FOREST MANAGEMENT PLAN

Great Pond Mountain Conservation Trust – Orland, Maine

Hothole North – Ownership Block

October, 2024

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Great Pond Trust Land Steward

FOREST MANAGEMENT PLAN

NRCS EQIP Contract # 7412182405M

Planning Period: 2024 - 2034

Great Pond Mountain Conservation Trust

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Landowner Phone #207-469-6929

FSA TRACT # 61, Field 8

Town of Orland

Hancock County, Maine

167 Forested Acres in Plan

October 2024

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Certification of Conservation Activity Plan:

I assume responsibility for the development of the above stated Conservation Activity Plan/Stewardship Plan Addendum provided. The plan provided: (1) complies with all applicable Federal, State, Tribal and local laws and requirements; (2) meets applicable Department standards, specifications, statements of work and program requirements; (3) is consistent with the particular conservation program goals and objectives for which the program contract was entered into by the Department and the participant; and (4) incorporates alternatives that are both cost effective and appropriate to address the resource issue. Conservation alternatives will meet the objectives for the program and participant to whom assistance is provided.

Forester Lic. #_984_____Signature _____Date _____

Landowner/Producer Signature_____ Date_____

NRCS Signature_____ Acceptance Date _____

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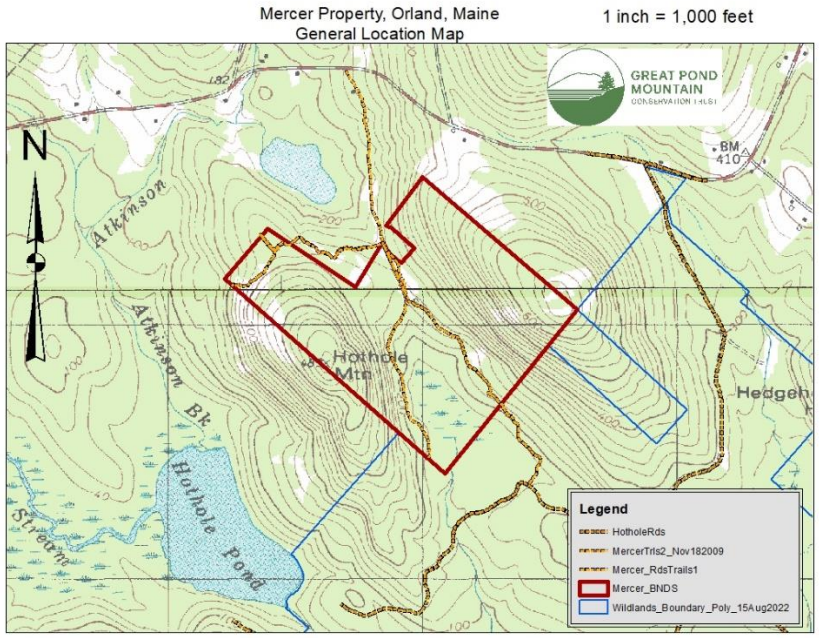
A. Introduction & Executive Summary

This Forest Management Plan builds upon the existing forest management plans for the Hothole and Dead River-Blocks prepared in 2017. This plan addresses the 2023 acquisition of the Mercer property in Orland, at the north end of the Hothole Management Block, now known as Hothole - North. The foundation for recommendations in this plan is the current condition of the 186-acre forest and its potential for managing a forest that is demonstrably further along in its development than both other large blocks). Managing on a conservative ecological basis that includes all aspects and components of a forested landscape will be pursued by forestry staff in the careful application of operations to improve overall health. vigor, value, and structure of this new purchase. This plan has been prepared according to guidelines of the Natural Resources Conservation Service (NRCS) and for which, supporting funding has been approved. Required sections of the plan content are referenced to the latest NRCS Forest Management Plan checklist (March, 2022), found in the front pocket of this document's binder.

The core fee-owned area for this property occupies approximately 183 acres of land in the town of Orland, Maine. This GPMCT Core property lies near Orland's west boundary between U. S. Route 1 and the Bald Mountain Road. This plan covers the Hothole – North's Block's 183 acres of which 167 acres are forested, and its location is shown below in Figure 1.

Figure 1 - General Location of Hothole –North Block



This property, north and adjacent to the Hothole Block, sits on the south side of the Bald Mountain Road in Orland and is accessed by the Nancy Field Road towards the south. Nestled between Condon Hill and Hothole Mountain, this parcel contains the steep slopes of both and the valley between them. A snowmobile trail follows an old logging road that connects to the Hothole Pond Road on the GPMCT Hothole Block.

Drainage on the block is generally south-easterly by one brook flowing into a large wetland (totaling about eighteen acres), and indirectly into the Hothole Brook after passing through three beaver flowages. Purchased in 2023, the current forest has been quietly growing after a limited harvest for sawlogs and some pulpwood of hardwood species in the early 2000's. The existing residual growing stock is of merchantable size with some patches of small to medium pole regeneration that are scattered throughout. There are opportunities that may represent a moderate level of immediate recompense to fund cultural improvements or growing stock adjustments towards improvement of forest health and vigor. Additional maps showing more specific details may be found in Appendix A, page 149.

From its inception, the GPMCT has been forward-looking in establishing a better forest to meet the stated goals of the Trust. This process will take a long time to build a forest whose characteristics include larger trees, diverse habitats, abundant wildlife, a mix of high-quality timber and non-timber products and a blend of uses for all to enjoy. This is an example of the "long view" necessary to rebuild a better forest and the GPMCT's commitment to the expected duration is, indeed, commendable. There is also a realization that most of the objectives for wildlife, recreation, education, water quality, scenic views and income will depend upon active cultural operations favoring healthy trees and removing poorer ones to make adjustments that advance the forest improvement process. Just how these adjustments and changes are made encompasses a "land ethic" approach adopted by the Trust and is woven throughout the details of forest management. In short, this ethical view recommends that treatments to any aspect of the land (forest stands, wetlands, roads, streams, trails, infrastructure, etc.) be designed and implemented in a way that does not impair the regenerative capacity of the many attributes that comprise the whole. Clearly, the GPMCT understands that the organizational capacity, level of stewardship and community ties through outreach all need to be developed to support the conservation and protection of all forest resources. Involving the Trust membership in volunteerism supporting maintenance activities in all aspects has been proven to be an effective way to show progress towards intended goals over extended periods of time.

During the time when fund raising towards acquisition was being considered, a spate of large, forested parcels which were cut heavily, then

subdivided were sold for development. This practice has been going on in Maine for a long time, at first for generating revenue through sales of raw material and more recently to capitalize on a market for "developed" large properties. This situation has been present throughout the state. Preventing such a fragmentation of land used in this area became a driving force behind acquisition. Being such a larger parcel amid smaller ones within Orland and adjacent towns was seen as an advantage. The purchase of this particular property was envisioned by GPMCT as a conservation effort, rather than a hands-off preservation. With the more diverse mixture of species at a more advanced stage of development, this forest should provide a glimpse of the future forest conditions for the larger blocks on the eastern side of the Dead River.

While protection of rare, threatened, or endangered species has been a concern of the GPMCT, there are few found on this parcel. Smooth Sandwort may be found on the more exposed ledge areas mapped on this property and, no other species in the threatened or endangered categories have been noticed during the Natural Resource Inventory (Rees, 20242). The is, however, a cedar swamp that is heavily forested with spruce and fir species that may be used as a deer wintering area.

The prime reason for a Forest Management Plan is to help a forest owner make whatever changes might be necessary to achieve a desired condition in an organized, logical fashion over a given period. To be truly effective, such plans need to be of sufficient detail for a landowner to clearly identify what changes need to be made, when to make them and where they should be applied. On the other hand, they should also be general enough that the user of the plan's content can keep the larger picture in mind. Managing a forest towards a desired future condition is serious business and can often be expensive to boot. If one is serious about making substantive changes to a landscape (no matter how large or small), then the management plan should be both general enough to view details in the larger sense of their impact over time, while being providing details necessary to fully understand what, where, when, and how to make the necessary adjustments. It is in this context that this plan has been prepared.

The stated mission of the GPMCT is to: "Conserve land, water and wildlife habitat for the communities of northwest Hancock County." To achieve this mission on the core ownership area, there are five objectives (GPMCT Strategic Plan Update, 2013):

- ***Maintain/Enhance wildlife habitat and water quality.***
- ***Provide low-impact recreation opportunities.***
- ***Maintain scenic views.***

- ***Provide educational opportunities.***
- ***Provide a sustainable level of income from forest product sales.***

To reach these objectives, such a multifunctional forest will need to possess the following characteristics:

1. *Have a continuous forest cover except for the regeneration of early successional, shade intolerant species mixes.*
2. *Be composed of a mixture of species most suited to growing places.*
3. *Possess a well-developed irregular structure where trees of several ages and development stages are present.*
4. *Contain a mix of successional stages to diversify wildlife habitat that should be present across the landscape.*
5. *Begin cultural interventions that mimic natural disturbances.*
6. *Improved stand stability and resilience.*

The type of forest that would best meet the above goals and objectives is that of a ***Mixed-species, Multi-cohort, Irregular Unevenaged*** condition that provides a continuous high canopy cover. This type of forest contains trees of all sizes and species that are adapted to the site upon which they are growing. Changes from silvicultural treatments should be subtle and mimic natural disturbances. To achieve this condition, management actions must focus on improving forest health where individual tree potential, quality and habitat diversity guide all tending operations. Improving ecosystem functionality and the optimum use of each individual tree while ensuring successful recruitment to the main stand should guide the design and implementation of cultural activities at all stages. For management to be truly effective, the forest itself as well as its data and information must be organized in such a way that planning actions can be focused, concise and targeted. Results from silvicultural treatments need to be tracked to ensure that the desired effects from treatment were, indeed, obtained. More specific forest management objectives for this Dead River – West management block are directly related to the goals of ownership are the following:

- *Rehabilitate the existing forest to balance immature/mature stages of mixed species with increasing vertical strata. Maintain a continuous high-forest cover.*

- *Move the forest through development stages in a way that seeks to balance forest habitat structures according to a stated, definitive objective distribution designed to afford increased opportunity for wildlife of all kinds to flourish.*

- *Ensure that conditions minimizing soil movement are met and that water flows, temperature regimes and clarity are improved whenever possible.*

- *Identify and balance species mixtures, development and density classes with varying understories and ground vegetation to provide multiple habitats and visual interest.*

- *Design specific treatments to keep views open within defined extents by periodic treatments that provide interest within the viewing area.*

- *Design and implement a monitoring system to keep track of changes in a manner that can be used to contrast forest conditions and silvicultural treatment methods over time.*

- *Identify areas that are representative of both the existing and new, developing forest with its varying conditions of species composition, ground vegetation and the gradual return of mature forest conditions. Make allowances for observation and study.*

- *Improve the health and growth rate of all tree species present while producing the highest value marketable product mix from all species.*

- *Concentrate removals on the poorest quality and vigor trees to improve each stand's stability most rapidly by allowing healthier trees to take full advantage of soil quality and growing space afforded.*

- *Keep the costs of administration and management as low as possible to perform the required tasks in an economically efficient fashion.*

- *Ensure that the mix of species and sizes is renewed by regeneration methods consistent with overall goals and in sufficient quantity to make forest yields sustainable.*

The current condition of the Hothole - North Block forest is of middle age (50-90 years) and the species mix is quite diverse, although there is some need to match species to growing site a bit better. As a forest, with a variety of development classes and adequate stocking levels in both basal area and volume, lightly applied adjustments can be made to increase the amount of healthy, high-quality trees in all stands. Habitat areas by type are also unbalanced and somewhat limited due to an insufficiency of both early and late successional habitats as well as some excess in others in the intermediate

to mature stages. Tree quality, the primary attribute of forest health, is on the poorer side, with only 38% of all trees classed as Acceptable Growing Stock (AGS) and 7% of the total trees are worthless culls – best suited as cavity trees. As a result of the foregoing, overall diversity needs to be spread across the categories of development more fully. See Section D4, page 56 for a more detailed discussion of existing forest conditions.

The effects on the forest from climate changes take decades to manifest themselves and, along with weather, insects and diseases can have adverse consequences. Taking an "adaptive" approach towards these effects should ease any transition necessary to adapt to a changing climate in our area.

There are three areas where we can plan for changes and specific tactics, we can employ that are part of our ongoing forest management. The beginning step in the process of building the future forest is keeping the GPMCT goals in mind. The first area of focus is ***Resistance*** to adverse changes. Two strategies to combat negative changes to the landscape are:

- **Continue to prevent the introduction of invasive species**
- **Protect sensitive or at-risk species and communities**.

The second area of focus is ***Resilience*** to adverse changes. Some of the recommendations to apply tactically and help increase resilience to climatic change could be:

- **Promote diverse age classes**.
- **Maintain/restore diversity of native tree species**.
- **Retain biological legacies**.
- **Maintain/Restore soil quality and nutrient cycling**.

Third, and last of the three focus items is ***Transition***. How we go about making a climatically induced shift from present forest community structures to those better suited for future stability. This task can be easily incorporated into our recommendations for forest management. Matching the right species with the right growing conditions and sites will ensure that treated stands will be adjusted towards future stability of both species' composition and structure. Specific strategies and silvicultural regimes for adapting to climate changes can be found in Section E3, page 98. Three key tactics for adaptive management are:

- **Favor those native species that are expected to be better adapted to future conditions.**
- **Emphasize drought and heat-tolerant species and populations.**
- **Adapt species mixtures in each stand to better utilize site conditions.**

Changes to forest composition, structure and overall health take a long time to achieve but beginning as early as practically possible in the life of forest stands can shorten the improvement cycle. For example, under a more "preservationist" approach, where land is held, but not tended, it may be 60 to 80 or more years before income generation to support administrative operations becomes a reality. In the meantime, roads would deteriorate, boundary lines would become more obliterated and the quality and dimensions of material that could generate some income would be much less. Currently, this forest is in a mostly mature stage, but with fewer younger trees to replace the mature ones that continue to grow. Lighter thinning along with some regeneration efforts for each stand treated will provide trees for the future while improving growing space for more healthy and mature trees to develop.

Tending operations advance the tree-development process by making it happen sooner. This property offers some opportunities to make improvements that yield some level of saleable raw material, yielding cash flow sooner than the other properties owned by the Great Pond Trust. Hothole-North is such a property as there exists some stocks of merchantable material. The actual time will vary with the number of treated acres able to be completed. Our NRCS cost-reimbursement contracts (focused on both younger and depleted stands) can increase the average number of acres treated annually and help move towards the "ideal" forest sooner. Initially, being able to complete an average of 20 (or more) acres per year will ensure that forest productivity of healthier, better-quality trees increases. Successive stand treatments (at intervals of 10 to 15 years) should rapidly improve the characteristics mentioned above on this property in the first cycle of about 12 years. Early treatments should focus on improving species composition and at the same time address improvements in tree health and quality as well as development of a deeper crown habitat layer. In addition, as larger trees are developing, some may be selected for retention beyond the general 125-year rotation age limit. This provides for very large trees in most places that occur as individuals of interesting or unusual form or other visual characteristics.

Beginning this thinning/improvement process may begin generating small amounts of products that could produce a gradually increasing revenue stream. Most initial treatments will continue to produce low-value products like firewood, pulpwood and ties or pallet material. With the loss of five paper mills statewide, the market for conifer pulpwood like spruce, fir, and pine as well as mixed hardwood species had been greatly diminished. It is the low-value products that constitute most, if not all, of the volume removed in early treatments and if markets are sporadic, tending work will need to follow market trends and availability.

In time, as treated stands develop more rapidly, their ability to generate cost-offsetting income will increase. The level of income from forestry operations may support the operations budget for this property sooner rather than later.

This forest management plan has been prepared with the two most important components of information in place – forest stand maps and a forest inventory. Without such information it is impossible to construct a workable plan or predict future outcomes, so a bit of discussion about these key elements is advisable. Forest mapping for this property has been completed, including a boundary survey and broad-based forest cover mapping. Digital aerial imagery obtained for a larger area surrounding the Dead River and Hothole Blocks in 2012 contains sufficient overlap to cover this parcel and the Mercer property (Forest Management Plan in 2024). This imagery and more recent aerial data have been available and are used to develop forest cover types and plan for an inventory. All data referencing a stand cover type (Primary, Secondary Species, Development Class and Density Class) is included in a database file along with acreage of each polygon. This was done to enable rapid information development for adjacent parcels that may be considered for acquisition. An example of this has been the ability to link our very specific forest cover types to other useful, albeit more general classifications like the following:

- GPMCT WILDLANDS Detailed Forest Cover Types
- GPMCT WILDLANDS Forest Habitat Communities
- Maine Species Groups
- Forest Inventory Strata
- GPMCT WILDLANDS Forest Structural Classes (Horizontal & Vertical)
- Maine Natural Communities
- Society of American Forest Cover Types
- World-wide Ecosystem Classes (NatureServe)
- National Vegetation Cover Types (NRCS)
- Landscape Position

The inventory consisted of measurements on 62 sample locations on the Hothole-North property. Specific tree measurement data consisted of the following:

- Species
- Diameter at 4.5 feet above ground (known as DBH)
- Position of each tree in the crown canopy
- Product potential (a measure of tree quality)
- Total height from equations specific to species.
- Spatial Diversity measures to describe species richness, clumpiness (spacing of trees) and degree of complexity in tree sizes.
- Assessment of wildlife habitat characteristics from Maine Audubon's "Forestry for the Birds" assessment protocols.

Once we know what we have, how much there is and where it is located, the beginning of the improvement process can begin. We also can project current forest conditions forward by use of a forest inventory data management system called MBG Tools™, a product of Mason, Bruce & Girard – Natural Resource Consultants in Portland, Oregon. This system allows rapid compilation and reporting of inventory information and uses the widely available Forest Vegetation Simulator (FVS) to project forest conditions into the future.

Development of specific recommendations for treatment on the Hothole-North Block will be done on a "Broad Forest Type" basis, to be consistent with the Hothole and Dead River Management Blocks. These broad types [**IH**-*Hardwoods intolerant of shade*; **TH**-*Shade tolerant northern hardwoods*; **PH**-*Pine and Hemlock mixtures*; **SF**-*Mixtures of Red spruce and Balsam fir* and **LC**-*Lowland conifers like Cedar, Tamarack and Black spruce*] are recognized by the most predominant species or species group with treatment recommendations as follows:

In cases where much of the stocking consists of **Intolerant Pioneer Hardwoods** like Aspen, White or Gray birch, Pin cherry and sometimes Black cherry, these stands should continue to be managed on an evenaged basis. The Aspen-Birch broad type is a prime habitat for several wildlife species and to maintain sufficient area in this type (about 11 acres), efforts should be made to encourage a mix of various development stages within each stand. This can be accomplished by thinning in irregularly-shaped strips or patches until such time as an effort to regenerate these stands should be made – normally at age 40 to 60 years, depending on stand health and site quality. At that time, regeneration efforts will require more light for seeds of Aspen and Birch species to become established, so openings in the stand will need to be in a series of

open patches of three or four acres in size, irregularly shaped to conform to the landscape. The schedule of regeneration patches should cover a period of 10 years between treatments. Larger stands will have a greater range of patch ages than smaller stands. Adjacent stand conditions, especially of the same broad type group should be considered for treatment at the same time or maintained to offer more cover and protection to the regenerated patches.

Other species in these Intolerant Pioneer Hardwood stands in lesser amounts may be an indication that the more realistic management direction may be to encourage these other species (especially if there are abundant conifers present in an understory) towards dominance of the site. This will involve a species conversion over time, but in areas where the possibility of managing an even-aged stand of Aspen-birch species exists, it should be applied. Site quality will be the most important factor in the decision of whether to encourage a species conversion.

The mix of **Tolerant Hardwoods** consist of species that are predominantly shade tolerant. Typically the Beech-Birch-Maple cover type where the birch referred to is Yellow birch. Red maple also in part of the component along with Sugar maple. The intolerant White ash and limited amounts of Black (Brown) ash are also found on the moister portions of this type, as can White or Gray birch. Striped and Mountain maple, along with Eastern hop hornbeam occur in the understory as does smaller Beech. Usually found on the more northerly or westerly-facing slopes, this combination used to cover most of the hardwood sites on the Hothole-North Block, and now it shares the hardwood space with other stands where Red oak is the dominant species. This Red oak is sometimes mixed with not only other tolerant hardwoods, but also White pine and Hemlock. Of these latter two species, the White pine are usually scattered residuals left from many previous harvests while the Hemlock, where present, could be in greater abundance – probably due to its lesser quality and value. There is also a Spruce-Fir component that occurs in this broad type on the moister sites and in transition zones between types.

Of particular interest is a species that is found rarely but can be very useful in selected habitats. This species is American basswood (sometimes called American linden), which may have been previously more widely distributed in a predominant mixture with Sugar maple. Found on deep, moist sites, this species prefers lower slopes and there are sometimes found on the southerly side of the outlet to major wetlands. Where possible, this species should be an encouraged associate of the Tolerant Hardwood types containing a larger proportion of Sugar maple. Basswood is also an additional species that supports pollinator habitats. White or Black ash should serve as an indicator of where Basswood could flourish.

Stands of predominantly tolerant hardwoods should be managed towards developing an irregular structured unevenaged condition. Currently, the stands are all evenaged and should be lightly thinned at a 10-to-15-year intervals to first adjust species composition and improve basal area growth by reducing poor-quality trees, then by retaining better, more vigorous Sugar maple, Red maple, Beech, Yellow birch, White ash, Red oak and understory Hop hornbeam. Stands at their current age of 60 to 80 years can begin the transition to the unevenaged condition by initiating a series of small, irregular openings no larger than perhaps 3/4 to an acre in size but limited to 10% of the stand's area at each entry at the same 10-to-15-year interval. With maximum basal area stocking of 150 sq. ft./acre or more, management as an irregular stand may begin by conducting light removals to afford more crown expansion room in all development classes from poles to large sawtimber. Small, regenerated patches within these stands should also be treated, but largely to make adjustments to species composition.

Where scattered conifer species like Red spruce, White pine and Hemlock are found in the stand, some of the better-quality trees should be carried to maturity in order to increase diversity and offer habitats that tolerant hardwoods do not.

Since these stands will have species that will last longest, rotation ages with associated maximum size should be in the neighborhood of 100 years up to perhaps 125 years, with carefully selected Retention Trees of from 125 to 175 years old. These trees may reach 35 to 40+ inches in diameter.

PH stands are dominated by White pine and Hemlock, are scattered and may be only a secondary component. Red oak is also a component in some stands, providing some interesting alternatives for tending operations. In riparian areas, Hemlock is generally the major component, rather than White pine, which has always been a preferred species to remove. The White pine now usually occurs as a scattered overstory that developed from residual trees too small to harvest during the last major cutting. Where it is found, it is scattered among hardwoods of either tolerant or intolerant species or a minor stand component where spruce and fir are the more dominant conifers.

