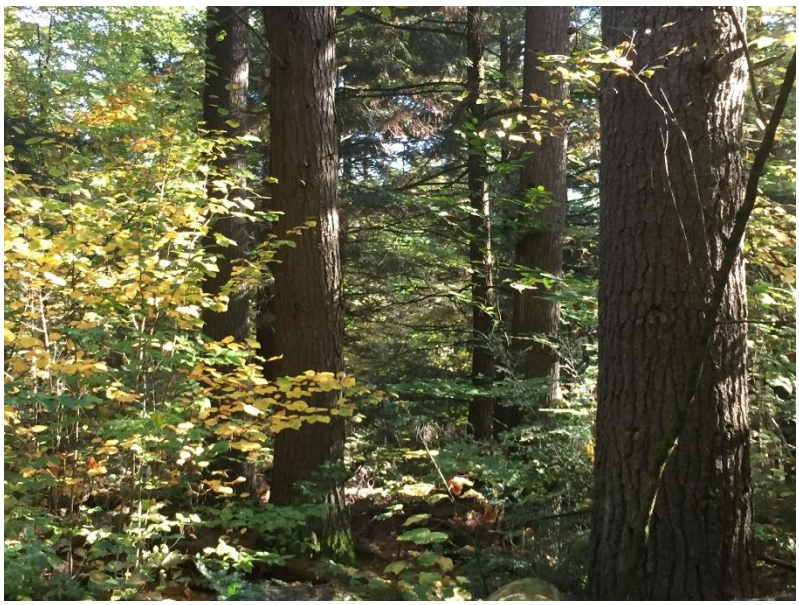
Between groups, single tree selection (see Glossary) will occur. This treatment will remove individual trees in all age classes which are poor in quality, declining, or crowding trees of superior form or condition. This will reduce basal area in the stand to approximately 80 ft^2/acre.

Stand 2

Size: 11.4 acres

Forest Type: White Pine - Hemlock

Structure & Composition: This stand is two-aged, with the dominant cohort comprised mostly of large, mature white pine (60% of the stocking by basal area), in addition to hemlock (30% of the basal area) and scattered hardwoods of variable quality, mostly red oak, present in the midstory. The younger age class in this stand is the result of the harvest conducted in 2002. This harvesting resulted in the establishment of an understory which is dense in some places with pine, hemlock and hardwood regeneration.



General Description: This stand occupies a thin strip of flat ground between the Indian Brook Reservoir and a section of steep rocky ground occupied by Stand 1. The white pine timber in this stand is mature and of a very high quality overall. This stand occupies a section of the Indian Brook Forest that buffers the reservoir, and is also highly used for recreation. The future management of this area will be primarily guided by recreational considerations, as well as with consideration to protection of the reservoir. Most of the unacceptable growing stock in this stand is comprised of poor-quality, suppressed white pine in the smaller size classes.

Stand Summary: 3 plots, 10 BAF prism

Total Basal Area/Acre:	120 ft^2
Acceptable Basal Area/Acre:	60 ft^2
Quadratic Mean Stand Diameter:	12.2 in.
Trees/Acre:	147

Approximate Stand Age: 80-100/15 (younger age class)

Stand Health: This health is in good condition overall, with no concerns of note, aside from natural mortality of mature and suppressed white pine. Light blister rust and white pine weevil damage was noted in the stand.

Invasive Species: None noted.

Soil Types: Lyman-Marlow complex.

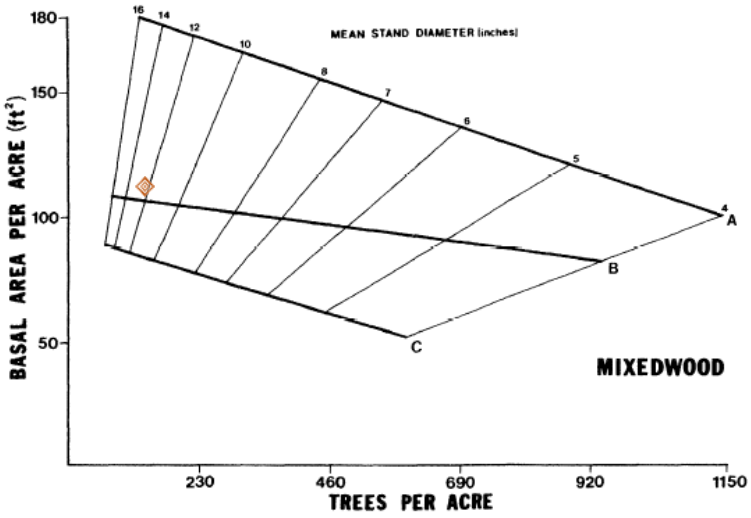


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

History/Previous Activity:
This stand originated from field abandonment sometime in the early 1900's, and was probably thinned in the 1970's. It was harvested with horses in 2002. This appears to have been a light thinning, to remove mature white pine sawtimber.

Access and Operability:
This stand is accessed via the parking area at the end of Indian Brook Road. There is an established system of skid trails in the stand, though most of these are currently heavily used as walking trails.

Management Objectives:

Due to the location of this stand, it will be primarily managed for recreation and as a buffer to the reservoir. No cutting will be done unless it is in the interest of protecting water quality, enhancing recreational values of the stand, or removing hazard trees.

Management Activities:

No forest management for timber. Recreational trails should be maintained to limit erosion and negative impacts to seeps and streams in this stand. Hazard trees and deadfall may be cut along trails. This stand should be continually monitored for the presence of invasive exotic plant species. If they are found, they should be immediately removed.

As in other stands, it should be noted that not all trails in this stand were installed with permission of the town. Un-authorized trails should be reviewed to determine if they are necessary, and steps should be considered to mitigate the soil disturbance associated with un-authorized trail establishment and use.

Stand 3

Size: 25.3 acres

Forest Type: Red Oak – Northern Hardwoods

Structure and Composition: This stand is dominated by red oak (64% of the basal area), with white oak (12%), aspen (9%), white pine (8%) and mixed northern hardwoods and hemlock comprising the balance. This is a mature, even-aged stand with little to no understory in most places. Where the understory is present, it is dominated by witch hazel and American beech, probably due to heavy deer browse following the harvest in the 1970's. Additional structure in the stand comes from the scattered super-dominant pine, which tower above the stand's primarily oak overstory.

General Description: This stand features the highest quality timber on the Indian Brook property. Most areas are dominated by oak species, with occasional large, emergent white pine, and pockets of hemlock and northern hardwoods. This area was harvested in the 1970's. Field evidence suggests that this harvest removed large, mature white pine, a treatment which likely released the now dominant oak. Remnant pine are variable in quality, with some white pine weevil damage and a high likelihood of interior defects. In general, the understory is poor in quality, as described above, with little oak and pine regeneration.

Stand Summary: 6 plots, 10 BAF

Total Basal Area/Acre:	145 ft^2
Acceptable Basal Area/Acre:	102.5 ft^2
Quadratic Mean Stand Diameter:	12 in.
Trees/Acre:	153

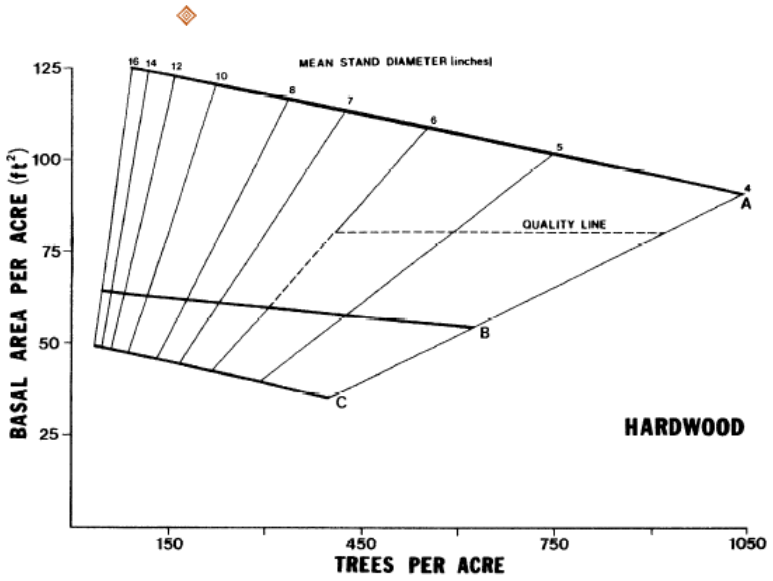


Figure 6.—Stocking guide for main crown canopy of even-aged hardwood stands (beech-red maple, beech-birch-maple) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking. The C-line is minimum stocking. The quality line is the density required to produce high quality stems of beech, sugar maple, yellow birch, and red maple.

Approximate Stand Age: 80-100 years

Stand Health: The trees in this stand are generally healthy, with the exception of white pine weevil damage and senescence in overstory white pines.

Invasive Species: None noted, although common buckthorn was noted in adjacent stands.

Soil Types: Lyman-Marlow complex.

History/Previous Activity: Large pine was removed from this stand, probably in the 1970's. The result of this logging was the release of a cohort of oak which was present in the understory or midstory of this area at that time. These oaks had probably been partially released previously as the pine in this stand was thinned sometime in the mid-1900's. Scattered large pine were left as residuals following the 1970's harvest.

Access and Operability: The best access to this stand will occur from McGee Road. A short section of road and landing will need to be established to accommodate logging from this access point. The revenue from the timber sale recommended in this stand should easily cover the costs of this work.

This stand may be harvested in in summer or in winter, though summer logging may be preferable in order to recruit oak and pine regeneration.

Management Objectives:

The primary objective for management of this area is the establishment and the maintenance of structural and species diversity, the maintenance of high quality wildlife habitat, the sustained production of forest products using low-impact logging techniques, and the continued use of this area for dispersed recreation.

The use of uneven-aged management techniques will transition this stand over time to a condition which is rich in species diversity, structural diversity, and well-stocked with high-quality timber. This is a condition which is the most beneficial to forest health, wildlife habitat, and the sustained production of high-quality forest products.

Management Activities:

This stand will be treated with a single tree and small group selection treatment, scheduled for 2020. The goal of this treatment will be to increase the amount of structural diversity in the stand while capturing the value of poor-quality, declining and mature stems and concentrating growth on the highest quality stems in the stand. If possible, this work should be done in the fall of, or winter following, a red oak, white oak, and/or white pine seed year.

Groups will be harvested in areas of poor-quality, defective, and declining stems up to ½ acre in size. In these areas, all stems will be severed, with the exception of occasional high-quality seed trees, immature growing stock, and desirable regeneration. All snags and cavity trees will be retained within these groups. Groups will be evenly distributed throughout the stand, but will be placed wherever stocking is poor in quality or condition and/or where advance regeneration of desirable species exists. Groups will cover about 20% of the total stand area, or 5 acres in total. The goal of these groups will be to establish a suite of native species well-suited to this site, though red and white oak and white pine are the targeted commercial species.

Between groups, single tree selection will occur. This treatment will remove individual trees in all age classes which are poor in quality, declining, or crowding trees of superior form or condition. This will reduce basal area in the stand, between groups, to approximately 80 ft^2/acre.

As stated above, this harvest may occur in any season, provided that soil conditions are dry or frozen. This harvest will occur in conjunction with cutting in Stands 1, 4, 6, and the eastern portion of Stand 9. A cable skidder is the most appropriate equipment for this work, although other similar equipment mixes may be considered. It is likely that this harvest will occur over the course of at least 2 years.

Stand 4

Size: 37 acres

Forest Type: White Pine – Northern Hardwoods

Structure & Composition: This is a stand dominated by a mix of species, but most prominently white pine (33% of the stocking by basal area), red maple (16%), and red oak (15%). Beech, black birch, and other northern hardwoods are also present. This is a highly variable stand, but for the most part is even aged, without much understory or midstory structure. Species composition varies widely from west to east. The understory which is present is dominated by beech and witch hazel.

General Description: This stand occupies an east-facing hillside to the west of the Indian Brook reservoir and its associated wetlands. This Stand is distinct from Stand 3 primarily due to a higher presence of white pine. A greater proportion of this pine was likely immature at the time of the harvest in Stand 3 in the 1970's, and so more of it was left following this harvest. This white pine is variable in quality, but is generally straighter and healthier than pine found in areas east of this stand. Poorer quality pine is found in patches, especially in eastern portions of the stand. This stand is patchy in composition, with areas stocked by nearly pure white pine, and other areas which are stocked by an oak-hardwood mix, especially where soils are thin. There are a few areas, where soils are deep and moist, which feature rich-site hardwoods such as sugar maple, white ash, and American basswood.

Stand Summary: 6 plots, 10 BAF prism

Total Basal Area/Acre: 123 ft^2

Acceptable Basal Area/Acre: 61.7 ft^2

Quadratic Mean Stand Diameter: 11.3

Trees/Acre 178

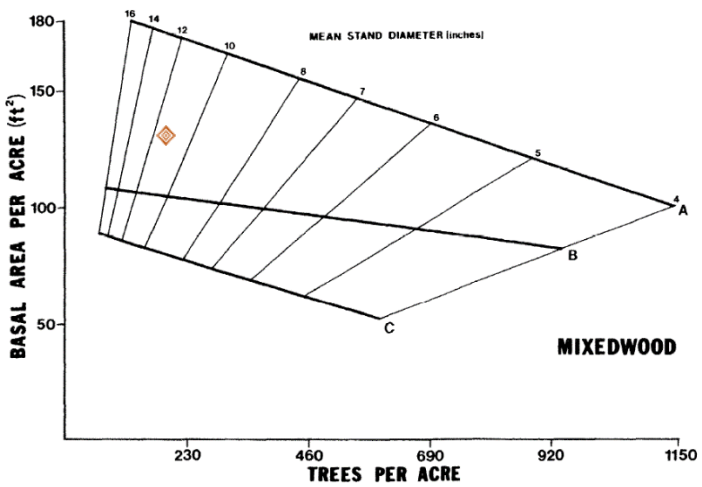


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

Approximate Stand Age: 90-100 years

Stand Health: Blister rust and white pine weevil damage were noted on some pockets of white pine, especially in the east of the stand. Trees with these afflictions are generally in poor health.

Invasive Species: Common buckthorn and Japanese barberry were noted, scattered throughout this stand.

Soil Types: Lyman Marlow complex.

History/Previous Activity: This area was logged in the 1970's in conjunction with Stands 3, 6, 7 and 9. This harvesting appeared to remove mostly large white pine. The response from this logging was the release of immature white pine and red oak in this stand, in addition to the establishment of a sparse understory dominated by beech and witch hazel, probably due to extensive deer browsing following the harvest.

Access and Operability: Access to this stand will be from McGee Road. As described above, some improvements are necessary to make this possible. Access to this stand is good, with the exception of some areas of steep slopes and thin soils, especially in the area of Stand 5. This area may be logged in winter or summer.

Management Objectives:

The primary objective for management of this area is the establishment and the maintenance of structural and species diversity, the maintenance of high quality wildlife habitat, the sustained production of forest products using low-impact logging techniques, and the continued use of this area for dispersed recreation.

The use of uneven-aged management techniques will transition this stand, over time, to a condition which is rich in species diversity and structural diversity, and well-stocked with high-quality timber. This is a condition which is the most beneficial to forest health, wildlife habitat, and the sustained production of forest products.

Management Activities:

This stand will be treated with a single tree and small group selection treatment, scheduled for 2020. The goal of this treatment will be to increase the amount of structural diversity in the stand while capturing the value of poor-quality, declining and mature stems and concentrating growth on the highest quality stems in the stand. If possible, this work should be done in the fall of, or winter following, a red oak, white oak, and/or white pine seed year.

Groups will be harvested in areas of poor-quality, defective, and declining stems up to ½ acre in size. In these areas, all stems will be severed, with the exception of occasional high-quality seed trees, immature growing stock, and desirable regeneration. All snags and cavity trees will be retained within these groups. Groups will be evenly distributed throughout the stand, but will be preferentially placed wherever stocking is poorest in quality or condition and/or where advance regeneration of desirable species exists. These groups will especially target pockets of pine in poor health, with blister rust and white pine weevil damage. Groups will cover about 20% of the total stand area, or 7 acres. The goal of these groups will be to establish a suite of all native species well-suited to this site, though red and white oak and white pine are the preferred commercial species.

Between groups, single tree selection will occur. This treatment will remove individual trees in all age classes with are poor in quality, declining, or crowding trees of superior form or condition. This will reduce basal area in the stand to approximately 100-110 ft^2/acre.

The presence of invasive exotic plant species presents a serious threat to the forests in this area. This area should be carefully surveyed for invasives prior to harvesting, and as many as possible should be removed through a combination of hand-pulling and cut-stump herbicide application. Following harvesting, this process of monitoring and treatment should be repeated annually.

As stated above, soil conditions in this stand afford the opportunity of timber harvesting under winter or summer conditions. In any case, logging must only be done when soils are dry or frozen. This harvest should occur in conjunction with harvesting in Stands 2, 3, 6, and western portions of Stand 9. A cable skidder is the recommended harvesting equipment for this work, although other equipment mixes may be considered.

Stand 5

Size: 5 acres

Forest Type: Dry Oak Forest

Structure & Composition: This forest is unusual in composition. It is dominated by chestnut oak (46% of the stocking in the stand by basal area), a species which in uncommon in Vermont. Other members of this community include white pine (36%), hemlock (14%) and red oak. The structure in the stand is uneven, with trees of a variety of age classes and canopy positions, though the overstory is limited in height by very thin soils. Chestnut oak regeneration is abundant throughout the stand.