Where White pine is present, it should be encouraged to take a more prominent place in the stand. This can be done by releasing subordinate trees with live–crown ratios of at least 40% and of good quality during early light thinning treatments while the stands are still evenaged. As the transition to the unevenaged, irregular structure begins and small patches of regeneration are created, the openings must be large enough to allow White pine to become established in greater numbers along with some Hemlock and other species. To boost success, timing of seed years and scarification to expose mineral

seedbeds may need to be employed. Keeping the newly regenerated patches dense will discourage weevil damage to pine leaders and allow the accelerated height growth characteristic of the species. Using other species as a "nurse crop" will further protect the White pine from weevil damage and produce healthy, straight stems rapidly. Using Hemlock along with any hardwoods present (tolerant or intolerant) to encourage self-pruning until the pine reaches 40 feet in total height with a 40% - 60% live-crown ratio could be the point at which a heavier thinning of other trees can be made to adjust both species composition, diversity, spacing and individual tree quality. Further thinning to increase growth rates in individual trees should be made based on the latest thinning guides for White pine and mixed species stands. Vertical dimensionality will increase rapidly at this point as pine becomes a "superstory" above the main crown canopy while the remainder of the species coexist between and beneath the White pine.

In terms of maximum age carried, White pine could live well beyond the 100-year mark and some individuals could be carried to 150 years and very large size to occupy a semi-permanent place in the stand until they succumb to old age (400+ years). Hemlock present in the stand could be carried as long but in fewer numbers as its value has been historically low. If this improves, there could be more of it in the maturing stand. Once these trees increase beyond 80-100 years of age, their financial return through additional growth becomes lower, but since financial return is not an immediate priority, it can be ignored for the time being. For some level of revenue to be generated from all managed stands, the limit on the largest diameters to be grown by species should be specified as it relates to the availability of equipment designed to handle and process larger diameter stock. The maximum DBH could vary from 14 to 16 inches for Quaking aspen, Balsam poplar and Black spruce to 25 or more inches for White pine, Hemlock, Sugar maple, Yellow birch and Red oak. Much depends on the growing site and how the trees are developing, along with tree vigor and risk of loss.

Stands of **Lowland Conifers** are usually found on poorly drained sites where growth is slow, and stocking is high. This is especially true of the area adjacent to the Dead River where wet areas are more common. Species like Northern white cedar, Tamarack, Red and Black spruce, and much Balsam fir predominate. Hardwood associates like Red maple and the occasional Yellow birch along with alders, winterberry, and other shrubs (as well as the invasive honeysuckle) may be found.

Depending on stand composition and the type of site, many of these currently low stocked areas could become prime quality deer wintering yards if managed towards that end. Only stands that have regenerated to a preponderance of Red or Black spruce, Northern white cedar and Balsam fir

with Hemlock would suffice for an attempt at "rebuilding" an adequate deer wintering area. The current practice of issuing "permission slips" for hunters might be used to control excess herd levels. Managing these stands for forest products is a lower priority due to the low productivity of the sites upon which they are found and are sometimes better off as maintained wildlife habitats. With sufficient stocking, these stands can withstand heavy snow and ice storms while providing good cover. Currently, though, their stocking has been reduced by past excesses and it will take time for them to increase to the point where they can be managed properly, even though the management will be limited and extensive, rather than intensive.

Spruce/Fir conifer stands predominantly composed of Red spruce and Balsam fir are usually found on what are called "primary" or "secondary" conifer sites. Primary softwood sites are those with poor or impeded drainage in lower topographic locations such as spruce-fir flats or swamps. Here, Red spruce and Balsam fir will dominate the site, with a few hardwoods like Red maple, Yellow birch or Aspen found scattered throughout. Secondary softwood sites are those that occur on more well-drained soils at a slightly higher topographic position like lower and mid-slopes and on the thin soils of ridgetops and bald summits. On the former two, there may be hardwood species that could occupy from 25 to 75% of the stand. Hardwood species found here include Sugar maple, Yellow birch, Beech, Striped and Mountain maple. Of these, Yellow birch is very scarce and should be encouraged to occupy a larger share of stands in which some individuals are found. Generally, the lower the site, the sooner both spruce and fir will completely occupy the stand.

Areas on the Hothole-North Block possess "fingers" of predominantly Balsam fir, but with some Red spruce and Hemlock, too, along with some scattered hardwoods. These secondary sites on the property are well to excessively drained as the soil is rocky and the slopes are steep and far-reaching. On these sites, Balsam fir does not do well. The drier soils limit growth and internal decay is prevalent – sometimes at rather early ages. Throughout the margins of hardwood stands, there exist many small blowdown patches of primarily Balsam fir. The fir in these areas is generally between 45 and 65 years of age and have reached their biological limits on these drier sites. For the time being, if we look at the Soil/Site Productivity map, the fair sites may develop into primary softwood sites regardless of what is present now. The good sites, on the other hand, could become secondary softwood or mixed species sites, depending on a variety of factors which should be assessed as they become candidates for treatment. A mix of both hardwood and conifer species (other than Balsam fir) should be encouraged.

Conifer stands on primary softwood sites composed of spruce and fir should be transitioned to the desired unevenaged, irregular structure with a sequence of light, low thinnings that should begin as soon as possible, or when the stand average size reaches 4.5 inches and has a minimum total basal area of more than 100 sq. ft. Removals should not be greater than 25% of the total cubic foot volume per acre. These thinnings should continue at a 10 to 15-year intervals until a mean stand diameter of 7 inches is reached. At that time, the transition to the unevenaged, irregular structure can be initiated by making small openings no larger than ¼ acre by group selection methods. Like the hardwoods, the number of openings made in each entry period should not exceed 10% of the stand area. Once the irregular structure is obtained, periodic tending operations would focus on trees of all sizes and species to provide adequate growing space and stand stability.

Since these conifer species on poorer sites are subject to windthrow during extreme weather events, thinning treatment in all diameter classes should seek to develop trees with at least 40% live crown ratios and a height to DBH ratio of less than 80%. The object here is to avoid trees that are too slender to resist the forces of moderate winds (Kamimura et al, 2008; Wonn, 2001; Gardiner et al, 2008; Ruel, 1995; Canham et al, 2001).

A final recommendation for forest management includes the identification and creation of **Strategic Ecological Reserve** areas where no active forest management will be applied, unless some catastrophic event occurs - requiring remediation efforts. In the case of Hothole-North, areas that are deemed inoperable due to steep, bouldery slopes on both Condon Hill and Hothole Mountain could suffice.

These set-aside forest stands are designed to provide locations within the interior of the Hothole-North Block that can be left to develop without efforts at rehabilitation. In that way, there should exist some basis of comparison with those similar stands on similar sites that have undergone the full regimen of rehabilitative treatments to create an irregular, unevenaged forest structure. [an example might be stands 611 or 612.

As our management of this property begins, areas suitable for reserves can be identified for consideration. Conifer reserves may be found in the southern portion of the ownership within stand 600, which is also serving as a winter yarding area for deer.

It is most certain that forest cover types will change composition as treatments achieve their desired objectives for modifications. As they do, the acreage by broad forest type will change somewhat and that the Pine/Hemlock or TH type will surely increase in area. The White pine in some stands where it

is found is now a secondary species but should rise to prominence in a few decades.

Scheduling of treatments for these groups above will be made on a stand basis with very specific treatment criteria. These criteria are part of the development of complete silvicultural regimes that list what treatments should be applied, how intensive they will be and when they should be applied during the development cycles for each stand within a group. Once this first initial treatment is made, there may be up to three successive treatments conditioning these stands up until the point where the transition to a more unevenaged, irregular structure is made.

For the first 5-year planning period of (2025-2029), an operating plan might include initial treatments to complete a first round of improvement harvests on the acres of light thinning (NRCS practice 666-Forest Stand Improvement) in the Hardwood Strata. Stand candidates have been selected for this period and are listed below (and in the Record of Decisions form at the end of this plan)

Table 1: Hothole-North Preliminary Silvicultural Schedule

Hothole-North Block First 5-Year Silvicultural Plan

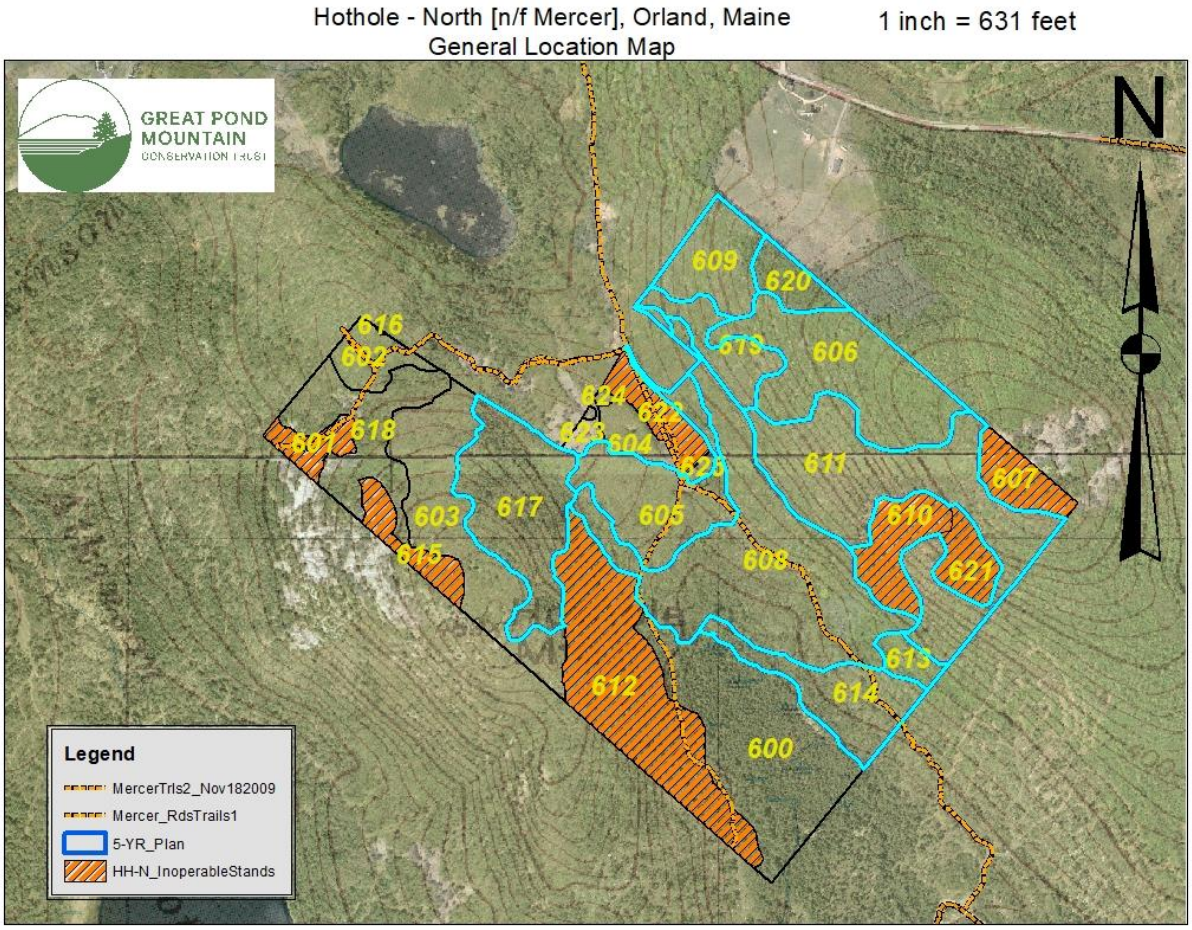
Stand No.	Acres	Thinned Ac.	*2025*	*2026*	2027	2028	2029
605	12	12			4		8
606	14	14			14		
608	25	25	11	14			
609	11	11					11
611	21	21				21	
613	2	2	2				
614	7	7	7				
617	12	0					
619	6	6		6			
620	2	2			2		
TOTALS:	112	100	20	20	20	21	19

Treatment priorities are stand composition and location in relation to the existing poor access road. Most of these stands have a degraded hardwood component that needs remedial care. There is an opportunity to improve tree health and initiate the transition to an irregular structure. Poor quality material will be removed to correct spacing and growth on the better stems of all species. Some species will be reduced, Hemlock being the most important one, as this species has been left behind with each logging operation and has

thus become a dominant species in four of the stands in the above list. Other stands will benefit from the adjustment of other species and the new openings necessary to secure regeneration of desired species will initiate the transition to an irregular structure. This five-year plan will also allow the determination of proper placement of a permanent access system so travel to portions of any stand will eventually be possible without undue skid trails.

This forest stand improvement work will be conducted under a new NRCS contract for practice Code 666, Forest Stand Improvement with several specific practices matched to the work that needs to be done. Design plans and installation will commence upon contract execution next year or the year following. This is to allow sufficient time to visit each stand for data collection and an evaluation on the ground. Stands scheduled to receive treatment are shown in the following map (a copy can be found in Appendix D, Page 152). Cost estimates for this work should be adequately covered by NRCS reimbursement for improvement at a contracted rate sufficient to cover 75% of the actual cost of operations, if rates current in 2024 stay the same. Work should commence once a new additional contract is executed sometime in May of 2025, depending on results from the newer contract under preparation.

Figure 2: Stands Scheduled for Silvicultural Practices



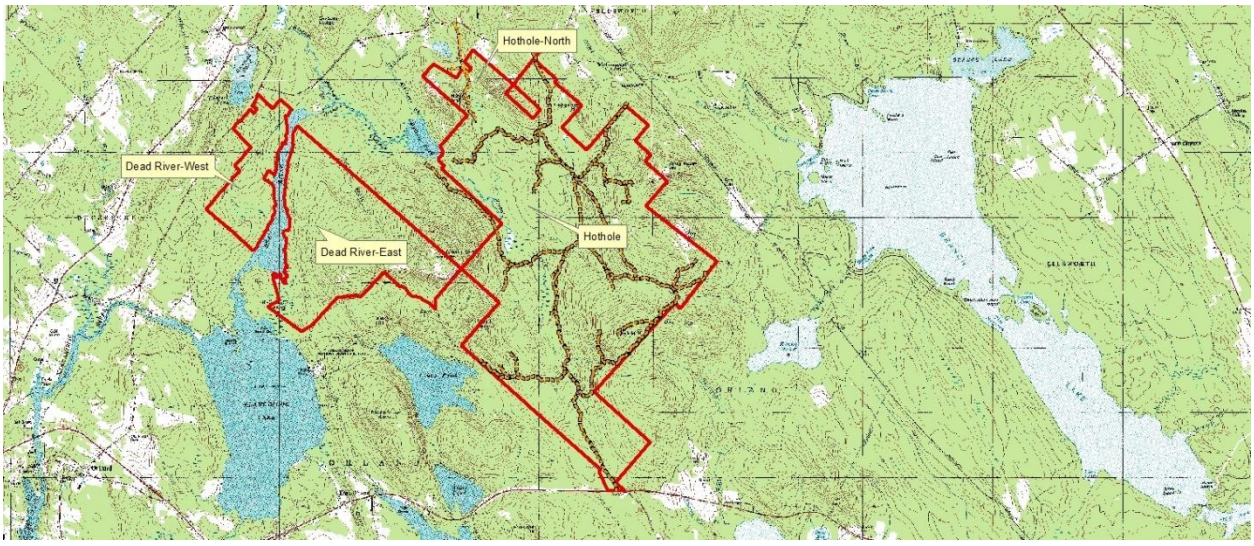
B. Property Summary and Setting

B1 Property Summary

B1a) Owner Name, Location and Acreage

The Hothole-North Block portion of the core Great Pond Mountain Conservation Trust (GPMCT) is located entirely in Orland, Maine on the south side of the Bald Mountain Road. The landowner's mailing address is PO Box 266, Orland, Maine 04472. Figure 2 (below) shows the location of the GPMCT core blocks against U.S. Geological Survey Map data for the area.

Figure 3:-Core Ownership Blocks Location

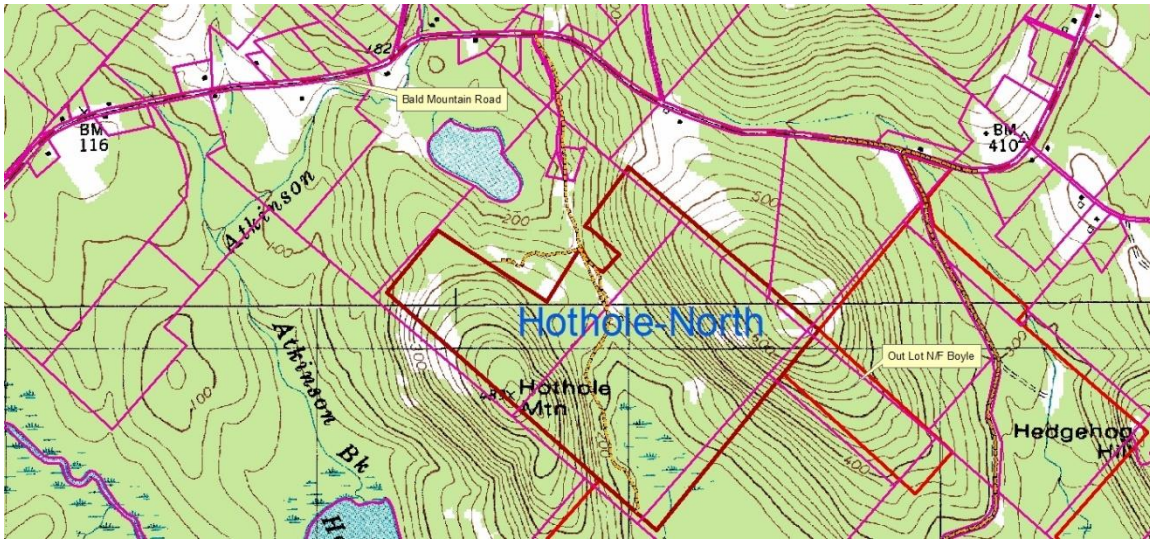


These ownership blocks now comprise approximately 5,063 acres in total (16% of the area in the Town of Orland). The Hothole-North Block portion contains 185 acres or 4% of the total acreage

B1b) Legal Description

Within the Town of Orland, the Dead River Block contains parcels according to the town's tax map as follows:

Figure 4: Orland Tax Map Overlay of GPMCT Boundaries



The Hothole-North tax parcels are highlighted in bright pink on this map, while the road lines are from the State of Maine Office of GIS's data library. The solid dark red lines are the boundaries of the major management blocks owned by GPMCT and are from field surveys done in 2006, 2019 and 2023. As can be readily seen, not all the lines are coincident. This is due to a comparison of very general location data (tax maps) with actual field land surveys. The Hothole-North consists of Lots numbered 17 (partial) and the entire area of Lot 18, as can be seen in the map above. The total acreage amounts to

B1c) Acquisition Date & Prior Owners

Ownership of the Hothole-North parcel was purchased from the Robert Mercer Family, who purchased the 183-acre property in 1950. Deeds for parcels in Bucksport and Orland lots conveyed to the Great Pond Mountain Conservation Trust are bound in an indexed volume in the GPMCT office in Bucksport.

Most of the core ownership parcels were acquired in 2005. Additional properties acquired from DiPaolo, McAllian and Ginn adding to the Dead River-East Block as well as the top of Great Pond Mountain were acquired in 2015. The Mercer property was acquired in the same year as the Dead River – West Block. These additions are included, but not shown, in the updated boundary file used for Figure 3.

B1d) Conservation Values/Attributes

Since the core ownership in general, and the Hothole-North Block in particular contains the significant hills of interest to the GPMCT, it was felt that an effort to protect these rugged forested resources was necessary. During

the time when fund raising towards acquisition was being considered, a spate of large, forested parcels which were then cut heavily, subdivided and sold for development. This practice has been going on in Maine for a long time, at first for generating revenue through sales of raw material and more recently to capitalize on a market for "developed" large properties. This situation has been present throughout the state. Preventing such a fragmentation of land used in this area became a driving force behind acquisition as was the protection of habitats. Being large parcels in the midst of smaller ones within Orland and adjacent towns was seen as an advantage. The eventual purchase of properties making up the Hothole and Dead River – East Blocks was envisioned as a conservation, rather than a preservation effort, since the majority of the forest had been heavily cut-over. Remedial work guided by this Forest Management Plan will help to restore the health and productivity of these forest ecosystems and ultimately, provide a sustainable source of income while protecting other attributes described in the Section C3b – Goals and Objectives, page 39.

B1e) Restrictions on Use

There are a number of areas within the boundaries of this property that are impacted by environmental zones that place limits on timber harvest. Protection of water features (ponds, streams, wetlands, etc.) are covered by shoreland zoning at the local level (Orland). The Maine Natural Areas office was contacted to discern whether areas of critical habitat were located anywhere on the properties (both Blocks). Any areas of critical habitat will be identified on the ground with appropriate management recommendations found later on in this plan (Section F3c, page 126). A map of critical habitat areas may be found in Appendix C, page 151.

Existing State laws that impact activities on the property consist of the following:

- Protection and Improvement of Waters Law
  Applies to discharge of pollutants into water bodies, including soil erosion.
- Erosion & Sedimentation Control Law
  Applies specifically to soil erosion and sedimentation into water bodies.
- Natural Resources Protection Act (NRPA)
  Regulates activity in, on, over and adjacent to water bodies. Harvesting activities must comply with standards in FPA.
- Shoreland Zoning Law
  Regulates all activities (including timber harvest) in all areas near all water bodies. Targeted towards development to preserve natural beauty & habitat.
- Forest Practices Act (FPA)

Regulates timber harvest practices (clear-cuts, regeneration) for all owners of over 100 acres by defining standards for residual trees, area harvested and regeneration minimums.

A more specific application of standards for each of these laws is covered in the Best Management Practices (BMP) Section G, page 136.

The GPMCT has restrictions on access where and when motorized vehicles (except for those where management operations are in progress) may travel. No ATV traffic is allowed during any season. In the process of preparing the entire property for eventual improvement of accessible forest stands, the question of a poorly maintained existing road from the Bald Mountain Road needs to be addressed. The GPMCT has a deeded right-of-way across the land of others to reach the Hothole-North property. This right-of-way should guarantee right of access for all uses appurtenant to the ownership. The current owner does have concerns about large log trucks passing near his residence, but that use would presumably be infrequent as operations that generate some saleable products might only happen every 10 or 12 years.

It is also important to note that there are no restrictions on hunting, fishing, or trapping, other than access to selected areas by foot or bicycle travel.

The most recent restriction on use pertains to the flying of unmanned drone aircraft anywhere on or over GPMCT lands.

B1f) Threats to Values or Areas of Concern

Any natural feature in the wild is threatened from time to time by any number of damaging agents: fire, windstorm, heavy snow, ice, flooding, insects, disease, visitor use, neglect, and invasive species, etc. Among the more specific adverse impacts are the following:

* Heavy snow, ice and wind damage to young and older conifers and young birch throughout the property.
* Widespread Beech Bark disease and mounting evidence of more serious Beech Leaf disease throughout the ownership.
* Loss of early successional habitats due to maturation of the forest.
* Unfettered snowmobile (and ATV) access by a maintained trail across the property, connecting with the Hothole Pond Road.
* Some existing and new footpaths throughout the property.