General Description: This is a Dry Oak Forest natural community, which is considered a state-significant natural community type by the State of Vermont. The fact that it is dominated by chestnut oak makes Stand 5 an even more unusual and interesting example of this natural community. It is unknown if this area was ever cleared for pasture. This stand is located on some of the thinnest soils on the Indian Brook property, which lends it a "scrubby" appearance.

Stand Summary: 3 plots, 10 BAF prism

Total Basal Area/Acre:	110 ft^2
Acceptable Basal Area/Acre:	40 ft^2
Quadratic Mean Stand Diameter:	7.5
Trees/Acre:	354

Approximate Stand Age: 60 years

Stand Health: Trees in this stand are generally moisture-limited and show signs of drought damage. Blister rust was noted on some of the white pine.

Invasive Species: Common buckthorn was noted.

Soil Types: Lyman-Marlow complex.

History/Previous Activity: Unknown. No evidence of cutting noted.

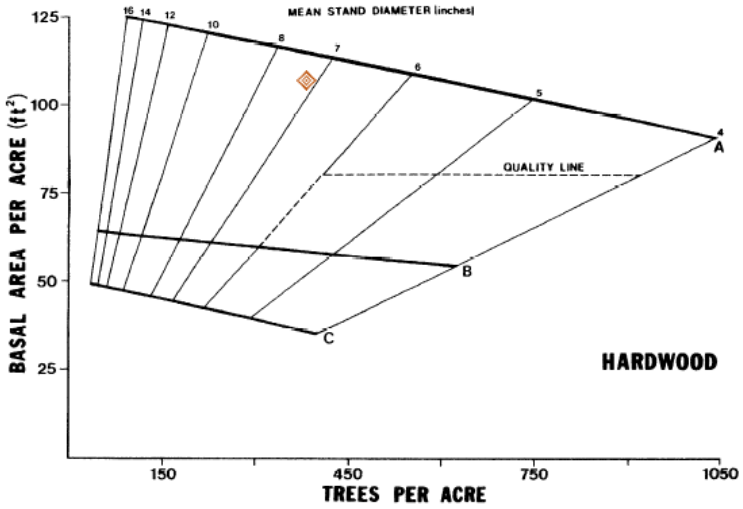


Figure 6.—Stocking guide for main crown canopy of even-aged hardwood stands (beech-red maple, beech-birch-maple) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking. The C-line is minimum stocking. The quality line is the density required to produce high quality stems of beech, sugar maple, yellow birch, and red maple.

Access and Operability: Access to this stand would occur via McGee Road.

Management Objectives:

This stand will be managed for its health as a representative of an unusual natural community, and as habitat for an uncommon tree species. Management will be limited to periodically surveying for, and removing, invasive species. Chestnut oak regeneration in other stands will be released when possible.

Management Activities:

Monitor for invasive exotic plant species annually, and remove those found in the stand.

Monitor the progress of chestnut oak periodically to see if trees of this species in all age classes would benefit from release.

Stand 6

Size: 32 acres

Forest Type: White pine - Hemlock

Structure & Composition: This stand is dominated by white pine (32% of the stocking by basal area), and hemlock (28%). Red maple provides an additional 19% of the basal area, and a mix of hardwoods provide the balance. This area features a more diverse structure than other stands in this area, due primarily to the presence of hemlock in multiple canopy positions, but still lacks understory stems.

General Description: This stand is located on relatively flat ground, bisected by numerous rocky ridges, in the southwest corner of the property. Site conditions in this stand are similar to stands 3 and 4 in many respects, but the composition differs greatly from these other stands. This difference is primarily due to differences in aspect (this areas has a slight westerly aspect) in addition to the presence of the ridges with very thin soils, and many vernal pools, seeps, and other surface water features located between these ridges. Hemlock seems to be poised to dominate this area in the future, though white pine and some northern hardwoods are also doing well in areas. On flat, well-drained areas, there are pockets of northern hardwoods in good condition.

Stand Summary: 6 plots, 10 BAF prism

Total Basal Area/Acre:	145 ft^2
Acceptable Basal Area/Acre:	77ft^2
Quadratic Mean Stand Diameter:	9.1
Trees/Acre:	319

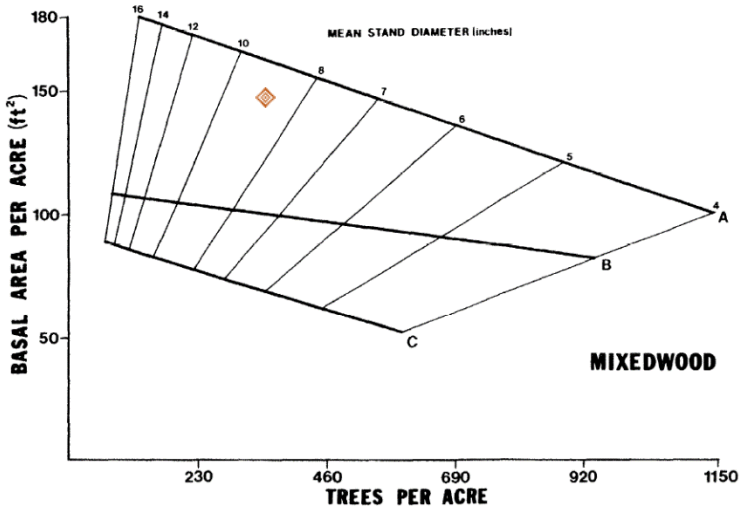


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

Approximate Stand Age: 90-100 years

Stand Health: Blister rust and white pine weevil damage noted on white pine in this stand.

Invasive Species: None noted.

Soil Types: Lyman-Marlow complex

History/Previous Activity: This stand was cleared in the early to mid-1800's, and then probably allowed to revert to forest in the late 1800's-early 1900's. This stand was probably thinned some time in the mid-1900's and was most recently harvested in the 1970's in conjunction with other stands on the western side of the reservoir. This thinning removed mostly large, mature pine.

Access and Operability: This stand can be accessed via McGee Road. Wet conditions in portions of this stand mean that winter harvesting may mitigate soil compaction and erosion, although summer logging during dry conditions may work as well, provided that skid trails are laid out carefully, and areas with sensitive soils are buffered and avoided.

Management Objectives:

The primary objective for management of this area is the establishment and the maintenance of structural and species diversity, the maintenance of high quality wildlife habitat, the sustained production of forest products using low-impact logging techniques, and the continued use of this area for dispersed recreation. This area is particularly important in that it constitutes the best deer wintering habitat on the property. The maintenance and enhancement of deer wintering areas is a stated objective of the 2011 MP.

The use of uneven-aged management techniques will transition this stand, over time, to a condition which is rich in species diversity and structural diversity, and well-stocked with high-quality timber. This is a condition which is the most beneficial to forest health, wildlife habitat, and the sustained production of forest products.

Management Activities:

This stand will be treated with a single tree and small group selection treatment, scheduled for 2020. The goal of this treatment will be to increase the amount of structural diversity in the stand while capturing the value of poor quality, declining and mature stems and concentrating growth on the highest quality stems in the stand and maintaining a continuous canopy for winter cover for white-tailed deer.

Groups will be harvested in areas of poor-quality, defective, and declining stems, primarily poor-quality hardwoods and white pine, up to ¼ acre in size. In these areas, all stems will be severed, with the exception of occasional high-quality seed trees, immature growing stock, and desirable regeneration. All snags and cavity trees will be retained within these groups. In hemlock areas, groups will be no larger than 1/10 - 1/8 acre. Groups will be evenly distributed throughout the stand, but will be placed wherever stocking is poorest in quality or condition and/or where advance regeneration of desirable species exists. These groups will especially target pockets of pine in poor health, with blister rust and white pine weevil damage, and areas with established softwood regeneration. Large, super-dominant white pine will be retained for structure. Groups will cover about 20% of the total stand area, or 6 acres. The goal of these groups will be to increase structural diversity in the stand, to capture value in poor quality stocking and to regenerate, and release established regeneration of, softwood species to serve as winter cover for deer.

Between groups, single tree selection will occur. This treatment will remove individual trees in all age classes which are poor in quality, declining, or crowding trees of superior form or condition. This will reduce basal area in the stand, between groups, to approximately 125 ft^2/acre.

As stated above, this harvest may occur in winter or summer, although the former option is preferred. A cable skidder is the recommended equipment for this harvest, although other equipment mixes may be considered. This harvest will occur in conjunction with harvesting in Stands 2, 3, 4, and western portions of Stand 9.

Stand 7

Size: 32 acres

Forest Type: White pine – Northern Hardwoods

Structure & Composition: This stand is dominated by white pine (53% of the stocking by basal area), and red maple (25%). A mix of hardwoods are present as minor associates. This stand is strongly even-aged, with a single cohort of 50-65-year-old white pine comprising the majority of the overstory stocking. Some regeneration has established due to canopy decline in the overstory of this stand, but the understory is generally sparsely populated with stems.

General Description: This stand is characterized by relatively immature white pine stocking in very poor health and condition. Overstory trees show signs of canopy dieback, white pine weevil and blister rust damage, and general low vigor. Site conditions in this stand point to a greater degree of suitability for northern hardwoods, particularly rich-site species such as sugar maple and white ash.

Stand Summary: 7 plots, 10 BAF prism

Total Basal Area/Acre:	125 ft^2
Acceptable Basal Area/Acre:	40 ft^2
Quadratic Mean Stand Diameter:	9.6
Trees/Acre:	249.6

Approximate Stand Age: 50-65 years

Stand Health: Blister rust and white pine weevil damage is widespread. Nearly all overstory pines are in poor overall condition.

Invasive Species: Common buckthorn noted, scattered throughout the stand.

Soil Types: Lyman-Marlow complex, Peru fine sandy loam.

History/Previous Activity: This stand initiated following pasture abandonment around 1950.

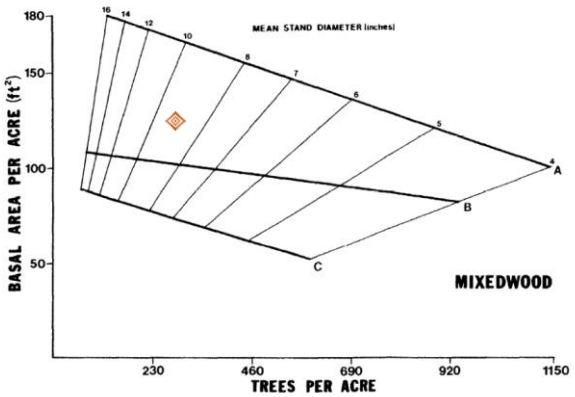


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

Aside from a few areas of minor blowdown, there has been no significant disturbance to the stand since that time.

Access and Operability: This stand can be accessed via McGee Road. Because of moisture conditions in this stand, winter harvesting is recommended, to mitigate soil compaction and erosion.

Management Objectives:

The primary objective for management of this area is the establishment and the maintenance of structural and species diversity, the maintenance of high quality wildlife habitat, the sustained production of forest products, the continued use of this area for dispersed recreation, and the protection of wetlands and water resources.

The long-term goal for this stand will be to remove the poor-quality white pine overstory, transitioning stocking in this area to native species well-suited to this site. This should be done over several entries to mitigate aesthetic impacts and to establish a patchy, uneven structure.

Management Activities:

This stand will be treated with an irregular group shelterwood treatment (see Glossary), scheduled for 2025. The goal of this treatment will be, as described above, to remove the low-quality overstory in this stand, eventually transitioning the area to native tree species well-suited to this site.

Groups up to 2 acres in size will be harvested in areas of poor-quality, defective, and declining overstory stems, primarily poor-quality white pine. Within these areas, all stems will be severed, with the exception of occasional high-quality seed trees, immature growing stock, and desirable regeneration. All snags and cavity trees will be retained within these groups. Groups will be evenly distributed throughout the stand, but will be preferentially placed wherever stocking is poorest in quality or condition and/or where advance regeneration of desirable species exists. Groups will cover about 30-40% of the total stand area, or 10-12 acres.

An additional 30% of this stand will be regenerated every 10 years, so that in 30 years the majority of the overstory of the stand will have been removed. Approximately 10% of the current overstory of the stand should be retained indefinitely as dispersed and aggregated individuals for structural diversity and wetland buffers.

Between groups, a light thinning will occur. This treatment will remove individual trees which are poor in quality, declining, or crowding trees of superior form or condition. This will reduce basal area in the stand, between groups, to approximately 110 ft^2/acre.

Prior to this treatment, this area should be surveyed for invasive species. Invasives found should be hand-pulled or treated with herbicide.

As stated above, winter harvesting is recommended for this stand. This stand should be harvested in conjunction with harvesting in Stand 8 and western portions of Stand 9. Due to the poor quality of softwood timber, it is likely that a whole-tree logging crew will be needed to complete this harvest.

Stand 8

Size: 27 acres

Forest Type: White pine – Northern Hardwoods

Structure & Composition: This stand is dominated by white pine (66.7% of the stocking by basal area), hemlock (11%), red maple (10%) and sugar maple (9%). Red oak and other hardwoods are present at low levels. This stand is even-aged, with a single cohort of poor-quality 65-year-old white pine comprising the majority of the stocking. Structure and composition are very similar to Stand 7.

General Description: This stand is located in the center of the Indian Brook Property, between the reservoir and two wetland complexes. As a result of this, the amount of dry ground suitable for logging is somewhat limited, especially in the south of the stand. The quality of pine in this stand is slightly better than in Stand 7, though overall it is still very poor.

Stand Summary: 6 plots, 10 BAF prism

Total Basal Area/Acre:	145 ft^2
Acceptable Basal Area/Acre:	68 ft^2
Quadratic Mean Stand Diameter:	10.5
Trees/Acre:	242

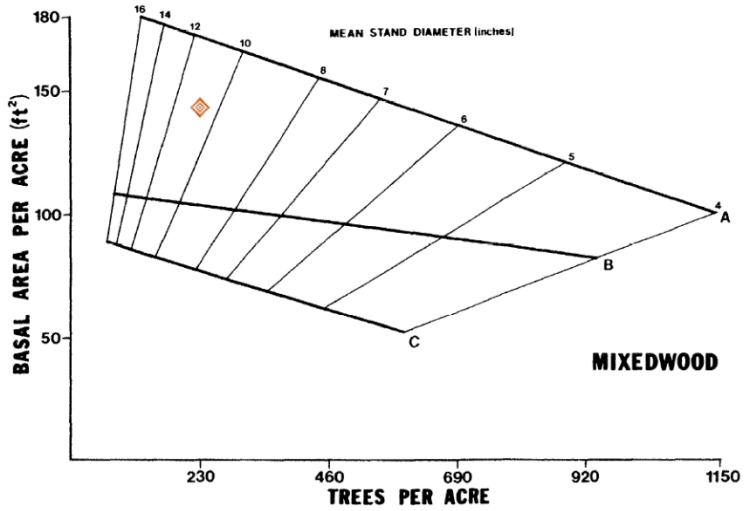


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

Approximate Stand Age: 50-65 years

Stand Health: Blister rust and white pine weevil damage is widespread. Nearly all overstory pines are in poor overall condition.

Invasive Species: None noted.

Soil Types: Marlow fine sandy loam, Lyman-Marlow complex.

History/Previous Activity: This stand initiated following pasture abandonment around 1950. Aside from a few areas of minor blowdown, there has been no significant disturbance to the stand since that time.

Access and Operability: This stand can be accessed via McGee Road or Brigham Hill Lane. Because of moisture conditions in this stand, winter harvesting is recommended.

Management Objectives:

The primary objective for management of this area is the establishment and the maintenance of structural and species diversity, the maintenance of high quality wildlife habitat, the sustained production of forest products, the continued use of this area for dispersed recreation, and the protection of water resources. The long-term goal for this stand will be to remove the poor-quality white pine overstory, transitioning this area to native species well-suited to this site. This should be done over several entries to mitigate aesthetic impact and to establish a patchy, uneven structure.

In some portions of this stand, management will be limited to areas around a single main skid trail, in order to maintain appropriate buffers around streams, wetlands, and the reservoir.

Management Activities:

This stand will be treated with a single tree and group shelterwood treatment, scheduled for 2025. The goal of this treatment will be, as described above, to transition the area to northern hardwoods well-suited

to this site. Because of operational restrictions in this stand due to wet soils, it is likely that only about 50% of the stand will ever be harvested. Areas with very sensitive soils will be avoided in the course of this treatment.

Groups up to 1/2 acre in size will be harvested in areas of poor-quality, defective, and declining overstory stems, primarily poor-quality white pine, and in areas with established, high quality regeneration. Within these areas, all stems will be severed, with the exception of occasional high-quality seed trees, immature growing stock, and desirable regeneration. All snags and cavity trees will be retained within these groups. Groups will be evenly distributed throughout the stand, but will be preferentially placed wherever stocking is poorest in quality or condition and/or where advance regeneration of desirable species exists. Groups will cover about 20% of the harvestable stand area (not including areas with sensitive soils and stream/wetland buffers).

Between groups, a single tree selection treatment should occur. This will remove trees of poor health, form and/or overall condition or those crowding stems of superior form and condition, lowering the basal area between groups to approximately 120 ft^2/acre.

Prior to this treatment, this area should be surveyed for invasive species. Invasives found should be hand-pulled or treated with herbicide.

This harvest will be performed in conjunction with harvesting in Stand 7 and western portions of Stand 9. Due to the prevalence of poor-quality, white pine timber in the stand, a whole-tree logging crew is recommended for this work, though other equipment mixes may be considered. As stated above, winter harvesting is recommended for this stand.