B1g) Threatened/Endangered Species

According to the Maine Natural Areas program database the following species and their current status in this area are “species of concern.” See their report in Appendix C, page 151.

- Smooth Sandwort (*Minuartia glabra*) is cited as species of Special Concern by the Maine Natural Areas Program. It appears abundant on ledge areas of both Condon Hill and Hothole Mountain. See the reference to these species in (Rees, 2024).

B1h) Nearby Conservation Lands

Within the Penobscot Bay area in a radius of 35 miles are lands of the Blue Hill Heritage Trust, the Frenchman's Bay Conservancy, Maine Coast Heritage Trust, Coastal Mountains Land Trust, Holden Land Trust, Bangor Land Trust, Brewer Land Trust, Orono Land Trust, Island Heritage Land Trust, Islesboro Land Trust, Landmark Heritage Trust, North Haven Conservation Partners, Vinalhaven Land Trust.

B1i) Adjacent Properties Characteristics

The area surrounding the Hothole-North Block is largely forested. Terrain physiography is also similar in that it is hilly with an abundance of rocks of many sizes. Slopes generally face a southeasterly direction, assuring a great deal of morning and early afternoon sunlight during the day.

B2 Setting

The Hothole-North Block sits on the westerly side of a small glacial valley defined by the intervale between Condon Hill and Hothole Mountain. This feature is oriented from the NNW to the SSW and bisects the parcel. This is generally part of the unsettled portion of Orland and runs in a band across the town all the way to the east line of the town. However, the area adjacent to the Bald Mountain Road has been settled, albeit sparsely. Old maps from 1860, 1877 and 1881 show few dwellings in the vicinity of the area, except for a house that was built on the Mercer-retained portion of the property in the 1990's.

For the most part, the soils are good with moderate to satisfactory drainage – good tree-growing soil. These soils have produced several tree crops that may have been harvested as early as the early 1800's on. Up until the late 1870's or 1880's, much of the volume removed was White pine, which may have occurred in prodigious amounts, especially in the earlier years of the 19th century. Red oak and Red spruce, too, were probably more widespread than they appear today. Both these species were in use for construction timbers, boards, planks, and a number of other commercial products.

B2a) Historic Context

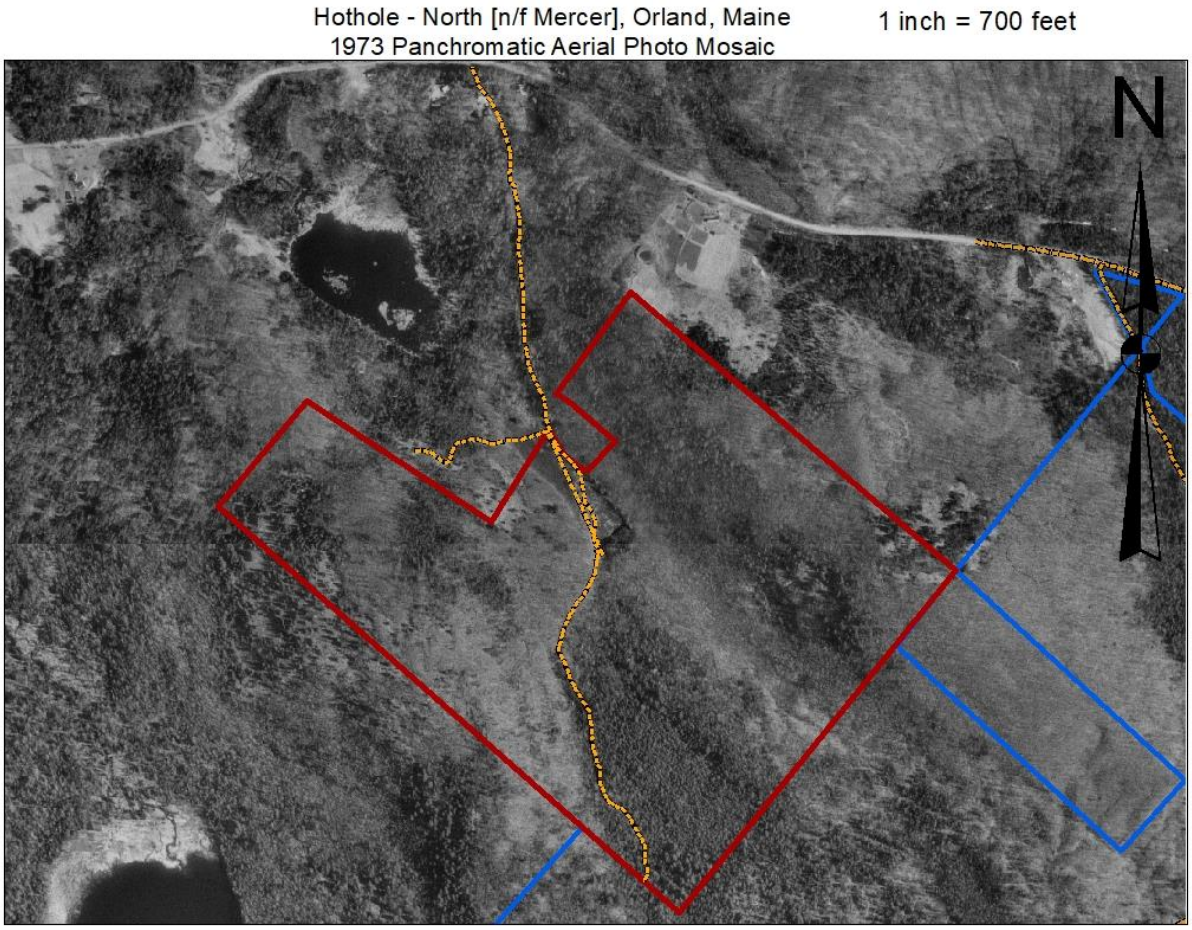
In the early history of Orland, this property remained as mostly woodland for its primary use. Steeper slopes, wet areas and the presence of rocks and large boulders throughout precluded all but minimal development.

This area of the Town of Orland is locally known as North Orland. Its settlement history dates back to the early 1800's where Abner and Nancy Crosby had a farm on the lower reaches of Condon Hill, hence the access road from the Bald Mountain Road to "Nancy Crosby's Field" became the Nancy Field Road. Back towards the west one may find the North Orland Grange Hall, the center of activities for North Orland folks.

Due to the less-than-prime nature of the land within the boundaries for agriculture, the opportunities for generating income and useable commodities came from supplying sawtimber to a number of local sawmills During that period, it is probable that some of the fine, large Sugar maple, Oak, Birch and Beech in the GPMCT ownership area was also cut, but probably in smaller amounts. Hardwoods were desired once the brick kilns (at least 10) for the local Gross, Leach, and Hutchins brick yards were built starting from around 1869 and eventually ceased operations around the late 1940's. Mason's mills along the outlet to Toddy Pond sawed some hardwood, probably for the furniture woodworking shop. Any remaining volumes of hardwood cut during this period undoubtedly supplied wood heat for businesses and residences as well as frame stock and parts for horse-drawn vehicles, etc. (Ames and Bray, 2000)

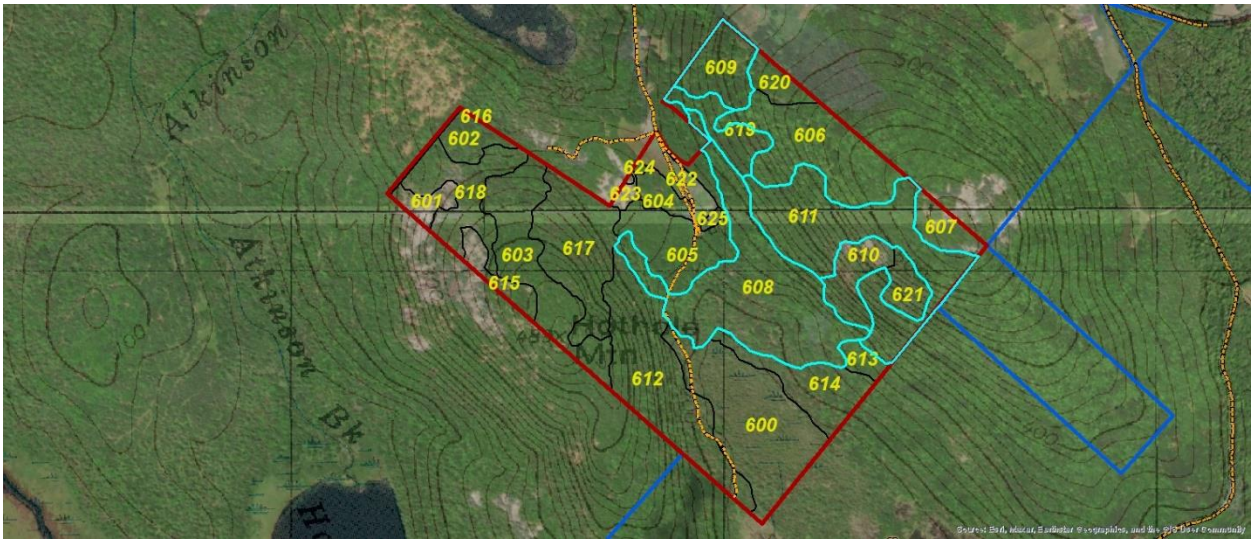
The 1973 black and white aerial orthophoto composite in Figure 4 (below) shows stands of hardwoods as lighter grays. Darker shades indicate conifers or mixtures of conifers and hardwoods, predominantly conifers.

Figure 5 - 1973 Aerial Photo Forest Cover



Periodic harvests for some or all forest products continued as market-driven episodes removed material leaving the remaining trees to grow. During this period from the early 1900's to the early 1950's mostly sawlog products were removed, gradually mining away at the storehouse of higher-value products. The most recent harvest for almost all species and products took place during 2008 by contractor Bernard Ginn. Of primary interest were oak and pine sawlogs along with hardwood pulpwood and chips marketed as biomass. New regeneration since that time is patchy and consists of Aspen, Balsam fir, White pine and very little oak. Primarily, harvest activity took place in stands 608, 609, 611 and 619 covering about 63 acres.

Figure 6 - 2022 Aerial Photo Forest Cover (most recent harvest area in bright blue)



The forest stands of the Hothole-North Block have been gradually adding total height and diameter to all trees present that took advantage of the growing space resulting from the most recent harvest. These released stands have closed canopies and are now between 60 and 75 years old as seen in Figure 5 (above). Scattered throughout the forested lands are some older and well scattered remnants of the preexisting forest. Left because the trees were inaccessible, too defective and larger than machinery could safely handle, these individuals generally exceed 100 years up to around 125+ years. There may be some of greater age.

B2b) Cultural Importance

While the 1860 and 1880 maps of the Town of Orland show only the Abner and Nancy Crosby home to the south of the Bald Mountain Road, no investigation was made to discover the remains of their home. It is well beyond the boundaries of the Hothole-North Block.

B2c) Socioeconomic Context

The main communities within the core area of the Great Pond Mountain Conservation Trust are Bucksport, Verona and Orland. A bit further out and adjacent to the core area are Dedham, Holden, Penobscot, Surry, Ellsworth, Prospect and Orrington. Population change in the core area has changed very little according to the US Census data from the year 2000 to 2010, a scant 1.6%. In the adjacent area, however, the magnitude of the change is larger at 11.9%. On the surface it would seem that recent population trends have more impact on the surrounding adjacent area than on the core area. This may not be true, though, as the sampling of population conducted by the Census

Bureau tends to confuse the results. Students from other states, borders, lodgers, servants, etc. are also included and may present a bias in the overall count. However, for our purposes the counts reported during these two periods provide the only evidence of population trends available, unless the total number of taxpayers were used from each town's tax rolls.

As part of its 2016 Strategic Initiative, the GPMCT seeks to strengthen its ties to the core and adjacent area communities by collaborating with others to improve both environmental and economic vitality and quality of space – beauty as well as bread, to paraphrase John Muir. For the Trust to achieve its goals of ownership (see Section C3, page 37) it must improve its forest. To do that, poor quality growing stock must be continually removed. Unless there is a market for a large portion of this material that supports its removal to some extent, the amount of improvement will be limited. Currently, the total local market for firewood can handle some volume (perhaps 2,000 cords), but if our currently subsidized (by NRCS) removals generate an average of 3.5 cords of firewood per acre, this block might yield 521 cords that need to be removed to improve the whole accessible forested area (149 acres). At our current rate of improvement by treating 20 acres per year, this would take 7 years to complete.

One idea that has surfaced is that of encouraging small to medium sized wood-using businesses (for whom local supply is a competitive advantage) in sufficient number to positively affect the local economy. Current efforts, though small, are underway to investigate the level of existing activity. Additionally, the GPMCT has stepped-up its presence in the local school systems by offering outdoor laboratory space where students may investigate real-world conditions that enhance math and science subjects like chemistry, physics, algebra, geometry, geography, history, general science, etc.

B2d) Landscape Context

The landscape in which this subject parcel is found consists of rolling hills with the glacial intervale as mentioned previously. The land cover is principally forest, or open blueberry field on this tract.

B2e) Legal Context

Grant Restrictions –

In order to effect the purchase of this property, the GPMCT obtained partial funding from the Maine Land for Maine's Future program. One of the restrictions attached to this funding was that the land remains open to the public for hunting, fishing, and trapping. GPMCT has fulfilled its responsibility in this regard by allowing these traditional outdoor activities as long as access is by non-motorized vehicles or on foot. Persons wishing to hunt, fish or trap on the Wildlands need to obtain an access permission slip from the Land

Steward. This gives some idea of how many people use the land for these purposes.

Federal or State Regulations – [See page 26 Section B, 1, e – Restrictions on Use]

Easements, Rights-of-Way, Other Restrictions

The only known restriction on use at this time is that due to having received State funding from Land for Maine's Future, hunting, fishing, and trapping must be allowed. A right-of-way for all uses appurtenant to the ownership had been obtained prior to purchase (see pg. 26).

C: Ownership Goals & Forest Mgt. Objectives

C1: Vision Statement

The original "Core-Forest" management plan (Maier, 2007) contained a vision statement prepared by the membership in a cooperative fashion. It presented several scenic vignettes that helped describe what the members would like to see. Paraphrasing this statement we can arrive at the following:

> *"We envision the restoration of a great forest of mature trees with a mix of diverse habitats for plants and animals. Many species of trees should exist in mixtures through all stages of development. We see sweeping views, clear streams, glades and small meadows. We also see carefully planned forest trails, strong, healthy and valuable trees where great solitude is found. This forest should be rehabilitated by forestry processes that are light upon the land using the best technology available. We see the use of this landscape by many people as a multi-generational involvement for educational purposes, general enjoyment through outdoor activities with a close relationship between the GPMCT and the communities it serves. We envision these lands as a flourishing, self-sustaining enterprise involving the growing and careful harvesting of forest and non-forest products in a setting where a harmonious relationship exists between the forested environment and the people who benefit from it."*

There is also a broader long-term vision, developed from a Strategic Planning effort by the GPMCT Board of Directors. This addendum to the original vision for the Trust lands themselves, encompasses the towns in northwestern Hancock County (Bucksport, Verona Island, Orland, Dedham) and addresses the economic, community and demographic changes that have occurred. The GPMCT as part of this wider community recognized the following facts:

- Conservation and outdoor recreation positively shape people's lives, from youth to seniors.

- The region's economy and identity are closely linked with clean lakes and rivers, sustainable fishery and forest resources, farms, recreation, and diverse, abundant wildlife habitat.
- More residents and visitors are active outdoors-walking, hiking, fishing, hunting, skiing, biking, horseback riding and participating in programs and events.
- There exists a well-maintained, widely used network of conserved lands, including recreational trails close to home, community forests, water access and large tracts of wildlife habitat like the Wildlands.

In this Vision Statement, whether in the original or abridged form above, there are several implicit elements that must happen to achieve this vision. The trick is to carefully craft a list of the things necessary to alter the trajectory of the development of the existing forest towards the desired forest. It begins with the explicit mission of the Trust and the definition of a set of Ownership Goals.

C2: Mission

The mission of the GPMCT is dedicated to conserving land, water, and wildlife habitat not only on its own ownership, but also elsewhere (through conservation easements) for the benefit of the communities of northwestern Hancock County. The values of the GPMCT are rooted in Respect for the Land - its inhabitants and history; a sense of Community and Stewardship as well as the high standard of Integrity necessary to succeed. Guiding principles include the following:

- CONSERVE – Working with community groups, individuals, and others to identify and conserve high-priority lands in northwestern Hancock County.
- STEWARD – take exemplary care of GPMCT's conserved lands; involve partners, users, and community members in stewardship.
- ENGAGE – Inspire and facilitate greater use of the outdoors, especially among students, families, and seniors.
- CONNECT – Identify ways of bringing people together on and for the land and contributing to the greater Bucksport region's revitalization in a manner and scale appropriate for GPMCT.
- STRENGTHEN – Explore practical, creative ways to expand GPMCT's capacity and impact.

Viewed in its entirety, this mission is one of active, focused activity to both promote and protect sufficient landscape throughout the defined area such that whole communities of people will benefit, in perpetuity. A noble enterprise, to be sure. As an example of the demonstrated commitment of the GPMCT to the mission, we have won the awards for Most Outstanding Tree

Farm twice – first for Hancock County (2022) and for the entire State of Maine (2023).

C3: Purpose of Plan, Ownership Goals & Related Forest Management Objectives

C3a) Forest Management Philosophy and Purpose of Planning

A conservationist is one who is humbly aware that with each stroke he is writing his signature on the face of his land. Signatures of course differ, whether written with axe or pen, and this is as it should be." Aldo Leopold.

The prime focus of preparing a forest management plan is to establish what is important to the client, describe the current versus the desired condition of the resource, and identify what needs to be done in the way of improvement. Also, a forest management plan is used to design silvicultural treatment alternatives that can achieve the desired results and where they might be applied most effectively.

Our philosophy regarding a forest management plan is that such a plan should be readily understood by each client, relative to their needs. The reporting should be in narrative format for easy reading and with a glossary to help a client understand the necessary jargon of the forestry profession in an effort to be specific. Doing these things helps each client understand their forest's existing needs as they relate to their goals of ownership and how to achieve those goals. Making a plan understandable to either client or another forester provides for consistency of approach over time, whether the plan is designed for near-term or future generations. Working with those whose legacy will be the improved forest, a plan so constructed offers a better possibility that the plan will be followed, and goals achieved to everyone's satisfaction.

The approach of the Great Pond Mountain Conservation Trust is a long-term one of first, rehabilitating the existing resources and then ensuring that improvement is made in the overall health, viability, and productive capacity of the forest within the existing constraints of soils, climate, and other environmental and economic considerations. By extending the time horizon of management actions and changing uses, the process becomes more adaptive to changing conditions that provide for more easily recognized alternatives.

While a long-term view of managing the forest is commendable, doing the work necessary to achieve ownership goals involves not only how to do things, but also how they are considered. Combining both elements (philosophy of ownership and an approach to managing resources): how we think about the forest and what values are applied to its management describes an ethical approach that embodies Stewardship – what we consider to be a responsible

way to plan and manage all resources. Since Aldo Leopold's seminal essay, "The Land Ethic," published in 1949, where he argued that we have an ethical relationship with the environment, much has been made of "ethical approaches." While it's good to say that you have an ethical approach to what is being done, it may be better to understand what this ethical approach really means. During the middle part of the 1990's as ethics crept more and more into land management in various sectors, a conference was held in Pennsylvania by the Pinchot Institute with the objective of determining what, specifically, was involved in the stewardship of forest resources. The result was a set of four guiding principles for resource managers known as "The Grey Towers Protocol," (Sample, 1995) named for the home of the first Chief Forester of the U. S. Forest Service - Gifford Pinchot. These stewardship principles were regarded as a moral imperative and hoped to avoid the lopsided application of forest management based solely on economic self-interest. Here they are:

I. Management activities must be within the physical and biological capabilities of the land, based upon comprehensive, up-to-date resource information and a thorough scientific understanding of the ecosystem's functioning and response.

II. The intent of management, as well as monitoring and reporting, should be making progress toward desired future resource conditions, not on achieving specific near-term resource output targets.

III. Stewardship means passing the land and resources, including intact, functioning forest ecosystems – to the next generation in better condition than they were found.

IV. Land stewardship must be more than good "scientific management;" it must be a moral imperative.

These statements of a "Land Ethic" mesh well with the GPMCT view of its forest and how it intends to manage towards achieving their vision, as contained in the section on both ownership goals and related, broad forest management objectives. Guaranteeing that, in time, the forest will become closer to the vision of the Trust members requires the use of the axe to make the adjustments necessary to fulfill each ownership goal as stated below, without permanently diminishing any of the other characteristics of other goals. Time is the essential element for the rehabilitation/improvement processes and as adjustments are made to each stand, the overall characteristics of the forest will change in a positive fashion.

C3b) Ownership Goals & Related Forest Management Objectives

Each stated ownership-level goal can be related to a broad forest management objective. These forest management objectives are directed towards general forest conditions of species mix and structure as well as specifying the things that an improved species mix, and structure can help to achieve.

Ownership Goal 1:

Improve and enhance wildlife habitat diversity and provide clean water quality.

Related General Forest Management Objectives:

Rehabilitate the existing forest from early and mid-development stages to balanced immature/mature stages of mixed species with increasing vertical strata. Maintain a continuous high-forest cover.

Move the forest through development stages in a way that seeks to balance forest habitat structures according to a stated, definitive objective distribution designed to afford increased opportunity for wildlife of all kinds to flourish.

Ensure that conditions for the minimization of soil movement are met and that water flows, temperature regimes and clarity are improved whenever possible.

Ownership Goal 2:

Increase low-impact recreational opportunities.

Related General Forest Management Objective:

Identify and balance species mixtures, development and density classes with varying understories and ground vegetation to provide visual interest and added complexity.

Ownership Goal 3:

Maintain scenic views.

Related General Forest Management Objective:

Design specific treatments to keep views open within defined extents by periodic treatments that provide interest within viewing area.

Ownership Goal 4:

Increase educational opportunities for individuals, schools, and others.

Related General Forest Management Objective:

Design and implement a monitoring system to keep track of changes in a manner that can be used to contrast forest conditions and silvicultural treatment methods over time.

Identify areas that are representative of both the old and new, forest with its varying conditions of species composition, ground vegetation and the gradual return of mature forest conditions. Make allowances for observation and study.

Ownership Goal 5:

Increase a sustainable level of income sufficient to cover administrative costs of ownership and management. Optimize both donor revenues and costs.

Related General Forest Management Objective:

Improve the health and growth rate of all tree species present while producing the highest value marketable product mix from all species.

Concentrate removals on the poorest quality and vigor trees to improve each stand's stability most rapidly by allowing healthier trees to take full advantage of soil quality and growing space afforded.