Stand 9

Size: 38 acres

Forest Type: White pine – Northern Hardwoods

Structure & Composition: This stand is dominated by white pine (57% of the stocking by basal area), hemlock (19%), and red maple (13%). Other northern hardwoods are present at low levels. This stand is even-aged, with a single cohort of 65-year-old white pine comprising the majority of the stocking, but also features a high-quality cohort of sugar maple poles, seedlings and saplings in some areas, in addition to pockets of more complex hemlock and northern hardwood mixes.

General Description: This stand differs from Stand 7 and 8 in two ways; firstly, the quality of pine is generally better, although a high proportion of this species (40%) is still in poor condition. Secondly, there is a presence of a high-quality cohort of sugar maple and other northern hardwood pools, seedlings and saplings present in areas throughout this stand. This lends the stand a slightly more complex structure than the aforementioned two stands. It is likely that these northern hardwoods established on areas of enriched soils, directly following field abandonment, and as a result of canopy dieback in white pine-dominated areas. There is also scattered evidence of harvesting from the 1970's which likely released and caused the establishment of some of these stems. In some areas, especially in the west, harvesting was heavier, releasing pockets of northern hardwood and hemlock regeneration.

Stand Summary: 6 plots, 10 BAF prism

Total Basal Area/Acre:	155 ft^2
Acceptable Basal Area/Acre:	95 ft^2
Quadratic Mean Stand Diameter:	11
Trees/Acre:	235

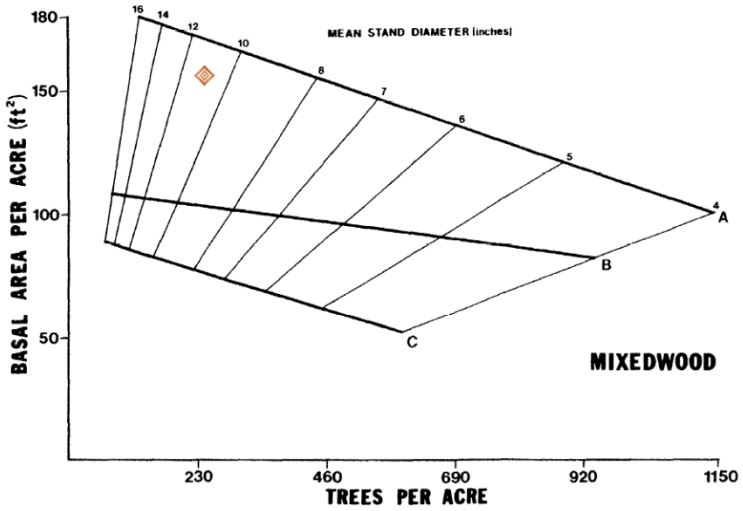


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

Approximate Stand Age: 50-65 years

Stand Health: Blister rust and white pine weevil damage is widespread.

Invasive Species: Common buckthorn noted, scattered throughout the stand.

Soil Types: Lyman-Marlow complex, Peru fine sandy loam.

History/Previous Activity: This stand initiated following pasture abandonment around 1950. Logging evidence, probably from the 1970's, was noted in this stand, especially in western areas. Field evidence suggests that this harvesting targeted large, mature white pine.

Access and Operability: This stand can be accessed via McGee Road or via Brigham Hill Lane. Winter harvesting is recommended to mitigate soil compaction and erosion.

Management Objectives:

The primary objective for management of this area is the establishment and the maintenance of structural and species diversity, the maintenance of high quality wildlife habitat, the sustained production of forest products, the continued use of this area for dispersed recreation, and the protection of wetlands and water resources.

The long-term goal for this stand will be to gradually remove the poor-quality white pine overstory, transitioning this area to native species well-suited to this site. In particular, harvesting should capitalize on the existence of high quality sugar maple regeneration that is established in the stand, releasing it whenever possible. This should be done over several entries to mitigate aesthetic impact and to establish a patchy, uneven structure.

Management Activities:

This stand will be treated with a group shelterwood treatment, scheduled for 2025 (eastern areas) and 2020 (western areas). The goal of this treatment will be, as described above, to transition the area to northern hardwoods well-suited to this site.

Groups up to 1 acre in size will be harvested in areas of poor-quality, defective, and declining overstory stems, primarily poor-quality white pine, and in areas with established, high quality regeneration. Within these areas, all stems will be severed, with the exception of occasional high-quality seed trees, immature growing stock, and desirable regeneration. All snags and cavity trees will be retained within these groups. Groups will be evenly distributed throughout the stand, but will be preferentially placed wherever stocking is poorest in quality or condition and/or where advance regeneration of desirable species exists. Groups will cover about 20% of the total stand area, or 7.5 acres.

Between groups, a single tree selection treatment should occur. This will remove trees in poor health, form and/or overall condition, or those crowding stems of superior form and condition, lowering the basal area between groups to approximately 120 ft^2/acre.

Prior to this treatment, this area should be surveyed for invasive species. Invasives found should be hand-pulled or treated with herbicide.

Western portions of this stand feature more high-quality advanced regeneration, and less low quality white pine. Additionally, logging in this area makes more operational sense when combined with harvests in Stands 2, 3, 4, and 6. A cable skidder or similar equipment mix is recommended for this portion of the stand.

Eastern areas can more easily be harvested with Stands 7 and 8, and feature a higher proportion of low-quality pine timber. A whole-tree logging crew is recommended for this portion of the stand.

Stand 10

Size: 15 acres

Forest Type: Early Successional (White Pine – Black Locust – Northern Hardwoods).

Structure & Composition: This stand is dominated by white pine (45% of the stocking by basal area), sugar maple (20%), red maple (15%) and black locust (5%). Other northern hardwoods are present at low levels. This stand is extremely patchy, with many small areas exhibiting decidedly distinctive characteristics.

General Description: This stand is comprised of some of the youngest forest on the Indian Brook Reservoir property, with aerial photos showing this area as somewhat open through the 1960's. Most of the stand consists of a white pine and northern hardwood mix, with variable quality overall. There are also small pockets of apple trees and orchards scattered throughout, comprising perhaps 1-2 acres in total. There is a black locust plantation 1-2 acres in size in the south of the stand, and a patch of Japanese honeysuckle about 1/8 to ¼ acre in size around a cellar hole in the central portion of the property. Regeneration is patchy, with invasive species well-established in most areas, brushy areas around old orchards, and some thick sugar maple regeneration coming up beneath black locust plantations.

Stand Summary: 4 plots, 10 BAF prism

Total Basal Area/Acre:	80 ft^2
Acceptable Basal Area/Acre:	45 ft^2
Quadratic Mean Stand Diameter:	9
Trees/Acre:	220

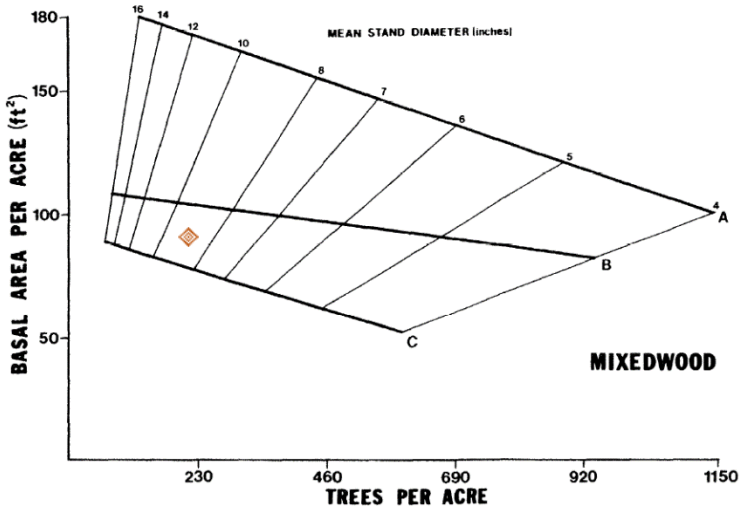


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

Approximate Stand Age: 50-65 years

Stand Health: Blister rust and white pine weevil damage is widespread. Black locust appears to be dying back. Invasive plant infestations are severe.

Invasive Species: Common buckthorn, shrub honeysuckle, Japanese barberry and Japanese knotweed noted. This last species is by far the most difficult invasive species to treat, and should be dealt with aggressively and immediately.

Soil Types: Marlow fine sandy loam, Lyman-Marlow complex.

History/Previous Activity: This stand initiated following pasture abandonment around 1965. Aside from a few areas of minor blowdown, there has been no significant disturbance to the stand since that time.

Some Eagle Scouts were involved in releasing some of the apple trees in this stand from competition in summer/fall 2017.

Access and Operability: This stand can be most easily accessed via Brigham Hill Lane. Winter harvesting is recommended to mitigate soil compaction and erosion.

Management Objectives:

The primary objective for management of this area is the establishment and the maintenance of structural and species diversity, the maintenance of high quality wildlife habitat, the sustained production of forest products, the continued use of this area for dispersed recreation, and the protection of wetlands and water resources.

The long-term goal for this area will be to gradually transition it to a diverse stand comprised of multiple age classes of native species.