Keep the costs of administration and management as low as possible to perform the required tasks in an economically efficient fashion.

C4: Desired Forest Benefits, Condition and Attributes

C4a) Forest Health -

Naturally developing cut-over forests typically suffer not only from an imbalance of more desirable species but are also poorer in vigor with a higher risk of loss. Vigor refers to how healthy a tree is in relation to its potential for growth and development. Risk, on the other hand, refers to how long a tree is expected to be able to remain in place over time. Risk is influenced by the kind and amount of mortality-causing defects that, when present, subject a tree to an increased risk of loss. For forests developing in an untended fashion, overall productivity is lower than for healthier, tended forests. Production of high-quality trees and their associated products is limited. Healthy forests grow at the levels afforded by their growing places in the landscape and soils upon which they are rooted. Healthy trees have better roots and larger crowns and can take better advantage of the growing space. These trees are also more stable in the face of things that damage them – storms, wind, ice, snow, insects, disease, etc. Their ability to grow well allows them to adjust quickly to

treatments designed to achieve ownership goals through forest management objectives.

C4b) Water Quality –

The quality of the water yield from the forest is good, as it relies on an absence of silt entry, good oxygen aeration and a cooler temperature year-round. The long intervals between harvests have allowed insults to the terrain to heal to a greater extent. The major wetland area is in the southernmost corner that flows directly into the string of beaver ponds to the north of the Hothole Pond road. It must be remembered that for every inch of rain that falls on the Hothole-North parcel, there are 5 million gallons of rainwater that then flow through the forest ecosystem!

In the last 80 years or so the poorly built access road connecting the Nancy Field Road to the Bald Mountain Road has been the only one built. The remainder of the access to specific areas has been by various (recent and older) skid trails that crisscross numerous places. In recent years we have had some major storms that have dropped large amounts of water in a short period of time on the Wildlands. These downpours have increased erosion of old, exposed skid trails on steeper slopes and especially on areas of exposed ledge. Without an investment for the primary access road, it will continue to deteriorate until it is completely unusable for heavy trucking. Perhaps an alternative route from the Hothole Pond Road to the blueberry field might be possible if done in small segments and with NRCS assistance. There is still much to be done and improvement of water quality, as well as access, will be a continuing process.

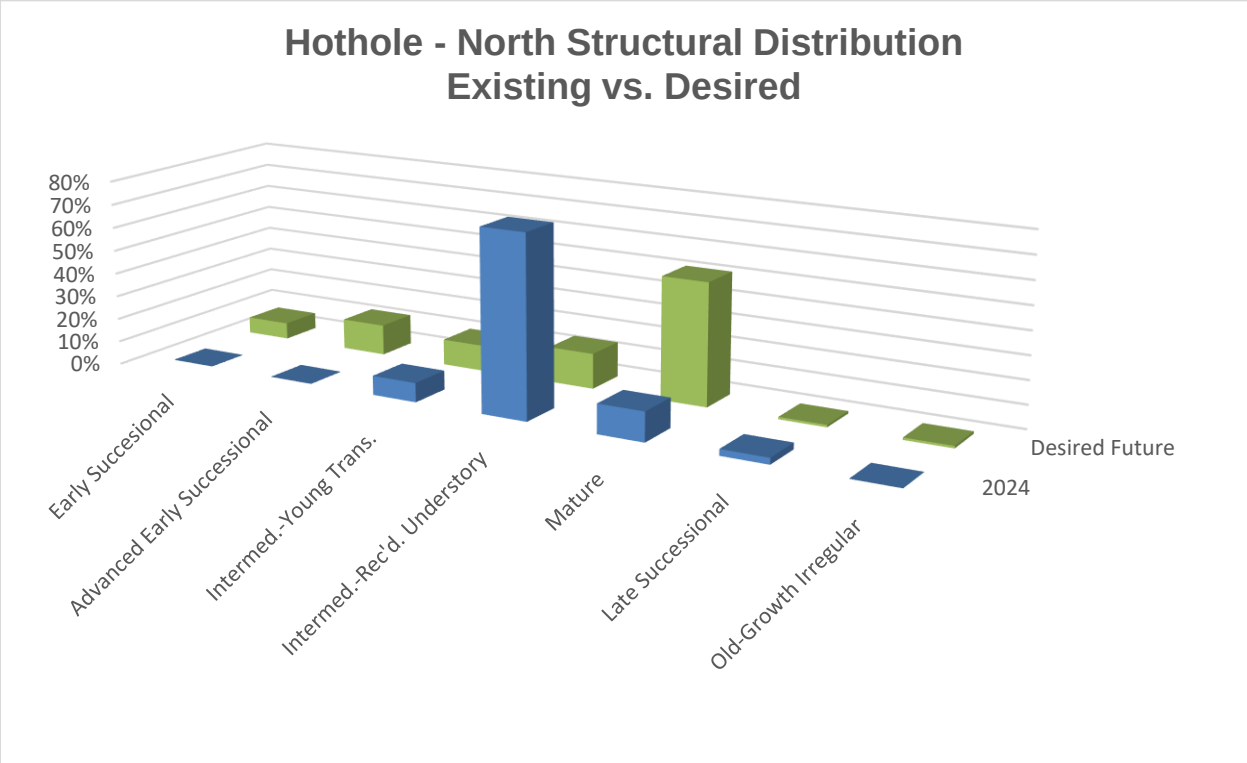
C4c) Wildlife Habitat & Management

The habitats present on this new parcel are largely a mix of successional stages that are mature. Generally, those stands that were not part of the last harvest entry are relatively mature mixtures of both pole and sawlog-sized material. The most recently harvested area has a mature overstory and an understory of sapling material, mostly Beech and other hardwood species aged at 12 to 15 years. Creating a balance of successional stages can be done by early, light thinning of overstories and understories through subsidies from the Natural Resource Conservation Service (NRCS), a Federal agency.

Improving growth of treated stands will help to move them into more balanced stages sooner and eventually, the Hothole-North Block will begin to conform to the recommended percentages of land area in DeGraff et al (1992). Since the goal of management is to begin creating an irregular structure in all stands, each stand scheduled for silvicultural treatment will have 10% of the stand's acreage in regeneration where irregular shelterwood treatments will create the openings necessary for a period of early succession to develop. The

size of the openings will be fixed at 10% of total stand area, but the amount of reserve trees will be varied to optimize seeding of the desired species. The current distribution of habitat types is changing as shown in the figure below, along with the established structure percentages according to DeGraff et al.

Figure 7: Percentage of Hothole-North Block Acres by Habitat Class



Since early successional habitats have been lost due to natural succession, efforts can be undertaken to create more where possible and where funding from NRCS is available. In addition to the recommendations by DeGraff et al, for forest areas, Aldo Leopold suggested including 10% of the area in slash and 10% in open meadows. The blueberry field can function as an open meadow, since it has a surrounding fringe of meadow grasses and other vegetation. Depending on marketability of harvested trees, the amount of slash in regenerated areas will vary somewhat. Its presence on the ground is not long, as decomposition rapidly turns the smaller material into mulch quickly. New log yards will create some early successional habitat openings that could be mowed to maintain meadow-like characteristics once these areas are cleared of debris and rocks. The creation of some slash (limbs, tops, and in some cases whole trees) has been made in areas where crop-tree release and light thinning practices have been applied on the other Trust lands. While it appears a bit messy, the new accumulation of coarse, woody debris provides micro-habitats while slowly adding organic matter back into the soil.

C4c-1Habitat Characteristics & Quality

Habitats on the Hothole-North management block are described in a fashion similar, but more general than our forest cover typing. Because wildlife is rather adaptable, any particular species might prefer one type of habitat but use others if available. So, when describing a particular forested habitat, the vegetative condition uses a primary (dominant) species like Aspen, Birch, Northern Hardwoods, Red maple, Balsam fir, Red spruce, Hemlock, Oak, White pine. These can be generalized into more familiar broad types like Aspen-Birch, Northern Hardwood, Swamp Hardwood, Spruce-Fir, Hemlock, and Oak-Pine. Our more species-specific classes can be easily translated into either the general habitat species group or the more specific species associations. Habitat types also use development classes to describe structure. While we use 7 development/structure classes, the habitat characterization for structure most commonly uses 5: Seedling/Sapling, Pole, Sawtimber, Large sawtimber and Unevenaged (describing a mix of size classes with widely differing ages). Habitats for non-forest conditions make it easy to relate our similar range of non-forest conditions. Density is also an important characteristic and while the habitat usage recognizes three broad levels of vegetative density (Open, Partial or Closed canopy), we recognize four (Open/sparse, Low, Medium and High). Along with seasonal activities like Breeding or non-breeding, Shelter or Feeding, each identified habitat condition relates to the species that have a preference for the one in question. A Habitat Database has been developed that allows queries to show what species might be present in the selected habitat. Conversely, a species may be selected and the habitats it might use can be identified. Further, this database may be linked to GIS (Geographic Information Systems) to allow spatial queries for any forest stand or group of stands to identify creatures that may be seen. This is a proprietary database available to the Blue Hill Heritage Trust and the Great Pond Mountain Conservation Trust, having been funded by grants from each. For the Hothole-North tract, each stand also has a defined habitat assigned to facilitate such information queries.

C4c-2 Specific Habitats and Species

In cooperation with the Blue Hill Heritage Trust, the Great Pond Trust has funded the development of a comprehensive proprietary database of habitat characteristics and species that can be linked to a GIS geodatabase for each forest and non-forest cover type. Data for some of this effort was provided by the U.S Forest Service's Technical Guide to Wildlife Habitat Management in New England (DeGraff et al, 2006). Some habitat summaries for this plan that have been generated by this database may be found in Appendix C, page 155. Briefly, the habitats found on this property are as follows:

- ✓ Northern Hardwoods

- ✓ Aspen-Birch
- ✓ Northern Hardwood-Conifer
- ✓ Spruce-Fir HS mix
- ✓ Northern Red Oak
- ✓ Oak-Pine mix
- ✓ White Pine
- ✓ White Cedar

These habitat groups may seem rather general, but the species using them are mostly generalists that do not discriminate according to the finer classifications assigned to forest stands. So, for each stand and its primary and secondary species components, the nearest, more generally applied habitat is assigned. Where adjustments are made over time to individual stands, the preponderance of species are also likely to change, perhaps indicating a different habitat. Keeping track of those changes is part of the remediation process and we can predict some changes in the species of mammals, birds, amphibians, and reptiles might be attracted to those changes.

Queries to find lists of species for a given stand, group of stands or the entire forest will provide species lists for all species that MAY prefer a particular habitat, however, it must be remembered that the lists are not of species that are really there! Any given species MIGHT be found there, but unless we conduct periodic surveys, these are only lists of possible species that might be seen.

C4d) Recreation –

Affording opportunities for low-impact recreation may help encourage visitors to become supporting members of the Trust. Creating a boost in members helps to provide annual financial support for both management and administration of these properties. But how much is enough and at what point does increased recreational activity begin to have an adverse impact on the very attributes being conserved? This is a question that needs to be addressed sooner, rather than later. For Hothole-North, good planning for few foot trails and the development of a more permanent system of access trails for people and machinery will provide walking trails that will be appreciated.

C4e) Visual Qualities –

Appearance is important whether interviewing for a job or looking at a famous landscape painting. Thus it is that the appearance of the forest can either be pleasing, or not, depending upon who is doing the looking. Large drastic changes to areas, with unchanged adjacent areas present a dramatic contrast to the casual observer and often are met with revulsion – even if the dramatic change was warranted. This has been especially true for any thinning operations where the cut material is left on the ground. Since more

coarse woody material is needed and the amount of material may be too low to be removed or even sold as firewood, it is left in place. Yes, it looks messy but in addition to providing a new habitat and more organic matter for the soil, the space left by the removals are occupied by the residual trees that will develop more rapidly, providing more differentiation in size due to growth, habitat characteristics and value. It's also temporary and in 5- or 6-years easy walking will be possible. Slow change, on the other hand, whether from untreated annual growth and development or from light, but frequent silvicultural operations can enhance the appearance of stands by allowing visibility to a greater depth, revealing larger trees, improving the opportunity to view wildlife, see the variety of tree sizes, etc. As the current forest continues its rapid successional development, some trees will die naturally, while others in treated stands will be cut and overall appearances will change, but not so dramatically. Viewsheds can be maintained and are good places for picture points so that, over time, changes in the appearance of a larger portion of forest land will become more readily apparent.

C4f) Educational Outreach Opportunities –

One of the GPMCT's goals is to better connect with the communities such that a greater proportion of the area's students, families and seniors may benefit from a wide variety of educational uses. Part of this strategic direction is collaboration with local schools, colleges and other land trusts. Providing access and identification of specific educational examples of the variety of conditions in the Trust landscape is a priority.

Over the last 19 years, the Trust has provided numerous forest tours and provided educational opportunities for a variety of educational institutions and organizations. This tract will provide some truly different conditions to show those whose interest in the forest is stimulated by seeing for themselves.

C4g) Income –

Ownership Goal 5 may be last, but certainly not least in importance. Without a financial means to support the activities necessary to achieve the goals of ownership, it is likely that those goals will not be adequately met. Generating income from a young forest is difficult, if not impossible due to the lack of saleable commodities. Even firewood may not be generated in sufficient volume to be feasible to recover. In this forest of Hothole-North, however, its development is sufficiently mature to offer some possibilities for generating revenue. The overall goal of forest improvement over revenue is the path to be followed. This is a critical time for active silvicultural work to be undertaken, though, for improving each treated stand's ability to let better trees grow faster means that some of them will reach higher value size and quality in a shorter period (as much as 10 to 15 years). Beginning the stand improvement process means that initial thinning may be applied as soon as possible. Each of these

thinnings, by removing poorer-quality trees, concentrates growth on better individuals that, over time, produce more volume and value from future treatments. Given the condition of the current standing inventory (only 30% acceptable growing stock) beginning the transition to the goal irregular structure will allow for initiating new regeneration in 10% of the area of each stand, while removing a lesser amount of the poorest growing stock in the remainder. This poor-quality material will depend on tree species and the need to make some reductions in stand basal area to boost growth of the better trees. More specific recommendations may be found in Section F6, page 129.

Stand stability, health, and resistance to changes in insect activity, disease outbreaks and changing climatic conditions will be improved as well. Following current plans for thinning a total of 20 acres per year should begin to cover 25% of the Hothole-North's total operating budget in approximately 15 years; 50% in 25 years and the entire operating budget (for this tract) in 35 to 40 years. These estimates are based on projections of income where costs increase by 0.4% annually. As better quality sawtimber becomes a larger portion of the silvicultural removal volume, a conservative estimate of price increases in this product is set at 1.6% annually based on Maine's historical average increases in sawtimber stumpage value. Better growth response to thinning and/or larger increases in the stumpage value of sawtimber will make operating budget coverage happen sooner.

C4h) Special Features –

There are a number of interesting features within the landscape of the Hothole-North Block that have been identified so far as further exploration continues. Such things as dense Cedar and Spruce wetland, a few large remnant trees from the original forest, geological features like Bouldery heights and slopes with good views, etc. contribute to the variety of attractive elements that people like to see. The effects of the most recent (16+ years ago) harvest activity (slash, etc.) are largely gone and travel through the woods is relatively easy. As the forest continues along its successional path, stands will continue to develop a dense forest cover, affording easier access. All these are valuable to educational endeavors, too.

C4i) Range of Uses –

Right now, there is little use the forest of the Hothole-North Block for hiking, birdwatching, wildlife viewing, photography, solace and quiet contemplation, hunting, fishing, trapping, exercising, as well as participating in programs and events held on this area. It is expected that the existing uses will continue and that new uses might be proposed – each will need to be addressed in planning for the future.

C4j) Ecological Issues –

Among ecological issues that need to be resolved are the following:

- Creating more habitats while decreasing the amount of poor-quality growing stock and shifting the species mix in each stand to a greater percentage of longer-lived, more valuable ones.
- Reducing the amount of diseased beech found in northern hardwood and stands of mixed species.
- Determining how the effects of long-term changes to local climate might affect our resources.
- Understanding how much effort is needed to maintain the existing foot-trail (Condon Hill Trail) from increased traffic.

C5: Sustainability of Desired Forest Elements/Conditions

Based on the definition of the term in several dictionary sources, the general meaning is "the capacity to endure." This use of "sustainability" is meaningless without specifying what is to be sustained. For the purposes of a forest management plan here are some things to sustain that relate directly to plans.

- Continuous forest cover.
- Diverse habitats.
- The capacity to produce clean water.
- The capacity to generate a continuous income at some level.
- The capacity to provide support to the economy of the core communities.
- The capacity to offer educational and recreational opportunities of various kinds at various levels.
- The capacity to provide additional benefits: aesthetics, spring flowers, scenic views, etc. throughout the forested area.
- The ability to provide continuity in the GPMCT ownership and direction of management.

Once upon a time, sustainability as related to forests meant stability of the soil – the producing medium of all forests with their wide array of components. In the early 1900's, this concept of sustainability shifted to the continuous yield of forest products as a principal goal, along with other forest elements. The amounts harvested could be limited to the growth rate taking place (*volume regulation of harvest*) or by a harvestable proportion of the total forest area divided by the length of time needed for trees to reach a desired size (*area regulation of harvest*). In this latter case, if a forest of 4,500 acres needed

100 years to grow sawlogs, then 45 acres could be completely harvested annually. In the former case, if the annual growth happened to be 150 board feet annually per acre, then the amount of harvest of sawtimber should not exceed a total of 675 million board feet. The problem with both of these approaches is that they only really work for forests with a balanced distribution of age classes – not the mostly young or very old forests. In a balanced forest, there's a steady "conveyor belt" of trees moving through time in size and product mix. In mostly "middle-aged" forests (like Hothole-North) the absolute growth rates are moderate, but there's very little merchantable volume to be had! If there is some older material available, the high growth rate would remove it too fast to adequately replace it. The idea of sustained-yield was also misconstrued as meaning that "sustained-yield" meant that other forest benefits were to be excluded or reduced from primary consideration to an afterthought. This was not true in the classical definition of sustained yield (which implicitly included all the other types of benefits) in concept, but not always in practice. For example, a forest could be considered "sustainable" if it were clearcut every 90 years, provided it was allowed to recover naturally. This was mining, not management of a resource.

Now, however, the definition of sustainability applied to all things that forests produce, regardless of the interests of a single beneficiary, i.e., some people like birds, some bears, some mushrooms. Each interest can be satisfied by managing the entire ecosystem as a whole. Hence, we have the term "sustainable ecosystem management" which encompasses all the goals of the GPMCT, stated or implicit. The key thing to remember is that a single use should not diminish other uses. It must also be realized that as forest conditions change from improvements, the place where vegetative things of interest are found will shift from their original location across other places in the forest.

Of those in the list above, perhaps the most difficult one to ensure is that of continuity in ownership and direction. Over a long period of time, directors, membership and managers will change and in a few cases on record, land trusts have simply dissolved, and the land was sold because of an inability to maintain the level of effort needed to manage for the long term. So, the stated goals and how to achieve them need to be sustainable, too.

D: Forest Assessment – Existing Conditions

This is the first step in managing a forested area – understanding what the existing conditions really are, then crafting a plan to develop the means to accomplish the objectives of ownership with the techniques, methods, and procedures of forest management. Many components of a forest need to be examined in some detail as they will undoubtedly be affected by how

management actions are applied (they are individually detailed below, in items D1 through D12). A landscape-level view of the current forest is desirable to take a hard look at what we have to adjust and how difficult it might be in some respects. It's like a look in the mirror that reflects everything back to the viewer, the good, the bad and the ugly!

This particular piece of forest land of GPMCT has evolved from a series of periodic harvests over the last 175 or more years to what we see today. A new forest of mixed species that is between 50 and 90 years old. This is a dense, mostly Evenaged forest where the range of stand ages is quite broad, yet conditions are very similar, except for the mix of species. A review of both the land cover mapping and forest inventory data for this Hothole-North Block shows:

- The forest is composed largely of mixed conifer or hardwood species (87% of the forest area).
- Five species make up 97% of the total basal area, but only 68% of the total number of trees. They are: Red oak, Beech, White Pine, Red maple, and Cedar.
- Of the above, Beech accounts for 42% of the total trees.
- Species of high value account for 29% of the total trees.
- Short-lived species account for nearly 24% of the total trees.
- Long-lived trees account for only 71% of the total trees. However, 60% of that total is Beech!
- The remaining trees are intermediate in longevity at just 5%.
- Only 29% of the trees are larger than 5 inches in diameter, just barely saleable for pulpwood or firewood.
- The trees are mostly sapling (1 inch to 4.5 inches) [71%] to small pole size (<9.5 inches in diameter) [5%] – totaling 76% of the number of trees.
- Only 30% of the trees are of Acceptable Growing Stock (AGS) suitable for long-term growth.
- 12% of the total number of trees are of sawlog quality.
- 29% of the trees have no commercial value (Culls).

This seems depressing that we have a large number of trees that are small, poor-quality ones that don't have much value – either for future growing stock or larger trees. However, it's understandable when we consider how this forest has developed (post-settlement) after many periodic removals of better, longer-lived trees of high quality. In each case, the more valuable species of larger size and high-quality were removed in variable amounts that reflected market demand and preferences at the time. Still, there is a light at the end of

the tunnel…and it's not an oncoming train. We have much to work with in making improvements.

One item we have in our favor is that our soils, while not of top agricultural quality, are good growing sites for trees (covered in detail in Section D3, page 51). The second is that we have abundant moisture that favors a diverse mix of species and provides good opportunities for regenerating new trees, when it's required. In addition, large gains in quality, health and habitat diversity are possible by designing a series of treatments that provide for rehabilitation of this well-used forest. It is with this in mind that we undertake an active, rather than passive approach – Conservation rather than Preservation.

D1: Property Boundaries

The exterior perimeter boundaries of the Hothole-North Block contains 7,467 feet of exterior boundary line that must be maintained. Locating and renewal efforts by land survey began in May of 2022. Thus far, on the Dead River -West Block, all exterior lines have been flagged and blazed and painted with red paint. See Appendix A, page 149 for a map showing boundary locations.

Shortly after the acquisition of the Dead River – West property in 2021, a survey of property boundaries was completed by Michael Cummons, RLS 2074 of Lincolnville, Maine. The result of this survey was a plan showing the location and condition of all boundary lines and corners (see Section D1, page 51 and Appendix A, page 149 for map). This boundary data was also made available to GPMCT as a digital file which was added to the GIS system and forms the basis for records of boundary maintenance.

A boundary maintenance plan aims to renew all perimeter boundaries every 10 years, which amounts to efforts of about 750 feet to complete every year. As of this plan date, we are on schedule to renew the boundary perimeter by 2024.

After much initial field examination of the perimeter lines, it was estimated that maintenance work had not been carried out for a period ranging from 50 to 70 or more years. Evidence of old paint, corner monuments and blazes were obscured, obliterated in some segments, and difficult to locate – hence the need for a proper boundary survey, which has been done.

D3: Soils and Sites

The 24 kinds of soil present on the Dead River Block constitute 28% of the total soils found in Hancock County. Most of the better soils in Hancock

County are found in areas that are currently tilled or fallow for agricultural uses. Woodland soils, on the other hand, usually have some limitations that preclude their use for growing crops. However, since the location of an old cellar and characteristics signs of pasture or tillage use in the center of the property, is proof that some family subsisted all alone on the easterly facing slope and could see Great Pond Mountain. Some are wet, most are very rocky and a good number of them are found on slopes too steep to be farmed. While most soils are of the woodland capability class, there are some small areas of what NRCS terms "Prime Farmland" that consist of the Tunbridge-Lyman-Marlow complex soils. This soil is typically found adjacent to the main entrance road (see Prime Farmland map in Appendix A, page 149).

To better understand the capabilities of our woodland soils, a Soil/Site Productivity classification (Soil/SitePro™) was applied (Greene, 1997 and 2003). Other site classification systems have been in use for some time but have usually been tailored to either specific species or species groups and sometimes to geographic regions (Briggs, 1994; Belli & Hodges, 1998; Baker & Broadfoot, 1979; Jones & Saviello, 1991).

The Soil/SitePro™ system used readily available soil characteristic data from the Natural Resource Conservation Service's most recent National Soil Survey. Data on suitability for a number of purposes, engineering, forestry, agricultural, waste disposal and development uses as well as physical and chemical properties have been compiled into a relational database. Supplementing this tabular data are mapped soil polygons that have been identified in the field and from large-scale aerial photographs for each county in the United States. These mapped soil features have been compiled as Geographic Information Systems (GIS) files. Combining many kinds of ancillary data, this spatial and tabular information can be utilized in a number of ways, one of which is the Soil/SitePro™ application (Greene, 1996). This approach was developed to supply several forestry landowners across the country with specific, easy to use information to identify areas where the capability of the soil to grow trees can be found and linked to a variety of forest information like tree cover classes, growth and yield, product production capabilities and wildlife habitat suitability.

Those variables that contribute most to tree growth and development, regardless of species are those that have been found of greatest influence to soil value as a growing medium, moisture and nutrient availability as well as the degree of aeration for tree roots. Following are the soil characteristic variables used in the system:

- **Soil texture** class in the B-horizon (the rooting area). Mixtures of sand, silt and clay particles, along with rock fragments of various

sizes form specific textures. Texture impacts root penetration, moisture and nutrient availability.

- **Topsoil depth –** This is the upper layer of soil, right beneath the organic pad, where nutrients from decomposed organic matter begin to accumulate.
- **Rooting depth**
- Presence and influence of impermeable layers (**fragipan**)
- Percent of **organic matter** by weight found in the rooting zone.
- Degree of **stoniness** for stones from 3 to greater than 10 inches.
- **Drainage** class for the rooting zone.
- **Water table depth** (average seasonal)

In addition to the above physical characteristics are several important physiographic characteristics. These relate to where the soil is found on the landscape, since an individual soil type may offer better or worse capability for tree-growing depending on where it is found. The physiographic variables are:

- **Aspect** direction – *a range of azimuths that show which way a slope is facing. Aspect affects soil and tree crown temperature, directly impacting microbial activity, transpiration, rates of photosynthesis and exposure to prevailing winds. Northerly-facing slopes are generally more favorable sites, while southerly-facing slopes are warmer and more exposed to drying from winds.*

- **Slope percentage** rise – *degree of slope in rise versus run. For example, a 45 degree slope angle yields a percentage of 100, since the rise and run of the slope are equal. Steeper slopes shed moisture more quickly and if their aspect is southerly, they will be drier sites of generally poorer quality.*

- **Slope shape** – *combinations of planform (across the face of a slope) shape (convex or concave) and profile (shape of slope in an up/down direction of the gradient). Convex sites generally have more exposure to wind and solar radiation. They also tend to shed water more rapidly, resulting in lower productivity. Concave sites, on the other hand, are more protected and drain less rapidly. These sites tend to accumulate nutrients and are more productive.*

- **Slope position** – this is a site's relative location along a line from a ridgetop or plateau to a local drainage (stream, intermittent stream or concave cove). Environmental conditions are more severe on ridgetops

and upper slopes and moderate as one moves down to mid and lower slope positions.

Each of these variables has a scored value across the range of conditions found. These scores are summed for all variables and spread across a maximum possible range of 0 to 100. The results are grouped into 5 classes of tree-growing potential:

Excellent – 81 to 100 points

Good – 61 to 80 points

Fair – 41 to 60 points

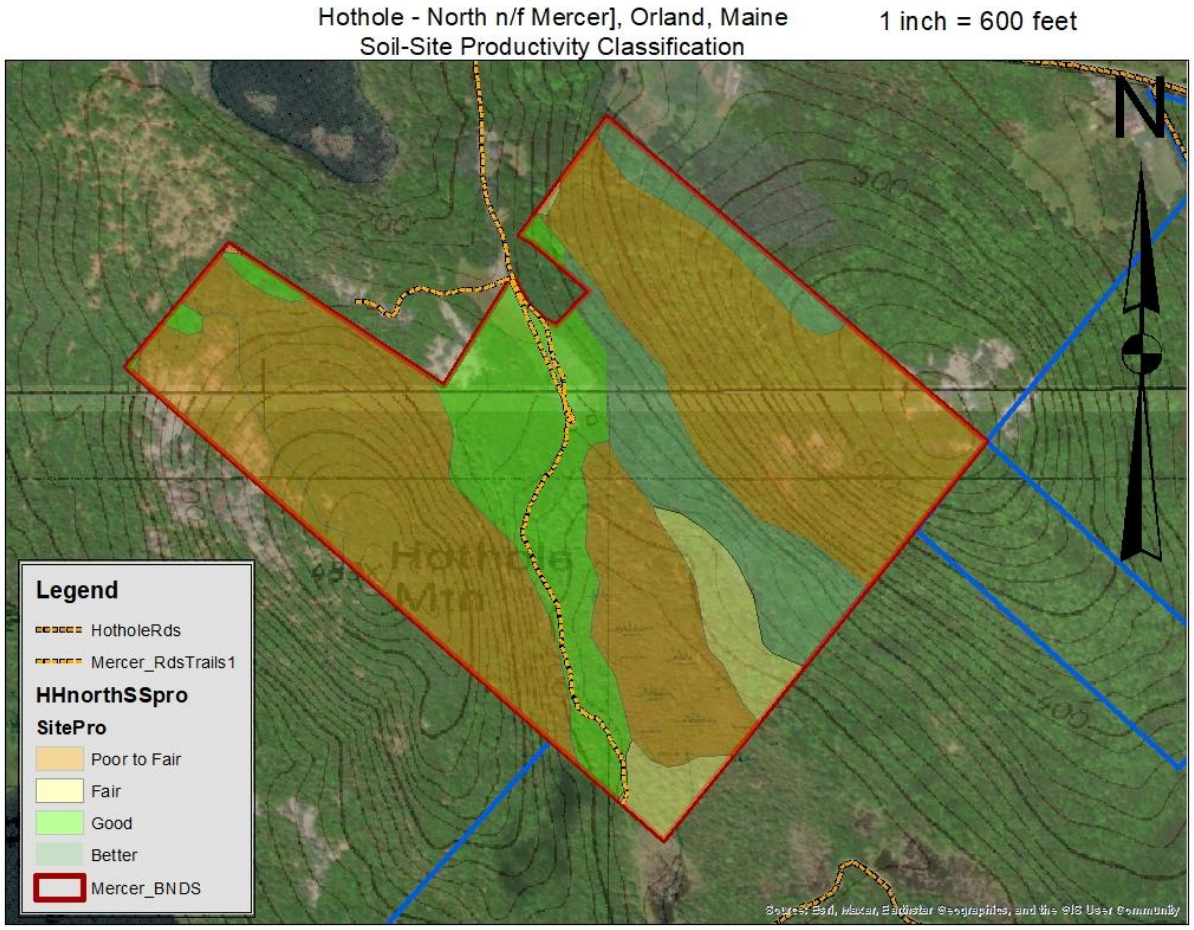
Poor – 21 to 40 points

Very Poor – 0 to 20 points

The use of 5 classes provides a rating that is more easily understood and related to the measured variables representing tree, stand and forest productivity. Use of this system can help schedule silvicultural treatments by avoiding areas adversely impacted by weather events, relate monitored stand conditions to growing sites, evaluate rates of change to the forest based on those key elements that define how a forest can be influenced over time - Site, Cover Type, Age/Development, Silvicultural Treatment Regimes applied.

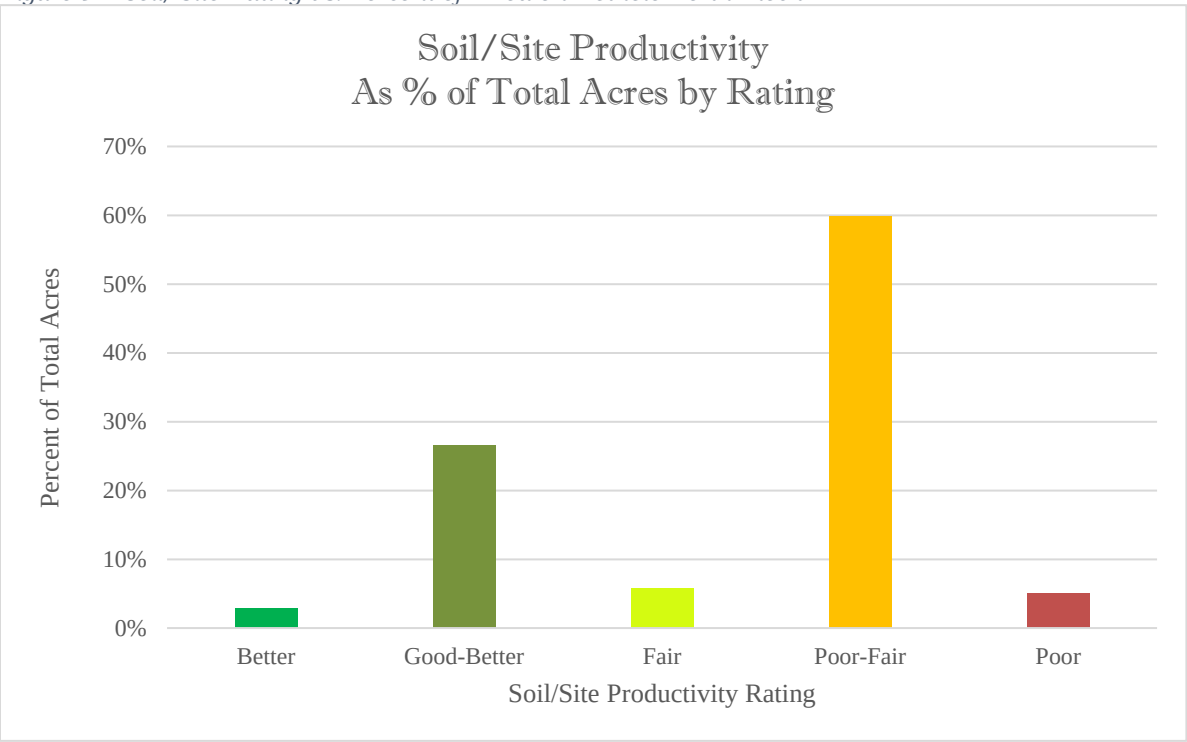
The rating and location of each of these Soil/Site Productivity classes is colored on maps where Red = Very Poor; Orange = Poor; Yellow = Fair/Average; Light green = Good and Darker green = Better. Below is a map (Figure 7) for the Hothole-North Block showing the distribution of Soil/Site Pro areas with superimposed forest stand polygons.

Figure 8 - Soil/Site Productivity for the Hothole-North Block



For informational purposes, the list of soil types present, their Soil/SitePro™ growing quality score and area are shown in the table below.

Figure 9 – Soil/Site Rating vs. Percent of Area on Hothole-North Block



D4: Existing Forest Conditions

While the general condition of the Hothole-North Block was covered earlier in this section, this part deals with the property forest conditions in more detail.

D4a) Forest Stands & Strata (Overview)

The basic units of management focus for forests are called stands. These are polygon-shaped areas with similar species mix, stage of development and density of crown cover. They range in size from a few acres to about 20 and reflect forest development since the most recent disturbance (natural or man-made). The same analytical processes that apply to stands may also apply, in a more general sense, to entire forests. Being mostly forested, the Hothole-North Block contains 25 individual forest stands that range in size from 0.3 to 21 acres. The largest (Stand 611) is in the eastern portion of the property on the slopes of Condon Hill. It's a reasonably dense small to medium sawtimber sized stand. Here, Red oak and Beech are the predominant species, with some Red maple and White pine. Beeh is predominantly found in the understory and is small in size (average diameter 2.8 inches). In this stand, there are 1,106 trees per acre containing 141 square feet of basal area and 5,000 gross board feet per acre of sawtimber. The total volume in cords is 20 per acre. Of all the stands, there are three classed as sawtimber-size and they account for 28.4

acres or 15% of the forested area. This tract is 91% forested. Aside from forested stands, there are barren areas, blueberries and bare areas of ledge at the upper reaches of Condon Hill and both lower and upper slopes of Hothole Mountain. All these non-forest areas comprise about 18 acres (9%) of the total 183.3-acre tract.

The smallest (Stand 625) occupies 0.3 acres and is found along the edge of the blueberry field on the southeast side. This small stand is a moderate-density Red pine plantation of medium to large poles and was planted around 1950. It has a high canopy with little understory so visibility within the stand is good. While it has not been sampled due to its small size, there could be perhaps 4 or 5 additional samples taken anyway, before and after thinning to the best density of stems for rapid growth.

While individual stands are an efficient way to recognize sometimes subtle differences and account for them in designing improvement treatments, taken as a whole, they appear to represent a crazy quilt of different things. Summarization into groups of similar general character offers the opportunity to view the forest area in a more understandable manner. It also allows the process of conducting an inventory of the forest to be done in a cost-effective way by reducing the number of elements to consider when preparing a strategy to meet the objectives of a landowner. These groups are called "strata" and the process of organizing the many individual stands into more general groups is called "*stratification.*"

The various forest cover types were organized for the inventory sampling into strata according to their **general forest cover** [*Spruce/Fir; Pine/Hemlock; Lowland Conifer; Tolerant Hardwood and Intolerant Hardwood*], **stage of development** [*Seedlings; Saplings; Poles and Sawtimber*] and **broad density classes** *[Low to Moderate and Moderate to High].* The number of samples required for an accurate assessment of each stratum could be held to a number that was reasonable to complete in a single growing season and within a reasonable budget. The stratification resulted in 136 possible strata, of which, each of 6 present received a share of the 62 samples in the block and covered 183.3 acres. From the 2023 Cover Type Mapping and the 2024 Forest Inventory, a picture of the Hothole-North Block's existing condition can be derived. The following information is based on summarizations of both sources. This data provides a baseline description of the Hothole-North Block that can be compared against measured changes as the forest moves forward. A table showing which strata are present within the range of development classes which were sampled during the 2024 inventory follows.

Table 1 - Broad Strata, Density & Sampled Development Classes

2024 Forest Inventory Stratum Summary						
Hothole-North Block						
						Count of
	Average	***Development Class***				**Density by**
Stratum Description	**Density**	**Saplings**	**Poles**	**Sawtimber**		**Stratum**
Spruce-Fir	Moderate-High					0
Spruce-Fir	Low-Moderate					0
Spruce-Fir/Pine-Hemlock	Moderate-High					0
Spruce-Fir/Pine-Hemlock	Low-Moderate					0
Spruce-Fir/Lowland Conifers	Moderate-High					0
Spruce-Fir/Lowland Conifers	Low-Moderate					0
Spruce-Fir/Mixed Hardwoods	Moderate-High					0
Spruce-Fir/Mixed Hardwoods	Low-Moderate					0
Pine-Hemlock	Moderate-High					0
Pine-Hemlock	Low-Moderate					0
Pine-Hemlock/Mixed Conifers	Moderate-High		☑			1
Pine-Hemlock/Mixed Conifers	Low-Moderate					0
Pine-Hemlock/Lowland Conifers	Moderate-High					0
Pine-Hemlock/Lowland Conifers	Low-Moderate					0
Pine-Hemlock/Mixed Hwds	Moderate-High					0
Pine-Hemlock/Mixed Hwds	Low-Moderate					0
Lowland Conifers	Moderate-High		☑			1
Lowland Conifers	Low-Moderate					0
Lowland Conifers/Mixed Conifers	Moderate-High					0
Lowland Conifers/Mixed Conifers	Low-Moderate					0
Lowland Conifers/MixedHwds	Moderate-High					0
Lowland Conifers/MixedHwds	Low-Moderate					0
Tolerant Hardwoods	Moderate-High		☑			1
Tolerant Hardwoods	Low-Moderate					0
Tolerant Hwds/Mixed Conifers	Moderate-High		☑			1
Tolerant Hwds/Mixed Conifers	Low-Moderate					0
Tolerant Hwds/Intolerant Hwds	Moderate-High			☑		1
Tolerant Hwds/Intolerant Hwds	Low-Moderate					0
Intolerant Hardwoods	Moderate-High					0
Intolerant Hardwoods	Low-Moderate					0
Intolerant Hwds/Mixed Conifers	Moderate-High					0
Intolerant Hwds/Mixed Conifers	Low-Moderate					0
Intolerant Hwds/Tolerant Hwds	Moderate-High		☑			1
Intolerant Hwds/Tolerant Hwds	Low-Moderate					0
Count of Strata by Development Class		0	5	1		6

The representation of the 6 strata on the Hothole-North Block reveals several salient points. The first, is that strata in the pole timber class are

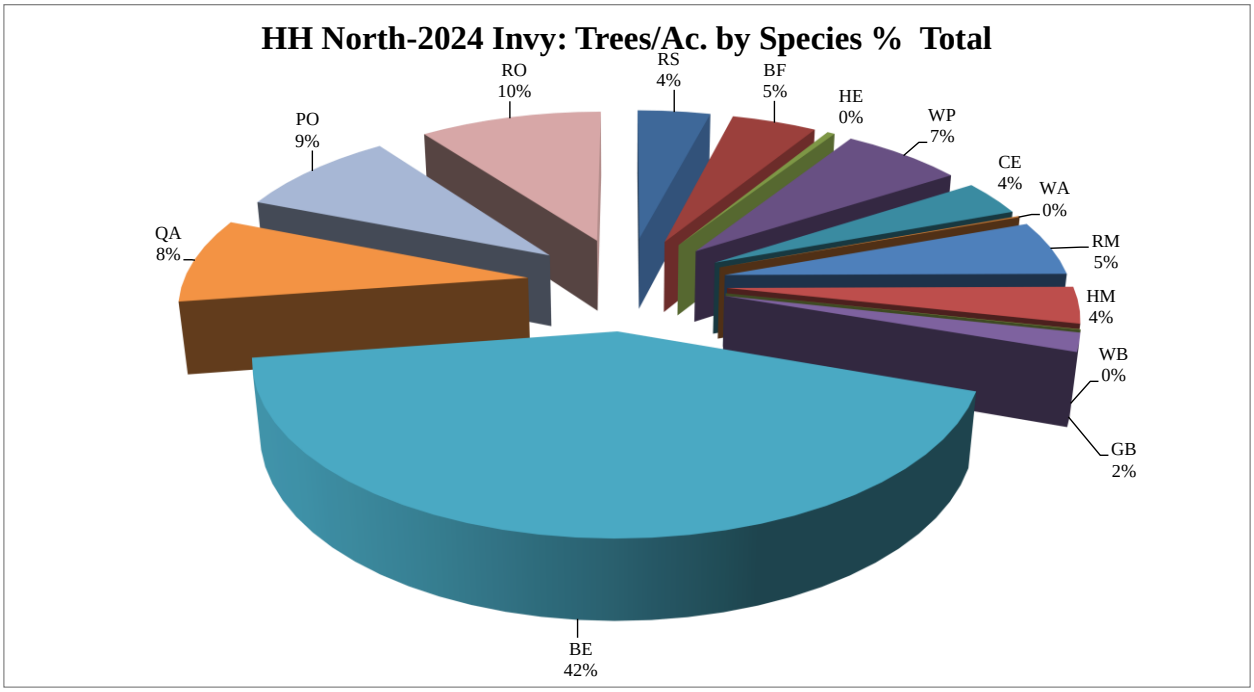
widely represented, which indicates that this is a moderately mature developing forest and while there are mostly medium to large poles, there is only a single stratum that represents a sawtimber stage of development, where it accounts for only 15% of the forested area, as mentioned previously. I believe that this situation came about by the recent harvest focusing on sawtimber, rather than including some thinning to improve growth and development in stands containing pole timber. If we look at the number of strata found by broad species groups (Spruce-Fir, Pine-Hemlock, Lowland Conifers, Tolerant and Intolerant Hardwoods), we can see that the most abundant species groups are the Tolerant Hardwoods, which, in some cases have a variety of conifers and mixed hardwoods associated with them. The least present broad species groups are the Spruce-fir. Pine-Hemlock and Intolerant Hardwoods (Aspen and Birch species). Seedling-size classes (under 4 feet in total height), although not sampled until they reach sapling size, are widely scattered amongst the more mature trees, present, but too small to map effectively. Most are of low to moderate density as these new trees became established under a more mature overstory that casts a great deal of shade – slowing development of any seedlings or saplings beneath.

D4b) Species Composition & Structure

Fourteen recognized tree species were found during the inventory on the Hothole-North Block. That's 32% of the tree species found in Maine. There are a few that escaped detection by inventory sampling, though. Basswood is the most notable exception but is so scarce that the chances of having one occur on an inventory plot was extremely rare. The same is true of tamarack (Eastern larch). Both of these species may be present, but pretty scarce – either due to the places they are found to be small or resulting from removal. My sense is that this property has had a longer history of partial species-driven removals and that may account for the lower number of species. Where possible, efforts at increasing their representation on suitable sites should be made.

Species composition may be represented in several ways: numbers of trees by species or as a percentage of the total number. The percentage of all species method clearly shows which species have a large share, but only as trees per acre. The following pie charts show conifer and hardwood species separately. Overall, though, hardwood species comprise 83% of the total number of trees.