Management Activities:

Because of the immaturity of this stand, in addition to the prevalence of invasive species, no treatment is recommended at this time. In this stand the sole focus should be the control of invasive species. The stand should be reassessed at the time of the next management plan update, to see if harvesting is feasible.

Stand 11

Size: 34 acres

Forest Type: White Pine – Northern Hardwoods

Structure & Composition: This stand is dominated by white pine (42% of the stocking by basal area), red oak (16%) red maple (14%), and sugar maple (12%). Other northern hardwoods and red pine are present at low levels. This stand is even-aged, with virtually all areas having established following field abandonment around 1950, but it has a two-layered structure in places, with the faster-growing white pine overtopping the hardwoods present.

General Description: This stand is comprised of young (about 65-year-old) forest in the northeast of the Indian Brook property. The forest is somewhat patchy, with some areas where white pine is dominant and dense, and others where the stocking is dominated by maple poles. Overall, white pine and red maple stocking in this stand is poor in quality (47% and 33% AGS, respectively), whereas sugar maple, red oak and other hardwoods are much healthier and in better condition.

Stand Summary: 9 plots, 10 BAF prism

Total Basal Area/Acre:	147 ft^2
Acceptable Basal Area/Acre:	80 ft^2
Quadratic Mean Stand Diameter:	6.6
Trees/Acre:	609

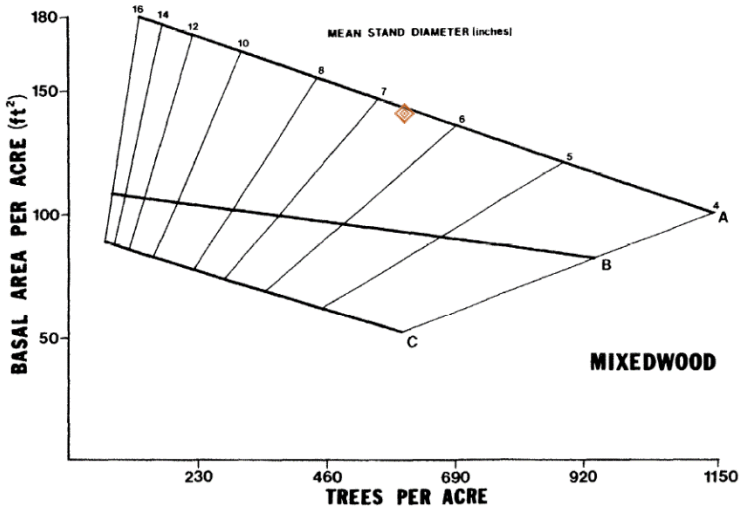


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

Approximate Stand Age: 50-65 years

Stand Health: Blister rust and white pine weevil damage is widespread. Red maple is generally low in vigor and poor n condition.

Invasive Species: Common buckthorn noted, scattered throughout the western portion of the stand.

Soil Types: Lyman-Marlow complex.

History/Previous Activity: This stand initiated following pasture abandonment around 1950. There been no significant disturbance to the stand since that time.

Access and Operability: This stand can be most easily accessed via Brigham Hill Lane. Winter harvesting is recommended to mitigate soil compaction and erosion. This stand should be harvested concurrently with Stand 10, and may in the future be managed in conjunction with northern portions of Stand 13.

Management Objectives:

The primary objective for management of this area is the establishment and the maintenance of structural and species diversity, the maintenance of high quality wildlife habitat, the sustained production of forest products, and the continued use of this area for dispersed recreation.

The long-term goal for this stand will be to gradually transition to a diverse stand comprised of multiple age classes of native species. This will consist specifically of attempting to release high quality hardwood and pine stems whenever possible, and taking steps to regenerate these species in areas where existing stocking is poor in quality.

Management Activities:

Because of the immaturity of this stand, no treatment is recommended at this time. In this stand the sole focus should be the control of the invasive species. The stand should be reassessed at the time of the next management plan update, to see if harvesting is feasible.

Stand 12

Size: 38 acres

Forest Type: White Pine - Red Oak – Northern Hardwoods

Structure and Composition: This stand is dominated by white pine (29% of the stocking by basal area) and red oak (24%). Also prominent are red maple (12%), white ash (12%) and sugar maple (9%). This stand is somewhat variable in composition, with a large portion stocked by nice red oak and northern hardwoods. Scattered, very large white pine and sugar maple provide high structure. There are pockets of hardwood saplings that may have established following the removal of large pine sometime in the 1970's.

General Description: This stand was allowed to revert to forest earlier than many of the other stands at the Indian Brook Forest; pasturing probably ceased in the late 1800's or early 1900's. This stand features a mixed composition, both in terms of species and structure. Old, massive white pine of variable quality are scattered throughout the stand, perhaps the remnants of a previously dominant white pine stand. Old sugar maple trees are also present in the east of the stand, as evidence that portions of this stand once functioned as a sugarbush. Most other trees were probably established in the understory of a previously dominant cohort, and released by the partial removal of that cohort, though pockets of stems appear to have regenerated since then. Field evidence suggests that this area may have been harvested around the 1970's, probably targeting large, mature white pine. Overall, this stand is very high in quality, and well-stocked with hardwood and softwood sawtimber.

Stand Summary: 8 plots, 10 BAF

Total Basal Area/Acre:	185 ft^2
Acceptable Basal Area/Acre:	115 ft^2
Quadratic Mean Stand Diameter:	11.8 in.
Trees/Acre:	245

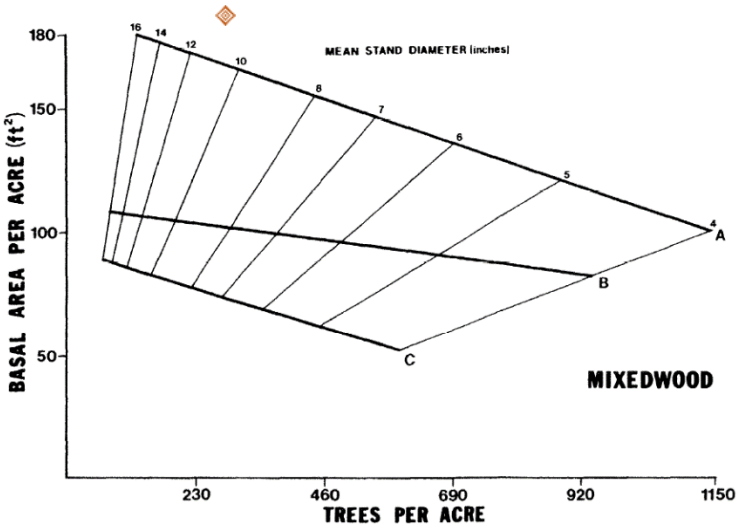


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

Approximate Stand Age: 100+ years

Stand Health: The trees in this stand are generally healthy, though some white pine weevil damage and blister rust is present on the white pine. Additionally, the chance of interior defects in the white pine is high.

Invasive Species: Common buckthorn was noted, particularly around the reservoir, where some dense populations are present.

Soil Types: Lyman-Marlow complex.

History/Previous Activity: Large pine was removed from this stand, probably in the 1970's. The result of this logging was the release of a cohort of oak which was present in the understory or midstory of this area at that time, and the establishment of some areas of new regeneration. Scattered large pine were left as residuals at a variable density.

Access and Operability: Access to this stand may occur from Brigham Hill Lane or from Indian Brook Road. This stand may be harvested in in summer or in winter, though summer logging may be preferable in order to recruit oak and pine regeneration. In order to buffer the reservoir and wetlands, in addition to popular recreational trails, most of the western 25-35% of the stand should not be harvested.

Management Objectives:

The primary objective for management of this area is the establishment and the maintenance of structural and species diversity, the maintenance of high quality wildlife habitat, the sustained production of forest products using low-impact logging techniques, the continued use of this area for dispersed recreation, and the protection of wetlands and water resources.

The use of uneven-aged management techniques will transition this stand over time to a condition which is rich in species diversity, structural diversity, and well-stocked with high-quality timber. This is a condition which is the most beneficial to forest health, wildlife habitat, and the sustained production of forest products. Harvesting in this stand should remove some large, mature timber, but should focus on retaining large trees as structure and removing low quality trees as much as possible, encouraging the growth of high quality stems and creating areas of new regeneration.

Management Activities:

The eastern 65-75% of this stand will be treated with a single tree and small group selection treatment. This work would benefit the stand but is contingent upon access, and so may need to be delayed until the time of the next management plan update, 2027. If access can be established prior to then, it is recommended that this work proceed at this time.. The goal of this treatment will be to increase the amount of structural diversity in the stand while capturing the value of poor quality, declining and mature stems and concentrating growth on the highest quality stems in the stand. If possible, this work should be done in the fall of, or winter following, a red oak, white oak, and/or white pine seed year.