Figure 10 - Trees/Acre by Species as % of Total



If we look at all those species that make up more than 5% of the number of trees per acre, we have the following most predominant species in order from most to least:

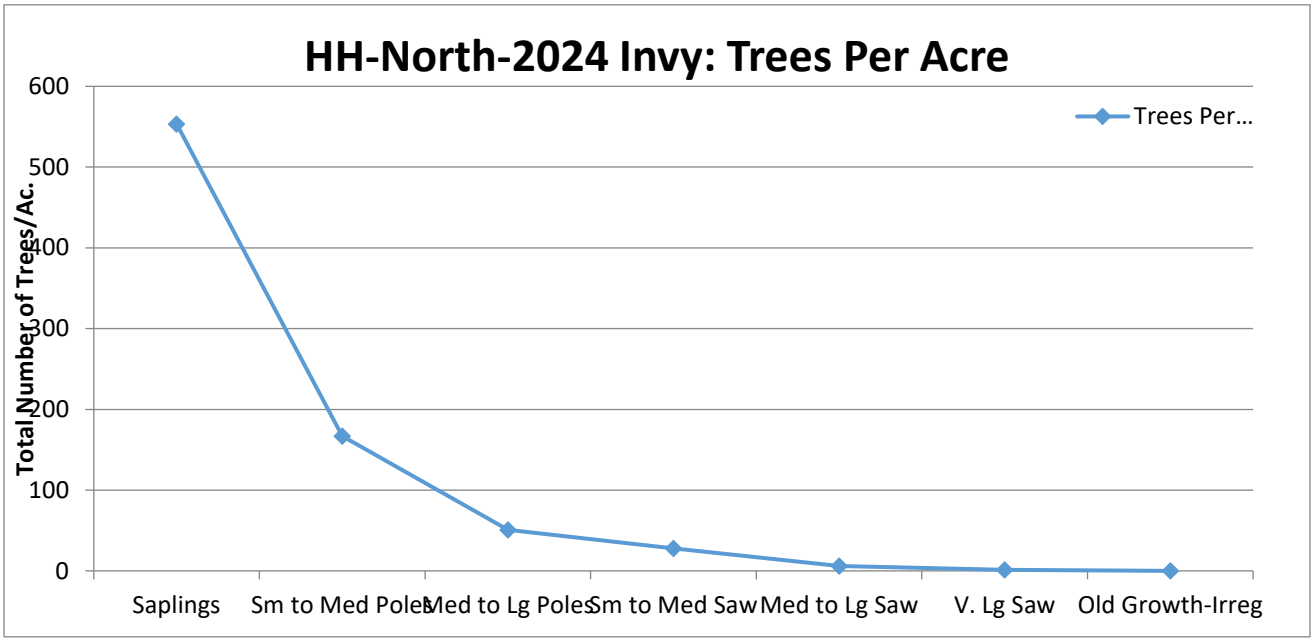
- Beech
- Red oak
- Quaking and Bigtooth Aspen
- White pine

Together, these species make up slightly more than 76% of the total number of trees of all species on the Hothole-North Block. In terms of long life from the trees in the above list, Beech, Red oak, Sugar maple, Yellow birch, White pine, Red spruce and Cedar can live longer than 250 years, if healthy (especially pertains to Beech). Note that Beech has the largest share of trees/acre, but they are of generally poor quality due to both the Beech Bark Disease (BBD) and the more recent Beech Leaf Disease (BLD). Thes two diseases may reduce their numbers dramatically over time. The others have biologically shorter life spans with White birch and Balsam fir at about 80 years while the aspens (Quaking and Bigtooth) can only live to a bit over 60 before they begin to deteriorate. Of the high-value species (longest living + high value) which are White pine, Red spruce, White Cedar, Sugar maple, Yellow birch and Red oak, these species account for only 29% of the total number of trees.

The structure of the forest on the Hothole-North Block is largely evenaged. That means that the trees in any given stand (regardless of species, except for Beech) might be in one or two age classes. As Evenaged stands move together through time and development stages from seedlings to mature trees, multi-aged stands have several development (size) classes of trees growing together. This provides for a much more complex vertical structure of tree crowns as well as a wider range of tree diameters. There are some even-aged stands that are largely Balsam fir thickets of recent vintage (last 30 years or so), or large sawtimber-sized Aspen (either Quaking or Bigtooth) that have grown in association with some sawtimber-size trees of either White pine, Red oak or both as well as small patches of sapling-size trees. This is the structure we'd like to encourage as if fills more habitat niches for wildlife.

Even-aged stands go through several growth phases as some trees die and some get larger in size. Initially, there are high numbers of trees in the smaller diameter classes with sharply reducing numbers in larger classes. A curve plotting the number of trees in each succeeding larger diameter class will show a reduction in numbers of trees per acre. Younger stands will show a steeper curve with fewer diameter classes being occupied. As evenaged stands mature the shape of the curve becomes more bell-shaped as the average tree size increases. The curve then flattens out a bit when the stands become more mature and older. So, being able to recognize stand (and forest) development from actual field data is important towards understanding the current phase of development. From the 2024 forest inventory, the shape of the distribution of diameter classes is shown below.

Figure 11 – Hothole-North Block Diameter Distribution

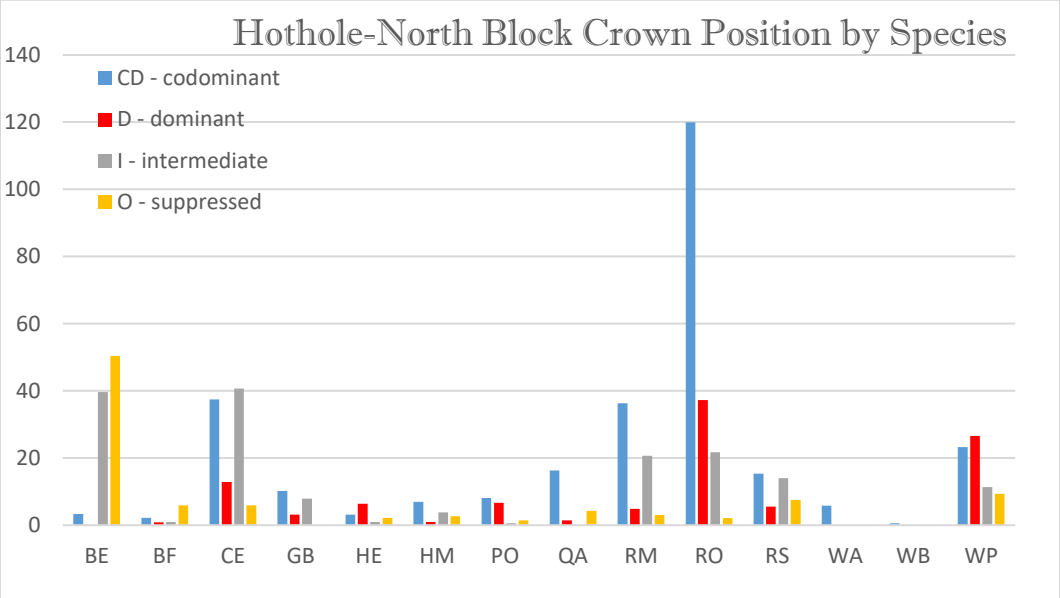


This chart shows the decreasing number of trees per acre by development class (*Saplings, Small-Medium Poles, Medium-Large Poles, Small-Medium Sawtimber, Medium-Large Sawtimber, Very Large Sawtimber and Old-Growth Structure*) as a line from smallest to largest trees of all species. The range is for all diameters from 1 to 30 inches. This is a very wide range, and it includes all trees in all stands sampled during the inventory. So, some stands have larger trees (especially in riparian areas where large Hemlock were left). The curve would be steeper if we only considered diameter classes up to 12 inches.

This type of structure (range of tree sizes) is called horizontal structure and depending on the range of diameters within stands of a whole forest offers an opportunity to describe how diverse it may be. Complexity of horizontal structure can be found by statistical analysis of all sized trees measured during inventory sampling. More on this subject may be found in the references at the end of this plan (Pukkala and von Gasow, 2012). Another kind of forest structure is a vertical one. This refers to the height and levels of foliar crowns of the trees within a stand or forest. Since smaller trees are generally shorter, the mix of smaller and larger trees offers more opportunity for wildlife habitat as more "crown depth" is available. In the mature forest of the Hothole–North Block, there are several layers. If we look at the distribution of various positions in the crowns of trees on this property, we can see that there's a pretty good mixture, depending, of course, on which species is under consideration. In the following graph of crown position by species, note that for some species it's present in at least 3 or 4 crown classes. These classes from

the lowest to highest vertical position are: Overtopped, Intermediate, Co-Dominant and Dominant. They are based on tree height and how much sunlight reaches all portion of the tree crowns.

Figure 12 Hothole-North Crown Position by Species



D4c) Stocking Level & Quality of Growing Stock

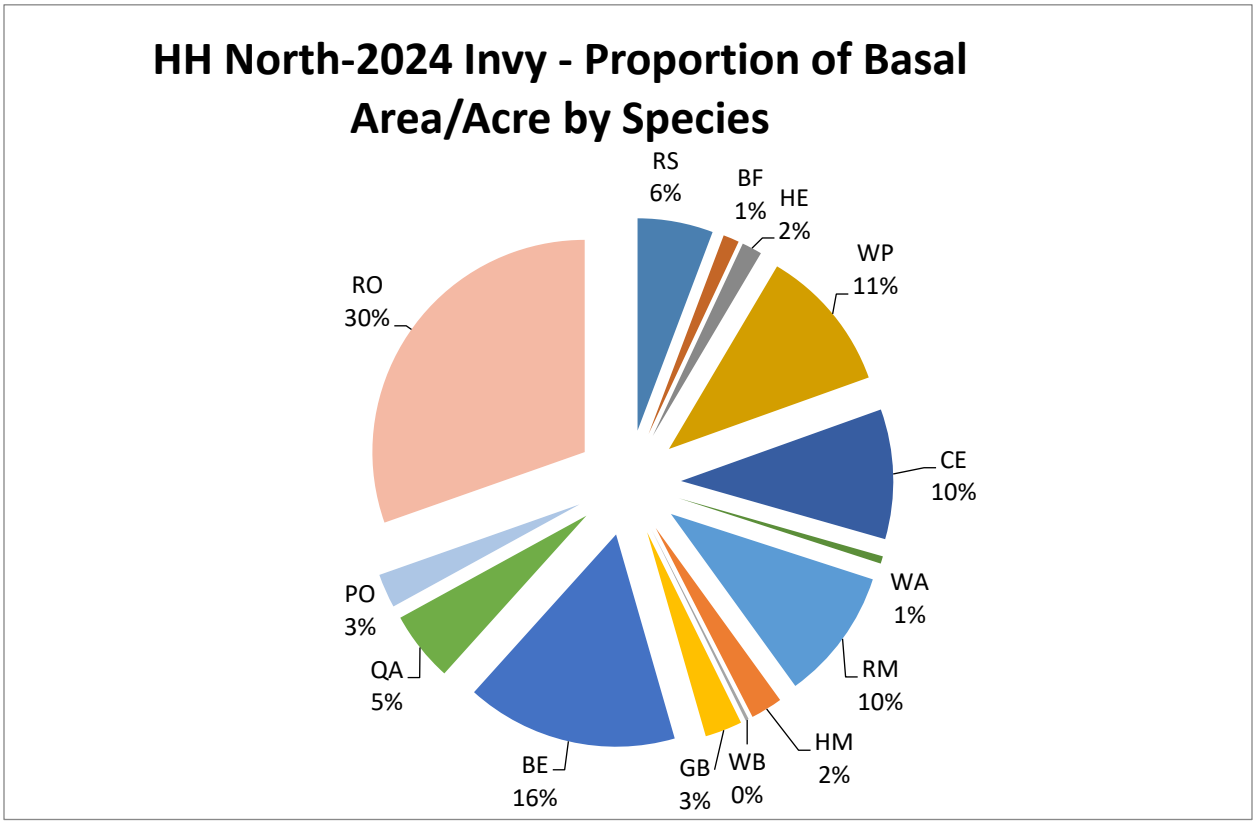
Stocking refers to the amount of tree material present compared to some amount considered normal (or optimum) for a forest of a given species mix, age, soil, etc. related to a unit of area. Generally, it refers to the amount in terms of numbers of trees, volume of wood, density of crown area or basal area per acre. If we speak about the number of trees per acre for the Hothole-North Block, that value would be 826. If the volume of wood of all species and products is the preferred value, then it would be presented in units per acre of whatever measurement was appropriate (cubic feet, board feet, cords, cunits, etc.). So, if the average number of merchantable cubic feet were the desired value, then, this block would contain an average of 1,666 cubic feet of merchantable wood per acre, about 20.2 cords. Just for comparison, this is **2.4 *times*** the average amount of the Hothole Block. However, it's also **38.3% *LESS*** than the Dead River-West Block. Our conclusion is that the Hothole-North Block's growing stock (as well as all the other properties) needs to both improve the quality and quantity of their growing stock to reach a fully sustainable condition.

Another way of measuring stocking is by basal area, mentioned previously. Basal area refers to the average cross-sectional area of each tree measured at a point 4.5 feet above ground level. The value for each tree is summed to derive a total basal area per acre. Basal area has been found to be

an easy to derive, useful measure since it relates very closely to other values like volume, tree height, etc. Usually expressed in square feet per acre, basal area is a useful measure of stocking density – a measure of solid wood (and bark) material. This value is rather low for young stands and as the stand or forest grows, the basal area increases to a maximum value that is dependent upon the mix of species, exposure, slope, elevation, soils, etc. For hardwood stands the average value for basal area at maturity is between 120 and 150 square feet/acre, while for conifer stands the range may be between 160 to 275 square feet/acre. For all the stands on the Hothole-North Block, the average basal area per acre stands at 132 square feet. This value is higher than the original blocks because the stands are generally of mixed species (conifer & Hardwood), mature and still developing. It will continue to rise as time passes.

Notice in Figure 12, that Beech, Red oak, White cedar and White pine make up about two-thirds of the total basal area. The higher-value species (Red spruce, White pine, Cedar, White ash, Sugar maple (HM), and White birch make up about 60% of the total basal area and this is a good thing as these species represent a seed source to help improve the forest as silvicultural treatments are applied over a long period of time. So, while work is being done to reduce the amounts of Red maple, Gray birch, Quaking and Bigtooth aspen, their numbers can be replaced with longer-lived, more valuable trees of good quality.

Figure 13: Basal Area Distribution by Species

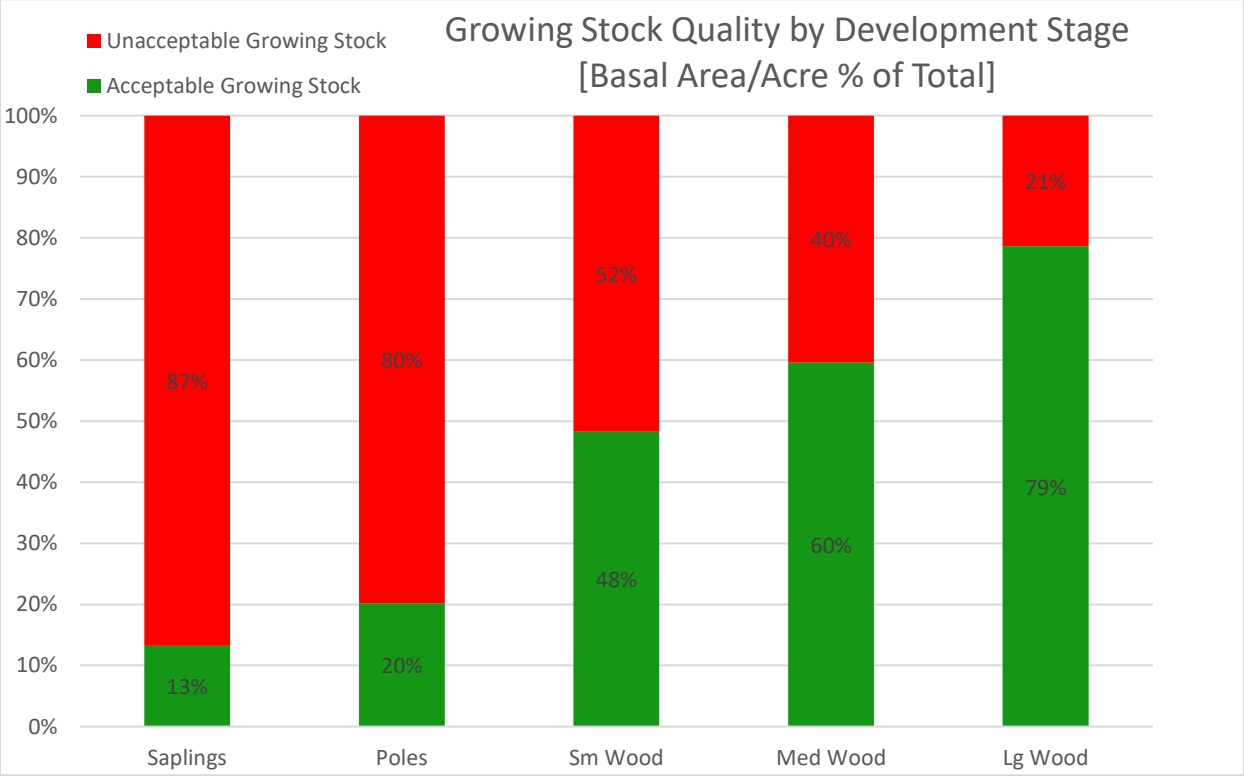


The quality of the growing stock of trees includes the overall health of the tree, its straightness of form, the number of defects observed (such things as crooks; rot; curvature of the stem; broken large branches or top; damaged bole or roots; etc.) and fullness and vigor of the crown area. Those trees that have a high probability of surviving for at least the next 10 or 20 years and making good growth during that period are termed "Acceptable Growing Stock, or "AGS." Those not making the grade and in risk of deteriorating or dying within the same period are termed "Unacceptable Growing Stock, or "UGS." The latter are trees that we would like to remove to make their space available to roots and crowns of better trees. Sometimes, however, a number of these UGS need to remain as placeholders until additional growing space is needed for the AGS.

When looking at the size ranges as development classes present on the Hothole-North Block, we find that the saplings and pole classes have more than half of their total basal area in poor-quality material. Development classes of larger material (Small, Medium and Large wood) are just the opposite. Figure 12, below, shows this relationship clearly. This is a consequence of smaller development classes having more trees, but also of the fact that, over time, the health and vigor of the established forest has been reduced by past removals of the better species and products. Our job now is to reverse this trend and foster the development of healthier trees of all species by

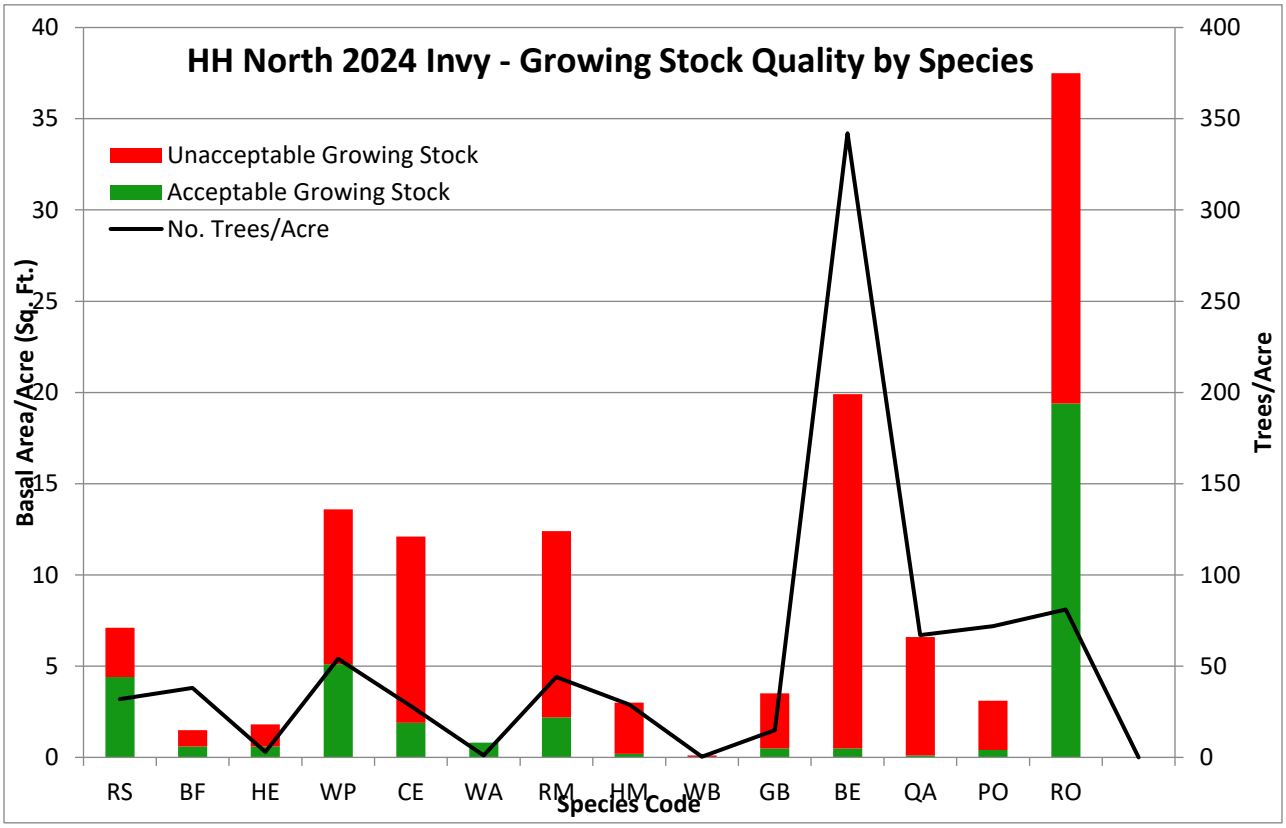
initiating treatments to cull out the poorer ones during early development of new trees.

Figure 14 – Hothole-North Growing Stock Quality in Percent of Total Basal Area/Acre by Development Stage



We can also see how quality is distributed among the species on the Hothole-North Block, as shown in the following graph.

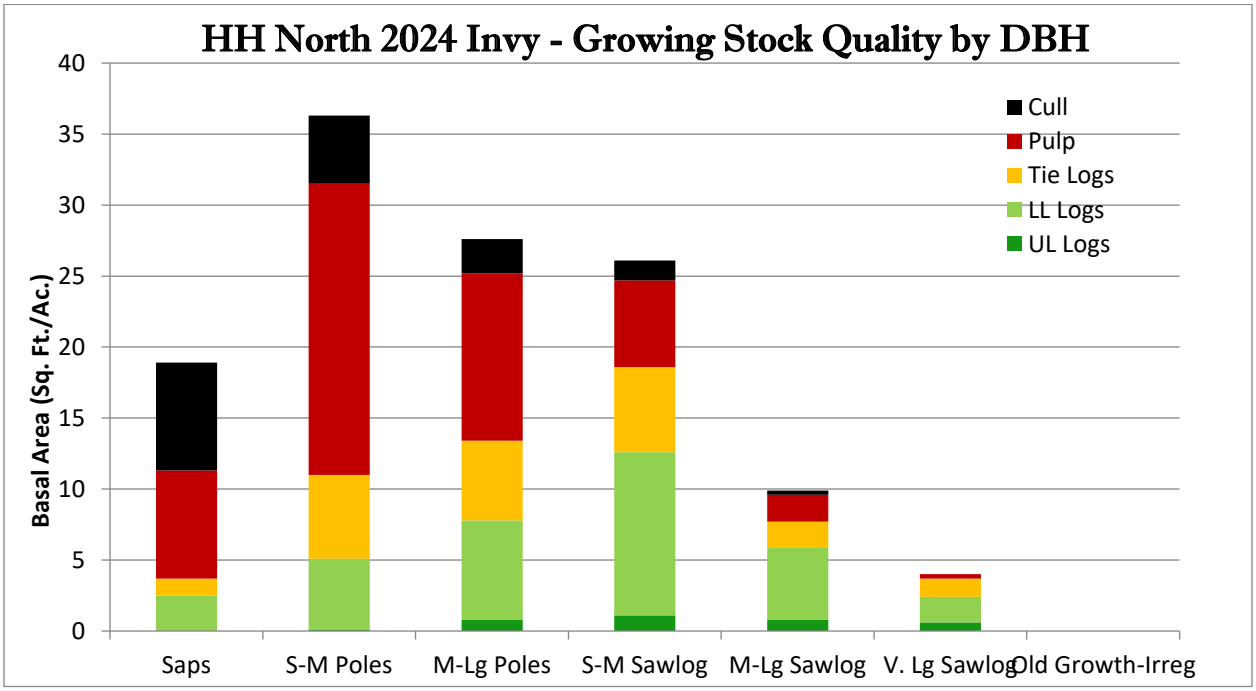
Figure 15 - Growing Stock Quality by Species Basal Area/Acre



Of the 14 species present on the Hothole-North Block, only two (Red spruce and Red oak) have over 50% of their basal area in acceptable growing stock. The rest have higher levels of unacceptable growing stock that put them at risk and should be removed, eventually. Overall, this forest, while it contains larger, more developed growing stock, the better trees are only 30% of total basal area. This is only slightly better that that found on Dead River – East or Hothole Blocks.

Looking at quality from a size perspective, we can see where the existing quality material resides as shown below in Figure 14. The coding categories in the legend represent "product potential" and they read from top to bottom: C-Cull (worthless); P-Pulpwood; T-Tie/Pallet; LL-Limited sawlog and UL-Unlimited. Notice that the better, healthier trees that are also more valuable are found in diameter classes at or above 8 inches. Below that, there is a great deal of low value, unhealthy material. In the smaller diameter classes there's not much hope for recruitment of good growing stock to replace the reasonably good stock in the larger classes as they grow larger.

Figure 16 - Growing Stock Quality by Diameter Class



D4d) Forest Products Volumes & Value

Using current measures of volume and the definitions of products, the forest products that are present (standing per acre) on the Hothole-North Block consist of the following:

- 58 board feet/acre of Veneer
- 2,134 board feet/acre of Sawtimber
- 994 board feet/acre of Pallet or Tie-grade sawlogs
- 0 board feet/acre of Boltwood
- 26 green tons/acre of Pulpwood
- 2.7 green tons/acre of Cull material

This represents good, marketable volume, and while the stands are still in mid-maturity, there is a good opportunity to address the shortcomings in all diameter classes as well as some desirable adjustments to species composition. The stumpage value of this merchantable material amounts to about $949 per acre. Appraised value by the Town of Orland (2025) is $149.75 per acre, which is a big difference that does not take into account the potential development value, so it is reasonable for undeveloped woodland in this area. The standing timber value would be if it was completely cut! However, some light thinning to

begin the removal of poor-quality material from the more developed stands, on the better sites, would help to rehabilitate this forest a great deal. At the current prices for removed material and the amounts it would be helpful to remove, a contractor doing the thinning would find himself needing to pick and choose his markets to cover the costs of operation and make a profit. Hopefully, market prices will rebound after their long decline, which will make some additional thinning work possible. This would be in addition to assistance from the Natural Resources Conservation Service (NRCS) that has helped us so much in the past years. A summary of the current standing value is shown in Table 4 (below):

Table 2: Hothole-North Block, Standing Value per acre

	Great Pond Mountain Conservation Trust - 2024 Forest Inventory							
	Average 2022 Stumpage Values for Hancock County							
			Hothole-North Block		185 Forested Acres			
STUMPAGE PRICES	☑	**2022**		**AMOUNT OF PRODUCT CATEGORY IN INVENTORY**				
					Volume/Ac.	Value/Unit x Units		
	Biomass (per ton)	**Average**		**Biomass**				
	All species	$ 2.00			2.7	$ 5.40		
	Boltwood (per MBF)			***Boltwood***				
	Sugar maple	$ -				$ -		
	White birch	$ 172.00			0	$ -		
	Firewood	***Cord***	***G. Ton***	***Firewood***				
	All species	$ 26.39	$ 10.00		12.5	$ 329.88	in cords	
	Palletwood (per MBF)			***Palletwood***				
	Hardwood	$ 24.00			0.23	$ 5.52		
	Softwood	$ 24.00			0.14	$ 3.36		
	Pulpwood (per ton)			***Pulpwood***				
	Aspen/Poplar	$ 6.00			2.9	$ 17.40		
	Cedar	$ 6.00			1.4	$ 8.40		
	Hemlock	$ 2.00			0.4	$ 0.80		
	Mixed Hardwood	$ 7.00			17.9	$ 125.30		
	Red pine	$ -			0	$ -		
	Spruce/Fir	$ 4.00			51.4	$ 205.60		
	White pine	$ 1.00			1.8	$ 1.80		

	Sawlogs (per MBF)			***Sawlogs***		
	Ash	$ 154.00			0.6	$ 92.40
	Aspen/Poplar	$ 124.00			0.3	$ 37.20
	Beech	$ -				$ -
	Cedar	$ 117.00			0.1	$ 11.70
	Hemlock	$ 69.00			0.11	$ 7.59
	Red oak	$ 231.00			0.03	$ 6.93
	Red pine	$ 44.00				$ -
	Red maple	$ 157.00			0.04	$ 6.28
	Spruce/Fir	$ 141.00			0.16	$ 22.56
	Sugar maple	$ 234.00			0.04	$ 9.36
	White birch	$ 182.00				$ -
	White oak	$ 129.00				$ -
	White pine	$ 189.00			0.25	$ 47.25
	Yellow birch	$ 153.00				$ -
	Studwood (per ton)			***Studwood***		
	Other species	$ 12.00				$ -
	Spruce/Fir	$ 23.00				$ -
	Veneer (per MBF)			***Veneer***		
	Aspen/Poplar	$ -				$ -
	Red maple	$ -				$ -
	Red oak	$ 446.00			0.01	$ 4.46
	Sugar maple	$ 862.00				$ -
	White birch	$ 622.00				$ -
	Yellow birch	$ 615.00				$ -
			Total G. Tons/Ac:		78.5	$ 364.70
			Total MBF/Ac:		1.87	$ 254.61
			Total Cords/Ac:		12.5	$ 329.88
		Standing Inventory Value/Acre				***$ 949.19***
	Total Forested Ac.:	**185**	Total Standing Inventory Value			**$ 175,599.23**

While this estimate of standing value uses survey values from the Maine Forest Service Stumpage Reports for the most current year (2022), actual values may be somewhat higher due to the better marketing effort made by our contractor, Astbury Forestscaping & Trucking. So, in this regard, the above table represents a conservative estimate.

D4e) Forest Health & Vigor

Overall, the current health of growing stock on the Hothole-North Block is fair, primarily due to the large amount of risky growing stock. With the large amount of unacceptable growing stock present, Adjustments can be made by removing the worst of each species as we encounter them. For those species that are near the end of their biological maturity (Gray birch and Aspen species), most of those trees can be removed if nearby, profitable markets are available. While there are good trees sparsely scattered through the hardwood stands, there are far too many poor trees of these and other species. If this forest was left to develop naturally, without intervention, many trees would be lost to mortality and those left to add some growth would decrease in vigor, continuing to produce a generally poor-quality forest that would be gradually falling apart. Of course, as some trees would die, room would be made for new trees and surely, there would be regeneration in the small patches that would occur. However, these patches, since they would mostly be small unless some catastrophic event occurred, would become stocked with shade-tolerant species and of that, most of it would be either Balsam fir, Red maple or Beech. Any new crop of Beech would be trying to grow up amidst the remaining diseased trees and both Beech Bark Disease and Beech Leaf disease infection would soon spread to the new trees, thus perpetuating the problems we are currently facing.

Efforts to rehabilitate this degraded forest should begin as soon as possible on a scale sufficient to be operationally possible to complete the initial job in the most damaged stands over a 10 or 12-year period. Such a program would need to cover at least 15 acres per year and if possible, more than that. Currently, with the existing poor markets for anything but the best veneer, dependence on the available subsidies from the NRCS's EQIP program is the only vehicle to make such a program possible.

D5: Access Roads & Trails

There are no good roads present on the Hothole-North Block. Most of the existing roads were built by previous owners. These lack proper ditching, good gravel, adequately sized culverts and only provide poor access to the property from the Bald Mountain Road. Truck access into the end of the blueberry field is very narrow for truck traffic and limited with numerous potholes. Beyond the blueberry field, there are two old skid roads that were left over from previous operations. One to the south boundary and one to the east boundary and onto the GPT ownership. Making these roads useable will be a gradual process, but with good planning, some portions of the old trail network may be made useable for future tending operations, depending on ground conditions and the

stands to be treated. Seasonality constraints will also be needed as some areas are much too wet to have heavy machinery damaging the soils. Any new improvements made to provide better, more permanent access to all parts of the property should be placed properly with subsidiary trails connecting to the main trails at an angle to prevent runoff and damage to residual trees needed for a seed source an additional growth in value.

A road, ditch, bridge, and culvert maintenance program should be established for this area and be ongoing to keep the main access roads in good condition for forest operations that may also include some recreational activity.

To address future repairs for the other washouts, funding could be sought from NRCS and any other organizations that provide funds for wetland improvements. However, on this block, there is only one major perennial stream, originating from a cold spring near the blueberry field. Funding may not be available for this type of work and alternative sources should be sought.

D6: Water Features & Management

There are three major water features present on the Hothole-North Block. These include a large beaver flowage that crosses the south boundary; a lowland conifer swamp that acts as a deer wintering area, and a small stream that originates at a cold spring just south of the current snowmobile trail and flows south. Average annual rainfall amounts to about 46 inches per year. Realizing that a single inch of rain on an acre produces 27,154 gallons of water, an entire year's worth of precipitation (about 46 inches in all forms) would amount to about 1.25 million gallons that flow through the forest ecosystem. None of the small watercourses are mapped.

All mapped streams fall under state and local regulatory jurisdiction. At present, no mapped streams are shown on any maps. Normally, any small streams are protected by a 75-foot buffer zone by State law. In theory, this 75-foot zone serves the purpose of protecting streams from erosion and sedimentation as well as wide temperature fluctuations. For the type of topography present on Hothole-North Block, it makes sense to extend the limit of a stream protection zone to a minimum of 100 feet and perhaps wider as one moves uphill and encounters any additional feeder streams, even if ephemeral. Doing so will protect the watercourses from adverse temperatures, exposure and natural siltation and is consistent with practices on all the other properties.

Another water feature that doesn't get much attention is that of vernal pools - those that hold a bit of water for a short period in late spring through mid-summer at the latest. It is unknown at this time exactly how many of

these small, ephemeral wet spots exist. They are good places for amphibians and reptiles to reproduce and during April and May are beehives of activity. As they are encountered, their locations should be mapped for any monitoring activities that may be deemed necessary.

D7: Wildlife Management

As the improvement of conditions for wildlife is one of the GPMCT's ownership goals, a forest that is more diverse in habitats is desirable. That is not to say that there is a scarcity of wildlife on the Dead River – West Block. To the contrary, wildlife species that favor more mature successional habitats are quite numerous – especially deer, bear, coyote, squirrel, beaver, Otter, bobcat, and porcupine to name a few. The goal of GPMCT is the first stated:

"Improve and enhance wildlife habitat diversity..."

This is a very direct, simply stated goal. It is left up to the managers to determine the most effective ways in which this goal can be met.

D7a: Meeting the Goal

As with any desired goal to be met, first we need to know something about habitats in general and those specifically that occur on the Hothole-North block. Habitats are the combination of conditions that make the particular place suitable of a certain mix of species: Amphibians, Birds, Mammals and Reptiles to find a home in which they can breed and prosper. They need to do this in numbers that are sufficient to sustain existing populations of whatever species is of interest. That means knowing about the myriads of habitat characteristics that are important to which creatures.

While there is a list of Maine Natural Communities identified in the Natural Resource Inventory (Rees, 2024), they are rather general in nature and include a variety of characteristics lumped under a single label. It's a bit like our Broad Forest Types as it makes reporting less complicated and improves understanding at a condensed, lower level of detail.

- ***Blueberry Fields***
- ***Cedar Swamp***
- ***Low Elevation Bald***
- ***Oak-Hardwoods-Pine***
- ***Red Pine***
- ***Red Spruce-Hardwoods***

The literature on habitats is similar but provides a bit more detail to sort things into more buckets, largely to improve understanding at a finer level of detail – more like our specific forest cover types were we record a primary and

secondary species, a stage of development and a density. As these things are related to reporting volumes in numerous ways, habitat listings, along with their detailed characteristics can make the process of initiating changes more effective.

Mid to late successional habitats in general, have gradually diminished in Hancock County as harvest activity sets succession back to more open earlier stages. Our property here, that were as saplings, avoided during the past harvests, have grown into small to medium poles and some to small sawtimber in the last 30 years or so. Other larger merchantable trees that remained also increased in height and diameter. In general, the Hothole-North Block, with its later successional mixture, uniform assemblage of stands and cover types, offers a multiplicity of habitats that are available to numerous species. The following list shows the habitats that are present currently and the number of stands in each category.

Table 3: Hothole-North: Number of stands by specific habitat and condition

Stands	***HABITATS***							
HABITAT Moisture Regime	***Aquatic***	***Aspen-Birch***	***Hemlock***	***N. Hwd***	***Oak-Pine***	***Spruce-Fir***	***Swamp Swd.***	***Grand Total***
Aspen		***1***						***1***
Dry/Mesic/Wet		*1*						*1*
Hemlock			***6***					***6***
Mesic			*6*					*6*
N. Hwd-Conifer				***4***				***4***
Mesic				*4*				*4*
N. Red Oak					***3***			***3***
Dry/Mesic					*3*			*3*
N.Hwd				***1***				***1***
Mesic				*1*				*1*
Oak-Pine Mix					***1***			***1***
Dry/Mesic					*1*			*1*
Palustrine	***3***							***3***
Bog	*1*							*1*
Deep Marsh	*1*							*1*

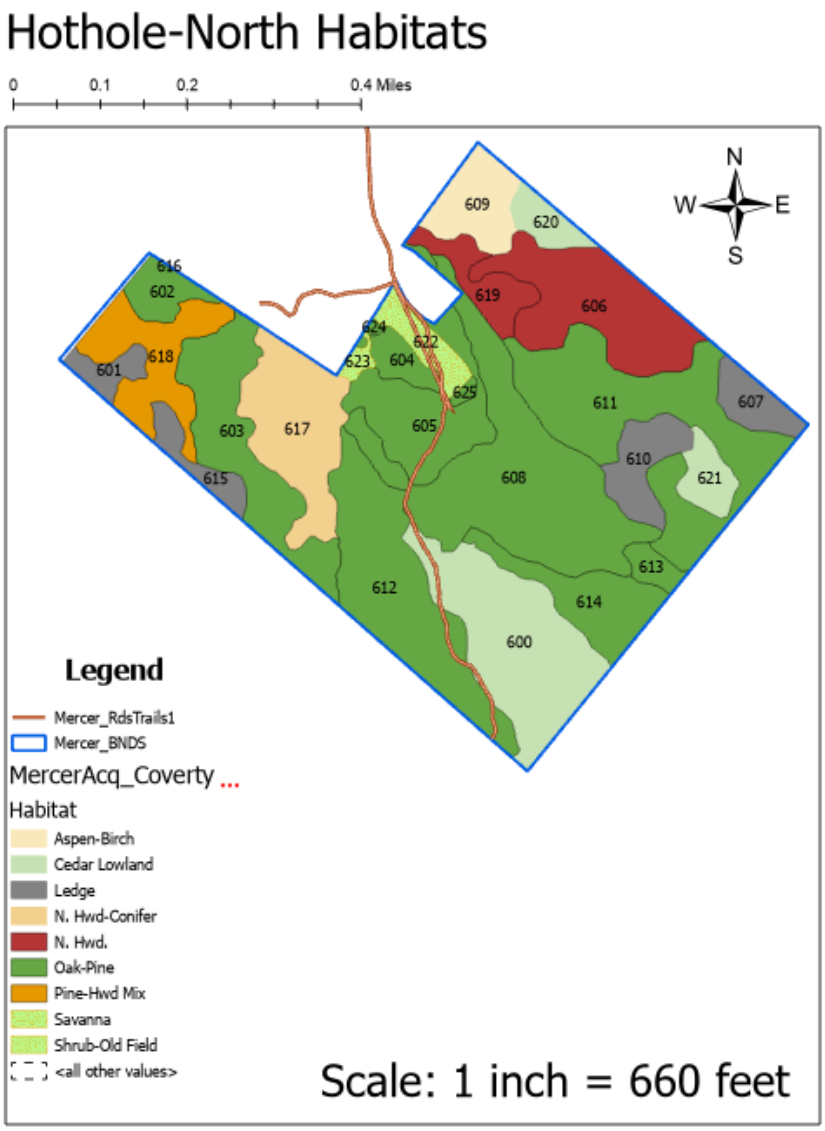
Shrub Swamp	*1*							*1*
Red Spruce						***1***		***1***
Mesic/Wet						*1*		*1*
Spruce-Fir HS Mix						***2***		***2***
Mesic						*2*		*2*
White Cedar							***3***	***3***
Wet							*3*	*3*
White Pine					***4***			***4***
Dry/Mesic					*4*			*4*
Grand Total	***3***	***1***	***6***	***5***	***8***	***3***	***3***	***29***

D7b: Existing Habitats

With its six distinct habitats, the property presents an opportunity to support a number of species. However, while there are many habitats available, the rather uniform development of these new forest stands does not provide the breadth of opportunity that a more diverse landscape might. By a more diverse collection of conditions, I mean a better mix of both horizontal (range of tree sizes) and vertical (more layers of canopy) diversity. The early successional habitats, once widespread, have largely transitioned to more mid or later habitat structures. "Patchiness" is a condition conducive to occupation by many species and provides a great deal of brushy "edge" preferred by some species, especially White-tailed deer, whippoorwill, and White-throated sparrow. Currently, the stand edges present are between those of the same broad forest type (Spruce-Fir, Aspen-Birch, Northern hardwoods, Lowland conifers, Pine-Hemlock, and Oak-Pine), but slightly different species composition and of similar development class and density. Not much patchiness exists, though there may be some damaged, large pole residual trees that offer perches for raptors, but not sufficient open space for successful hunting of prey species. The patches that currently exist are small and are the result of recent harvesting. So, while there is a large area of forested habitat, it is a bit too uniform to appeal to a wider variety of creatures. As the forest continues to develop naturally, with careful application of practices that encourage more structural complexity, it will pass through more advanced development (structural) classes like medium to large poles, small to medium sawtimber, medium to large sawtimber, etc. Patches of regeneration containing reserved larger trees are part of a plan to add some diversity without removing the "large tree forest" atmosphere of this property. As it does so, the

populations and variety of wildlife will change along with the forest, but the breadth of species will remain about the same or slightly less because more mature forests tend to be less diverse – both horizontally and vertically. Patches will be created by larger trees falling when they die and, in the process, creating small gaps. Especially in those stands too difficult to access, there will be losses due to windthrow, old age and deterioration. Of course, larger gaps or patches can be created by major catastrophic events like fire, windstorms, ice, etc. but these are generally infrequent. As some early successional conditions become available due to silvicultural practices, those species that prefer the early or mid-successional conditions will become more abundant. See below for a map showing the distribution of habitats on Hothole-North.

Figure 17: Distribution of Habitats Hothole-North



D7c: Habitat Breadth, Cover & Size Distribution

To be able to increase the breadth of species inhabiting the Dead River – West Block, some early successional conditions need to be created as well as gaps and patches in the developing forest stands. A portion of the forested acreage on this property should be focused on improving Horizontal diversity, mentioned above, which refers to the complexity of plant communities and habitats. Different forest cover type mixtures with a wider range of tree sizes present a greater potential that more wildlife species will be present. Vertical diversity, on the other hand, refers to the degree to which plant species are layered within a forest stand. Greater layering is achieved when tree species are mixed with different heights and crown characteristics and by trees of a wider range of ages is present. At present on the Hothole-North Block, most stands contain a single layer or at most, two layers. Having a higher degree of vertical diversity characteristically develops multiple vegetative layers consisting of overstories with rich (numbers) species composition and well-developed herbaceous, shrub understory and woody mid-story layers.

Increased diversity of habitats creates opportunities for more and different species to be present. Habitat Opportunity Classes (DeGraff et al, 2006) have been defined to present an idea of how breadth of habitat, size-class and forest cover type distribution may indicate habitat opportunity. There are four classes of landscapes with different wildlife opportunities:

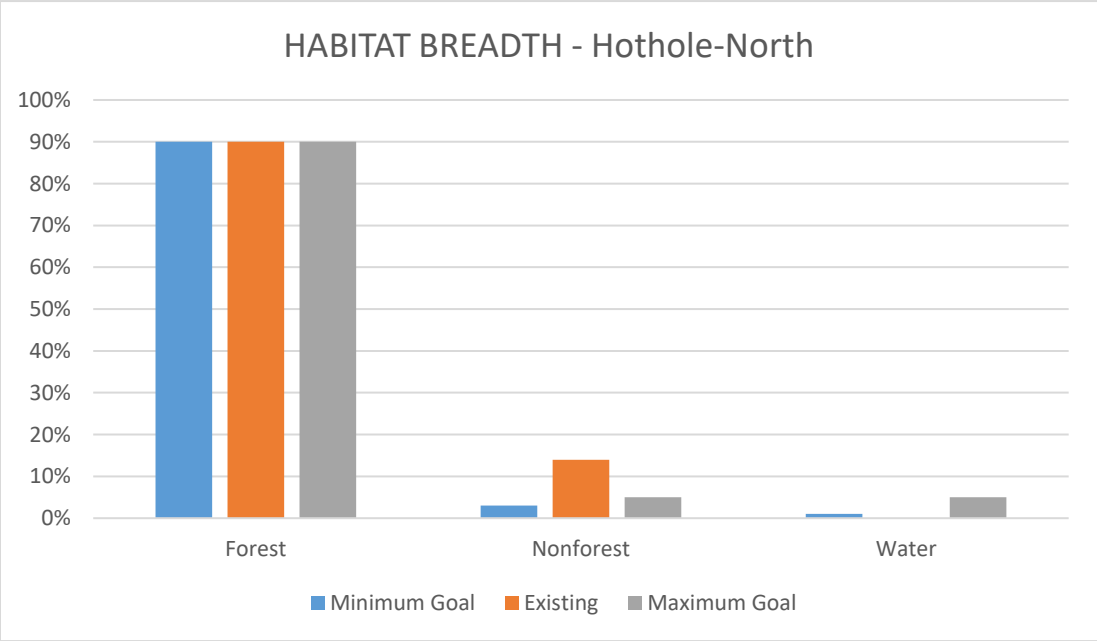
- *Habitat Opportunity Class I* – landscapes that are at least 90% forested. Water and wetland cover is less than 5%
- *Habitat Opportunity Class II* – landscapes that are at least 90% forested with more than 5% in water and wetland non-forest cover types.
- *Habitat Opportunity Class III* – landscapes with at least 70% forested with less than 5% in water and wetland non-forest cover types.
- *Habitat Opportunity Class IV* – landscapes that are at least 70% forested with more than 5% in water and wetland non-forest cover types.