Groups will be harvested in areas of poor-quality, defective, and declining stems up to ½ acre in size. In these areas, all stems will be severed, with the exception of occasional high-quality seed trees, immature growing stock, and desirable regeneration. All snags and cavity trees will be retained within these groups. Groups will be evenly distributed throughout the stand, but will be placed wherever stocking is poor in quality or condition and/or where advance regeneration of desirable species exists. Groups will cover about 20% of the total harvestable stand area, or 5-6 acres. The goal of these groups will be to establish a suite of native species well-suited to this site, though red and white oak and white pine are the preferred commercial species.

Between groups, single tree selection will occur. This treatment will remove individual trees in all age classes which are poor in quality, declining, or crowding trees of superior form or condition. This will reduce basal area in the stand, between groups, to approximately 100 ft^2/acre.

As stated above, this stand may be harvested in winter or in summer. In either case, it will be harvested in conjunction with Stand 13. A cable skidder is the recommended equipment for this work, though other equipment mixes may be considered. Due to the size of this job, combined with harvesting recommended in Stand 13, this harvesting will likely take place over the course of two years.

Stand 13

Size: 81 acres

Forest Type: White Pine - Red Oak – Northern Hardwoods

Structure and Composition: This stand is dominated by white pine (54% of the stocking by basal area) and red maple (19%). Sugar maple, red oak and other hardwoods are present as minor associates. This stand is dominated by a very large, overstory cohort of white pine, overtopping a younger cohort of mixed hardwood stems. There are pockets of pole and sapling-sized trees in this stand, scattered in a patchy distribution throughout the area.

General Description: This stand, along with Stand 12, was allowed to revert to forest earlier than many of the other stands at the Indian Brook Forest; pasturing probably ceased around the late 18800's – early 1900's. As a result, old, massive white pine of variable quality are scattered throughout the stand, perhaps the remnants of a previously dominant white pine stand. Old sugar maple trees are also present throughout the stand, as evidence that portions of this area once functioned as a sugarbush. Most other trees were probably established in the understory of a previously dominant cohort, and released by the partial removal of that cohort, though pockets of stems appear to have regenerated since then. Field evidence suggests that this area may have been harvested around the 1970's, probably targeting large, mature white pine. Overall, this stand is very high in quality, and well-stocked with hardwood and softwood sawtimber.

Stand Summary: 15 plots, 10 BAF

Total Basal Area/Acre:	165 ft^2
Acceptable Basal Area/Acre:	114 ft^2
Quadratic Mean Stand Diameter:	12.5 in.
Trees/Acre:	212

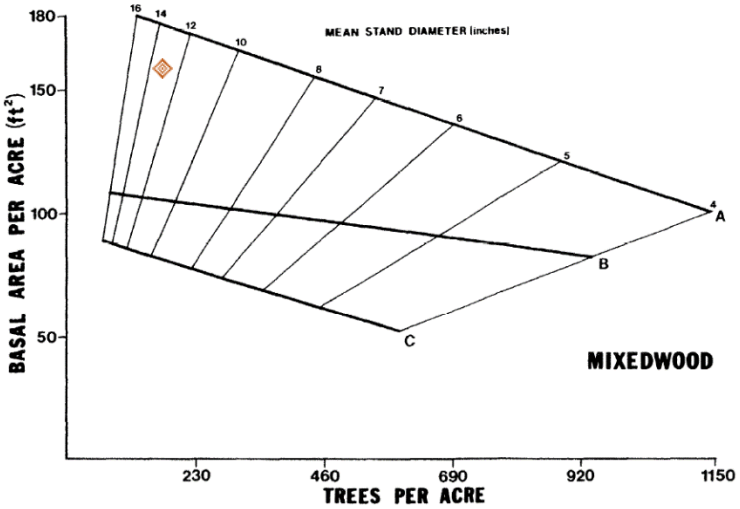


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

Approximate Stand Age: 100+ years

Stand Health: The trees in this stand are generally healthy, though some white pine weevil damage and blister rust is present on the white pine. Additionally, the chance of interior defects in the white pine is high.

Invasive Species: Common buckthorn was noted, particularly in the south of the stand.

Soil Types: Lyman-Marlow complex.

History/Previous Activity: This stand was abandoned from agricultural use sometime in the late 1800's or early 1900's. Field evidence suggests that the resulting stand was probably harvested, removing large pine, sometime in the last 40 years.

Access and Operability: Access to this stand may occur from Brigham Hill Lane or from Indian Brook Road. This stand may be harvested in in summer or in winter, though summer logging may be preferable in order to recruit oak and pine regeneration. All areas with thin soils should be avoided completely, except for under frozen conditions with deep snow.

Management Objectives:

The primary objective for management of this area is the establishment and the maintenance of structural and species diversity in this stand, the maintenance of high quality wildlife habitat in the stand, the sustained production of forest products using low-impact logging techniques, the continued use of this area for dispersed recreation, and the protection of wetlands and water resources.

The use of uneven-aged management techniques will transition this stand over time to a condition which is rich in species diversity, structural diversity, and well-stocked with high-quality timber. This is a condition which is the most beneficial to forest health, wildlife habitat, and the sustained production of

forest products. Harvesting in this stand should remove some large, mature timber, but should focus on retaining large trees as structure and removing low quality trees as much as possible, and on establishing new pockets of desirable regeneration.

Management Activities:

This stand will be treated with a single tree and small group selection treatment. This work would benefit the stand but is contingent upon access, and so may need to be delayed until the time of the next management plan update, 2027. If access can be established prior to then, it is recommended that this work proceed at this time.. The goal of this treatment will be to increase the amount of structural diversity in the stand while capturing the value of poor-quality, declining and mature stems and concentrating growth on the highest quality stems in the stand. If possible, this work should be done in the fall of, or winter following, a red oak, white oak, and/or white pine seed year. This harvest will focus on the removal of some of the large, mature, defective white pine, and the removal of unhealthy midstory stems.

Groups will be harvested in areas of poor-quality, defective, and declining stems up to ½ acre in size. In these areas, all stems will be severed, with the exception of occasional high-quality seed trees, immature growing stock, and desirable regeneration. All snags and cavity trees will be retained within these groups. Groups will be evenly distributed throughout the stand, but will be preferentially placed wherever stocking is poor in quality or condition and/or where advance regeneration of desirable species exists. Groups will cover about 20% of the total stand area, or 15-17 acres. The goal of these groups will be to capture value in mature pine, remove poor-quality growing stock from the overstory and midstory, release any regeneration present, and to establish new areas of high quality regeneration.

Between groups, single tree selection will occur. This treatment will remove individual trees in all age classes which are poor in quality, declining, or crowding trees of superior form or condition. This will reduce basal area in the stand, between groups, to approximately 120 ft^2/acre.

As stated above, this stand may be harvested in winter or in summer. In either case, it will be harvested in conjunction with Stand 12. A cable skidder is the recommended equipment for this work, though other equipment mixes may be considered. Due to the size of this job, combined with harvesting recommended in Stand 13, this harvesting will likely take place over the course of two years.

Stand 14

Size: 22 acres

Forest Type: White Pine – Northern Hardwoods.

Structure & Composition: This stand is dominated by white pine (50% of the stocking by basal area), sugar maple (26%), and white ash (18%). Other northern hardwoods are present at low levels. This stand is patchy, a combination of areas dominated by even-aged white pine and even aged northern hardwood poles. Overall, this stand is very low in structural diversity.

General Description: Along with Stands 10 and 11, this stand is comprised of some of the youngest forest on the Indian Brook Reservoir property, with aerial photos showing this area as somewhat open through the early 1960's. Most of the stand consists of even-aged pockets of either poor-quality white pine or rich-site northern hardwood poles. The former areas tend to be very poor in quality, with blister rust and white pine weevil damage, whereas the latter areas are high in quality and potential. Regeneration is patchy, with invasive species, especially common buckthorn, well established in most areas.

Stand Summary: 4 plots, 10 BAF prism

Total Basal Area/Acre:	125 ft^2
Acceptable Basal Area/Acre:	70 ft^2
Quadratic Mean Stand Diameter:	9.6
Trees/Acre:	250

Approximate Stand Age: 50-65 years

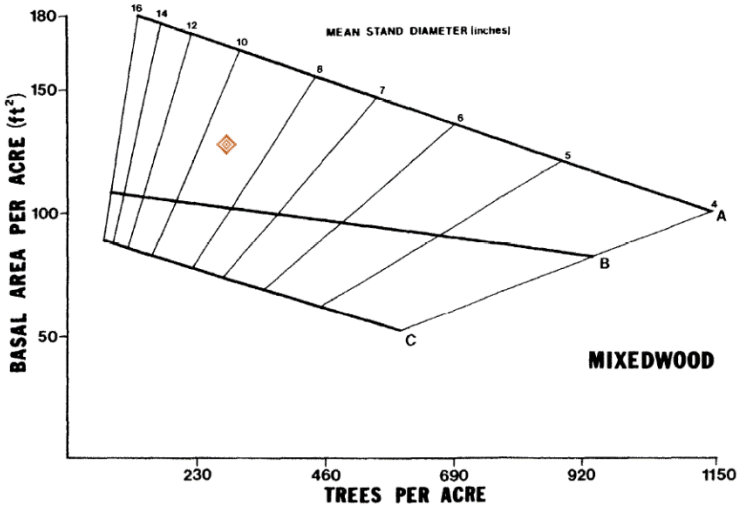


Figure 7.—Stocking guide for main crown canopy of mixedwood stands (25 to 65 percent softwoods) shows basal area and number of trees per acre and quadratic mean stand diameter. The A line is fully stocked, the B line is suggested residual stocking, the C line is minimum stocking.

Stand Health: Blister rust and white pine weevil damage is widespread throughout pine areas.

Invasive Species: Common buckthorn is present throughout the stand.

Soil Types: Marlow fine sandy loam, Lyman-Marlow complex.

History/Previous Activity: This stand initiated following pasture abandonment around 1965. Aside from a few areas of minor blowdown, there has been no significant disturbance to the stand since that time.

Access and Operability: This stand can be most easily accessed via Indian Brook Road. Winter harvesting is recommended to mitigate soil compaction and erosion.

Management Objectives:

The primary objective for management of this area is the establishment and the maintenance of structural and species diversity, the maintenance of high quality wildlife habitat, the sustained production of forest products, the continued use of this area for dispersed recreation, and the protection of wetlands and water resources.

The long-term goal for this stand will be to remove invasive and exotic species and unhealthy growing stock, and to gradually transition to a diverse stand comprised of multiple age classes of native species.

Management Activities:

Because of the immaturity of this stand, in addition to the prevalence of invasive species, no treatment is recommended at this time. In this stand the sole focus should be the control of the invasive species. The stand should be reassessed at the time of the next management plan update, to see if harvesting is feasible.

Schedule of Management Activities

Stand	Activity	Scheduled Year	Priority	Cost	Funding Source/Partners
All	Invasive species removal	Ongoing (beginning in 2017)	1	Unknown, up to $10,000	US Fish and Wildlife, volunteers, timber sale proceeds
All	Boundary Line maintenance	Ongoing	1	Approx $120 - $150 (paint)	County Forester/Volunteers
N/A	Build road and landing from end of McGee Road	2018	2	$5,000 – $6,500	Incorporate into timber sale contract.
3, 4, 6, 9	Conduct prescribed harvesting, using McGee Road Access	2020	3	Revenue positive	N/A
7,8,9	Conduct prescribed harvesting using McGee Road Access	2025	3	Revenue positive	N/A
N/A	Assess viability of access from the north, via Brigham Hill Lane	N/A	4	N/A	County Forester
12, 13	Conduct prescribed harvesting using Brigham Hill Lane, neighbor to the north, or Indian Brook Road	N/A	4	$10,000 - $20,000 if Brigham Hill Lane is used. Otherwise revenue positive.	Incorporate costs into timber sale contract. Consider seeking ERP or other road stabilization funding for Brigham Hill Lane.
ALL	Update Forest Management Plan	2027	1	N/A	County Forester

Glossary

AGS: Acceptable Growing Stock (AGS) is a classification given to trees in a stand which are considered healthy and capable of producing a sawlog sometime in the future.

Cable Skidder: A skidder which uses a cable and winch to drag trees out of the forest. These skidders are generally smaller and more low-impact that skidding equipment used by whole-tree logging crews.

Cohort: A group of trees of generally the same age (usually within 20 years), often initiating from the same disturbance event.

Composition: The proportion of trees of different species present in a given forest or stand.

Cover Type/Forest Type: A classification given to a stand based on the dominant tree species present at a given moment in time.

Even-Aged: A stand comprised of trees of a single age class (cohort), usually resulting from a single disturbance event.

Harvest: The process of cutting trees to extract a forest product from the woods.

Intermediate: The canopy position of trees who have been over-topped by other stems, but are still receiving some direct light from above. These stems are generally higher in quality than suppressed trees, and in the case of shade-tolerant species may be healthy, but overall they are poor in condition.

Irregular Group Shelterwood: There are many variants of this type of silvicultural treatment, but the version described here is a means for regenerating a stand over a period of time, while creating a patchy, uneven structure. Specifically, irregular shelterwoods of this type remove the overstory of a stand in groups (which can be larger than the groups described as part of a group selection system), retaining trees which serve as potential growing stock, seed sources, and shade within the groups. Trees regenerated in this environment are likely to be moderately shade-tolerant to very shade-tolerant, with some intolerant species mixed in. These pockets of regeneration are expanded progressively over several entries, at each stage releasing the established regeneration from the previous harvest. Over time, the overstory in the stand is completely removed, replaced by a young stand with a somewhat patchy structure.

Group Selection: This treatment system involves harvesting all stems in a small area, usually no greater than ½ acre in size. These areas in which all trees are harvested are called “groups,” and may be as small as 2-3 trees in size. The goal for these groups is to regenerate a new age class, or to release existing regeneration. Usually, these groups will regenerate a portion of a stand in proportion to the frequency of cutting and the rotation age of the stand. For instance, in a stand with a cutting cycle (frequency) of 20 years and a rotation age of 100 years, 20% of the stand would be regenerated using groups each time cutting is done. This way, by the time the full rotation age has passed, all areas have been regenerated and there are 5 age classes of trees in the forest. In reality, a fully-balanced age-class distribution would be next to impossible to achieve, but this is the general goal of this system.

Late Successional Forest: A forest dominated by older trees of long-lived species. In Vermont’s forests, late successional species include American beech, sugar maple, red and white oak, eastern hemlock and yellow birch.

Midstory: Trees with a canopy position below the overstory, but above the understory in a stand. The midstory of a forest usually consists of suppressed and intermediate stems and/or slow growing or shade tolerant species.

Natural Community: An assemblage of biotic/abiotic factors in an environment, and the processes that govern them. Natural communities consist of all levels of biota in a forest, and consider how forest composition and structure changes over time.

Overstory: The highest canopy position of trees in a forest. Overstory trees are generally those whose crowns are exposed to full or nearly full light.

Prescription: A silvicultural strategy for how to manage a stand to achieve a desired result. A prescription will detail exactly how to harvest a forest, including providing metrics for the residual stand, and a detailed description of trees to be cut and those to be retained.

Release: The process of removing trees from competition, allowing them to grow more freely.

Silviculture: The art and science of tending a forested stand, generally using timber harvesting as a tool.

Single Tree Selection: This treatment harvests trees of all age classes in a stand, to encourage the growth of higher quality stems and the establishment of regeneration of shade-tolerant tree species. This treatment can also be used to ensure that there is an even distribution of trees of different species throughout the stand. This treatment is often employed between groups as part of uneven-aged management.

Skidder: A tractor-like machine, used to drag or "skid" trees out of the forest.

Stand: An area of forest in a similar enough condition, with regards to structure, composition, history, and other factors, to be managed as a single unit.

Structure: In a forestry context, structure describes the presence of different age classes and canopy heights within a stand. Vertical structure is comprised of trees of different heights interspersed throughout an area, whereas horizontal structure described the presence of pockets of trees of different ages. In uneven-aged management, single tree selection usually creates vertical structure, whereas group selection creates horizontal structure.

Succession: The process by which trees in a forest move from one generation and condition to the next. "Early successional" stands are those that establish following a disturbance, stocked by shade-intolerant and pioneer species, while "late-successional" (sometimes used interchangeably with "old-growth") stands, occur when stands have developed into older forest types, often stocked by larger, older trees of shade-tolerant species.

Suppressed: Trees which have been completely overtopped by overstory stems, receiving little to no direct sunlight, are considered "suppressed." Except in the cases of very shade-tolerant species, suppressed trees are often stunted and poor in quality.

Timber: Timber is used to describe the forest products (sawlogs, pulp, firewood, etc.) located inside the standing trees present in the forest. This word is sometimes also used to describe these products after the trees have been cut but before they have been processed or milled.

Treatment: A silviculturally planned and executed timber harvest.

Two-aged: A stand which is comprised of two distinct age classes. This is a common condition in managed forests, as the overstory is often targeted for logging, regenerating a new understory cohort while retaining some overstory trees.

UGS: Unacceptable Growing Stock (UGS) is a classification given to unhealthy trees unlikely to live long or to produce a sawlog in the future.

Uneven-aged: A stand comprised of three or more distinct age classes of trees. This forest type is common in undisturbed and "old-growth/late successional" forests.

Uneven-age management: This management system seeks to emulate natural disturbance regimes and natural forest growth patterns by establishing and maintaining multiple age classes of trees within a single stand.

Understory: Trees located at the lowest canopy positions in the forest, usually consisting of very young stems less than 1" in diameter.

Whole-Tree Logging Crew: A type of logging crew that utilizes large, mechanized machinery to process trees from the stump up. Trees are processed on the landing into a variety of products, and tree tops and limbs are chipped.