The Hothole-North Block is 90% forested and has only one area of 18 acres that is quite wet. This stand number 600 represents only 10% of the forested area. Non-forest types (ledges and open fields) account for 14% of the total area. So, this block is in Habitat Opportunity Class I. Goals for this opportunity class in terms of cover type area are as follows:

- ✓ Non-Oak Deciduous Species: Short Rotation – 5-15%
  Long Rotation – 20-35%
- ✓ Hard Mast – Oak: 1-5%
- ✓ Coniferous: 35-50%
- ✓ Non-forest: Upland Openings – 3-5% Wetlands – 1-3%

When we compare the published minimum and maximum goal values for Habitat Breadth, Size-Class Distribution and Cover Type Distribution against the current existing conditions on the Hothole-North Block, we can see very quickly where we are related to where we'd like to be. The compilation of forest and nonforest area and water was made from an acreage summary of Maine Natural Communities according to Gawler and Cutko (2010) which were identified in the Natural Resources Inventory by Rees (2022). The Habitat Breadth is really very near the goal structure, perhaps a bit of non-forest area will reach the minimum amount over the next decade's work, if some of the open ledge area (which has some small trees scattered about) becomes mostly forested or completely bare.

Figure 18 - Habitat Breadth Existing vs. Goal

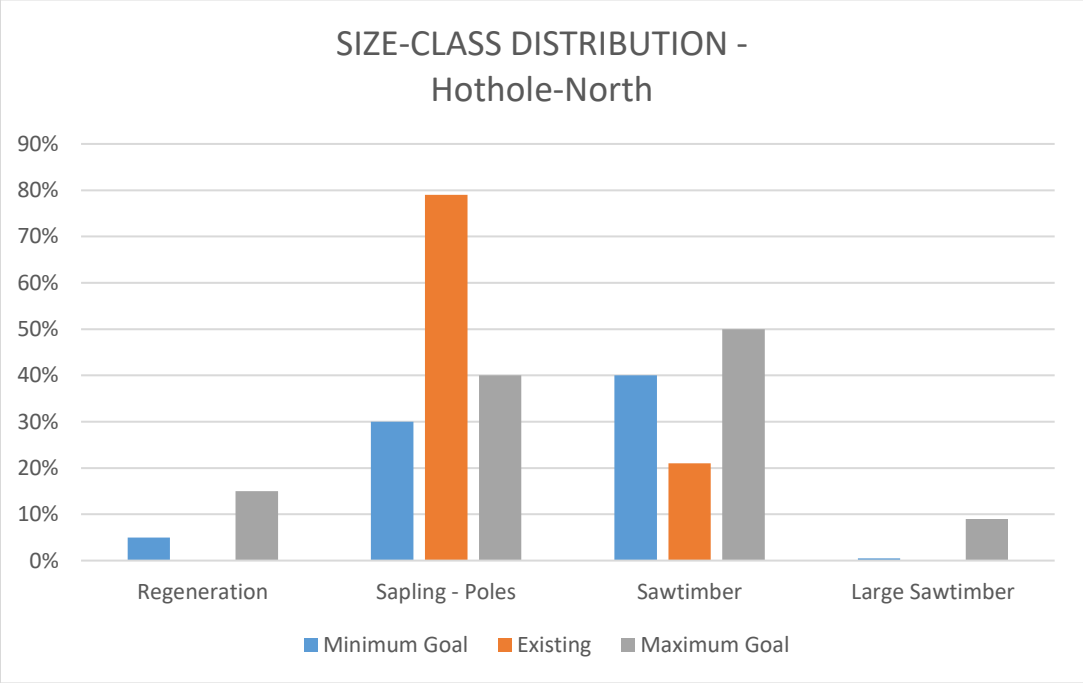


The distribution of sizes is really a surrogate for stages of development regardless of how long it takes a stand to move through each stage. While we actually keep track of 7 development stages, the list has been reduced to 4 for better understanding and consistency with wildlife management publications.

This brings up a subject for discussion as we see some difficulty in how our specific cover types are "rolled up" into other identifying categories. There's a lot that remains unsaid. This is especially true of the amount of non-forest wetlands because there are none on this property (with the exception of Stand 600, which is a forested wetland, but is truly forested). Adjacent to the southern boundary are a string of flooded beaver ponds on the big Hothole Block, so these count only when the entire property is classified. Since we know where they are, we can take them into account when managing wetland

species on Hothole-North. This is also true when we look at the distribution of tree sizes in the four categories below. This may suffice for biologists, but lumping saplings (non-merchantable) with both small to medium and medium to large poles can be misleading. The 7 classes that we use in managing are more specific and provide better information on forest horizontal structure. If age ranges were used in addition to size classes, one could see the differences immediately. However, to be consistent with published data, here are our results.

Figure 19 - Size Class Distribution: Existing vs. Goal

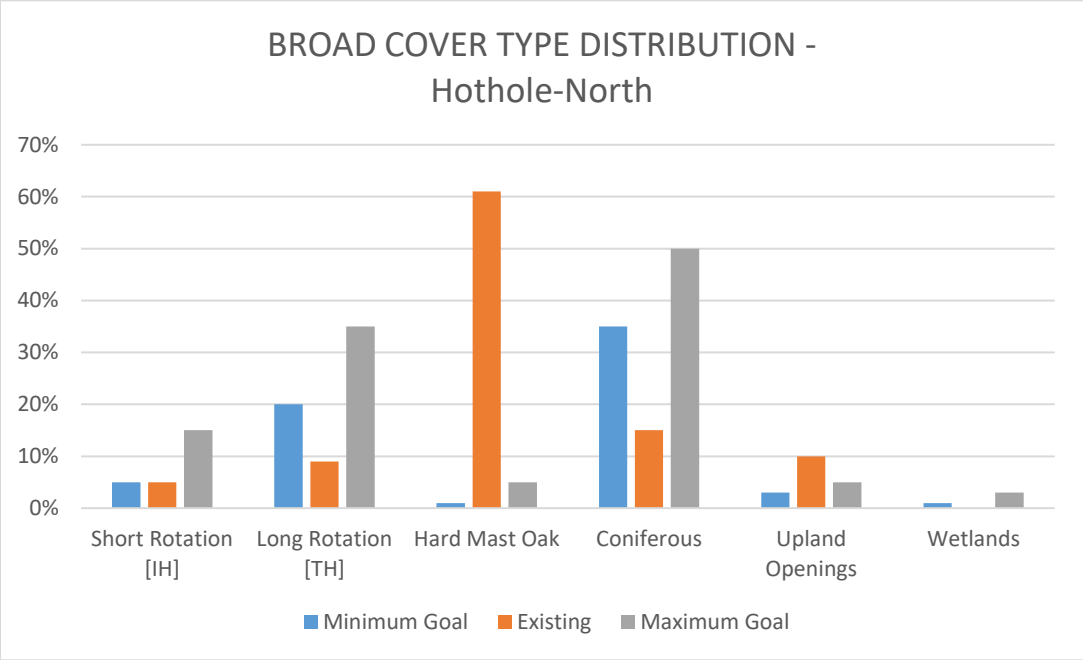


Here we can see very quickly how the Hothole-North's more mature, developing forest compares as a potentially better opportunity for diverse wildlife populations. While work will be undertaken to move the sapling and pole material into the sawtimber classes, the need to add back some area in regeneration or early succession cannot be forgotten. Doing so populates all development classes on the "conveyor belt" of forest dynamics. There is a shortage of more mature large sawtimber apart from scattered individuals present in stands that were last harvested in recent years past. Increasing the growth rate among the poles will help close the gap in sawtimber supply.

For New England cover type distribution in our area, the following chart shows in general cover type terms, how types in the Hothole-North Block are distributed. Notice that the cover types listed are rather limited in that no species mixtures are specified. In Nature, especially a heavily disturbed area like this property, many species become established in various mixtures and

some stands will develop with mixtures of both conifers, intolerant hardwoods like Aspen and Birch as well as tolerant hardwoods like Beech, Red and Sugar maple and Yellow birch. When looking at the chart, be aware that these types of mixtures are implicit in the chart and do exist!

Figure 20 - Broad Cover Type Distribution: Existing vs. Goal



The Hothole-North Block is composed largely of mixtures of Red oak with various tolerant hardwood species like Red maple, Yellow birch, and Beech that are tolerant of shade and would be found in the "*Long Rotation*" category. Another inconsistency with this approach at classification is that in stands dominated by larger Red oak, there are abundant other species of northern hardwoods. These tolerant hardwood species, normally in the *Long Rotation* category, when in combination with the more dominant Red oak are masked in the *Hard Mast* category, so there's really a bit more percentage of them that are Long Rotation. Parsing and lumping dissimilar species groups can create the impression that there is more oak and less northern hardwood, which isn't true.

Since those species that are intolerant of shade have rather short lives when compared to those species that are more tolerant and have longer lives, the time spent growing the shorter-lived intolerants is less. Stands containing them will need to be regenerated sooner, as they are near their biological limit of about 50 to 60 years. Their area could be increased as practical options present themselves. These intolerant species grow and develop very well in stands that are evenaged, where the trees are within about 10 or so years of each other in actual age. These intolerant Aspen and Birch occur in a general

mixed species category that isn't accounted for. We can manage to increase their occurrence a bit by making the residual trees in thinnings more spread out where Aspen and Birch are found. They occur as individuals and if they don't get sufficient light to keep them growing rapidly, they will gradually die out and disappear. Making portions of mixed species stands more open with patch cuts of perhaps 5 acres will keep these species in the mix. Doing so will create better and more varied habitat for Ruffed grouse, Woodcock and many other species. Creation of more area in upland openings could be made by holding newly created log landings in grasses and annual plants, or by creating additional new openings of a bit less than 5 acres where sufficient intolerant species are nearby to supply seed.

One item of interest is that when forest cover types are organized according to the classes in the graph above (Fig. 19), that particular classification doesn't allow for stands of mixed conifers and hardwoods. Such mixtures usually add another dimension to habitat suitability where increases in diversity and opportunities are available. This condition broadens the favorability for such mixed species stands for a greater number of species. For example, on the Hothole-North Block, there are 143 acres of these types of mixtures – fully 77% of the forested area! So the real breadth of cover types and concomitant better habitat suitability is greater than what is apparent from the three graphs above. I also believe that the seeming abundance of Red oak-dominated cover may be reduced a bit over time as silvicultural treatments restore a greater share of the forested area on this block to a better mix of hardwoods and coniferous species. The oak-dominated mixtures also contain significant amounts of Maple, Beech, White pine and even Red spruce! The changing of cover type designations is the result of time, and the changes it brings, so that the area apparently lost from mostly conifer cover is now more of a mix of hardwoods and conifers. As we take into account the type of growing site for each stand and plan to grow those species most suited to those sites.

Making changes to the landscape to better benefit wildlife is best accomplished by changing existing habitat. That can be most effectively done by designing silvicultural treatments that have wildlife diversity as a goal along with improvements to forest health and value. Adjustments made to improve forest composition include: increasing the proportion of hard and soft mast trees, retention of cavity trees, addition of coarse woody debris and can all be integrated into silvicultural regimes designed to address existing problems. A discussion of some of the treatments can be found in Section F4, page 127.

D7d: Habitat Spatial Diversity & Complexity

Understanding the kind and condition of existing habitats should rely on the collection of data, rather than casual observation. In addition to the usual categories of data for a forest inventory, data can also be collected to address habitat structural diversity in terms of the way trees are distributed, the species richness (numbers of species) and the complexity of the sizes found on each sample point. Also, key habitat variables for birds (from Audubon's Forestry for the Birds) may also be collected. Three variables can be used to gauge the following diversity variables: Aggregation (clumping of trees), Species Mingling (how well species are mixed), and Differentiation of Sizes (how complex the range of tree diameters are). The figure below shows how each of these variables are represented by trees on the ground. This type of data collection and analysis will be made as individual stands are sampled prior to designing the most appropriate treatment regime.

Figure 21: Forest Diversity Measures

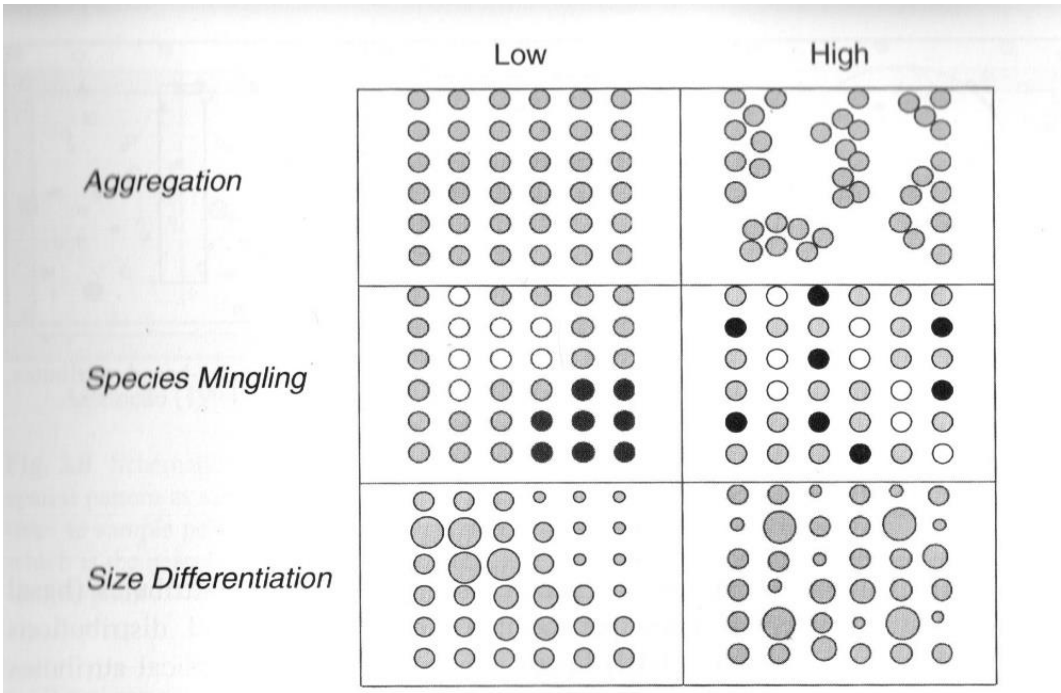


Fig. 2.10 Schematic representation of the three variables aggregation, species mingling and si differentiation which are used to describe forest structure and diversity

The first of these – Aggregation Diversity is an indicator of how uniformly the trees are spaced apart and ranges from uniform (as in a plantation) to tightly packed groups of trees. This is called "clumping."

The second kind of diversity is a part of species richness (the number of species present across the landscape) as well as how mixed together or separated into groups they are.

The third diversity variable is Size differentiation, which is a measure of how complex the mix of tree sizes are. It is based upon the statistical variable Coefficient of Variation where higher values mean more complexity in the mix of sizes.

Putting all three variables together is a different way that allows us to compare the average values for each of the three diversity variables with the objective values of our management efforts. In this triangular graph (Figure 25), each of the existing average variable values is shown by the blue triangle. Values for the same variables that we're trying to achieve over time are shown by the translucent gold triangle superimposed over the existing one.

From a wildlife standpoint, greater diversity values mean more opportunities for more creatures than would be possible with the current condition. These values are usually assessed during the measurement of individual stands scheduled for some type of treatment.

D7e: Forests for the Birds

During our sampling process, we can also make observations on conditions that affect our bird populations, most of which are transient depending on the season. So, what can we observe? Here's a list:

- ✓ *Type of forest habitat as in Section D7b above.*
- ✓ *Structure class (Development Class)*
- ✓ *Amount of cover in percent*
- ✓ *Size & number of canopy gaps in the Overstory, Midstory and Understory.*
- ✓ *Count of snags by size ranges.*
- ✓ *Amount of coarse, woody material on the ground.*
- ✓ *Amount of fine, woody material (brush piles).*
- ✓ *Thickness of hardwood leaf litter.*
- ✓ *The presence of invasive plants.*

As an example of habitat characteristics pertaining to birds, we'll use the data from the Dead River-West Block. There were 68 points of observation for the above characteristics and, overall, we found the following.

1. **The average size and numbers of gaps are small. This is a closed-canopy high forest.**
2. **There are very few snags of any size and where we did spot any, it was far away from our sample area.**

3. **The amount of coarse debris was between medium to high, but the number of pieces was low.**
4. **Fine woody debris (brush piles) were rather low, there's lots of trees of good sizes, but the forest is still young, even though it's mature.**
5. **The average depth of hardwood leaf litter was about 1 inch. There's not much piling up, which indicates that the decomposition rate is higher than one would expect. This may be due to the more calcareous nature of the bedrock in some places.**

These are general kinds of habitats which include many more discrete habitat types, but they are reflective as a broad level of guidance. There is plenty of forested acreage in the Hothole-North Block and perhaps we could have some additional non-forest land (early successional herbaceous) if some was created. One opportunity lies in the maintenance of old or new log yards as openings with annual plants or planted wildlife seed mixtures such as those offered for sale by the Sportsman's Alliance of Maine. This seed mix was designed by Gerry Lavigne, a very experienced wildlife biologist. This mix would make early-season green forage available to many species trying to recover from long winters. This mix would benefit several species from deer, turkeys, partridge, bear and other mammals and birds. Deer, however, represent a bit of a problem in wildlife management. Hancock County has a high population of deer and in Bucksport and Orland, it's commonly mentioned that the place is "overrun with deer." Household gardens are pillaged as are the herb layer in the understories of forested places. On this property it's no different than elsewhere and got the attention of Cathy Rees, a consulting ecologist, who mentioned the loss of herbaceous material in the understory of the forest on this property.

One solution is to offer hunting permits (the Hothole-North property and to post "Hunting By Owner Permission Only" signs regarding trespass, hunting and fishing.

D7f: Practices for Habitat Improvement

The solution to improving the kinds and distribution of wildlife involves adjusting habitats based on forest cover type, development stage and density. Changes can be made with silvicultural techniques that, while making compositional and structural changes to improve forest health and value, can also provide wildlife benefits. These benefits occur in the creation of gaps in the overhead canopy of various sizes and through the use of patches that foster a change in vegetation. The are more adequately described in Section F3, where recommendations are made for each of the major forest types present.

E. Forest Protection

In this section, protection of the Hothole-North Block forest against invasive pests, insects, disease, climate/weather, fire and trespass are considered and recommendations made. Beech Bark and Beech Leaf diseases are present as are various forms of internal decay on trees with injuries from natural or machinery causes.

E1: Forest Health & Vigor

Overall good health is the goal of almost every landowner, whether that goal is implicit or explicit. Given the current condition of the forest trees that suffer from many maladies, improvement in tree health and vigor allows stands of healthy trees to grow in both height and diameter more quickly as they pass through development stages, thus reaching the GPMCT long-term objectives sooner, rather than later. Improvements in both health and vigor not only make trees more stable and resistant to adverse conditions mentioned below, but also allow improvements in value to occur earlier.

E1a) Insects and Disease

The list of indigenous insects that inhabit Maine coastal forests is large, but most cause little long-term damage when endemic levels are normal. There are some, however, whose presence represents a threat to certain species. Damage caused by these insect pests can be substantial with not only the loss of tree vigor, decline in health, but also a loss in value as damaged trees may not improve in product development toward the highest and best use sought. Examples are the Hemlock Wooly Adelgid, Emerald Ash Borer, Anthracnose, Brown-tail Moth, Fall Webworm, White pine weevil, Forest Tent Caterpillar and the Asian Long-horned beetle. Of most importance in the disease category are: Beech Bark Disease, Beech Leaf Disease, Oak decline, Blister rust, and European Larch Canker. In addition, alterations to habitats from epidemic insect or disease outbreaks may result in undesirable conditions that directly affect wildlife populations. If we look at the insects that plague individual species, rather than listing just the insects, it should be more intuitive which ones to worry about. Oftentimes, inset damage is caused by stresses of advanced age, drought, or attacks by other insects or pathogens.

- ***Arborvitae (Northern white cedar):***

  Leaf miners – the tiny gray moths fly in abundance around the end of June near cedar trees. They lay their eggs on the edges of the leaf scales and when the larvae hatch, they are of a yellowish or gray color with a brown head. These very small worms bore into the tips of the leaves, which die and turn brown.

A second type of leaf miner causes similar damage with moths appearing in mid-June. Full-grown larvae are about ¼ inch long and have a black head and pinkish body. These mine into the cedar foliage and pupate in mined galleries, then appear as small, gray moths the following June.

- ***Ash (White and Black):***

The Emerald Ash Borer, is a bright green beetle that lays eggs which hatch into larvae that bore into the bark to get to the cambium (growth layer of cells). Another very damaging pest from Asia, they devour the cambium in a pattern, like other borers, that radiates out from the initial bore hole until the tree is girdled and killed. The exit holes are somewhat D-shaped. This insect has devastated ash trees in all states where it has been found and has been confirmed in both New Hampshire and Quebec. However, since our population of White and Black ash combined is less than 1% of the total number of trees, damage on the Trust lands may not be too severe.

- ***Beech:***

This species is most affected with a scale insect that entered the U.S. from the maritime provinces of Canada in the early part of the last century. The distribution of the scale insect has been from east to west and the "killing front" of the bark canker disease this insect spreads is now in Michigan and Wisconsin. The scale insect occurs in mass and appears as a cotton-like surface on the trunks and branches of Beech. During the summer, they feed on sap by piercing the outer bark. White, waxy threads coat the body of the insect. Adults are 1/32 inch in diameter, round, wingless and legless. Dense stands of Beech favor the insect as there is not much air movement to hinder their spread.

Lately (in the last few years) we have also seen Beech Leaf Disease affect Beech on all properties, although it seems more rampant on the southern side of the Hothole Block and even worse on the newly acquired Tower property near Route 1. The Hothole-North Block has the disease and it's affecting the understory trees more heavily. As Beech makes up 42% of the trees, but only 16% of the total basal area, the impact of the damage may not be too bad. The outcome of this disease is, as yet, unknown in terms of tree mortality. Just to be on the safe side, we have suspended the Hi-Stumping focus in stands dominated by Beech until we're sure that the overstory trees of this species will not die and open up the stands to more light. We're not ready to regenerate any stands at this time, until they are sufficiently cultured and improved to the point where they can respond to additional light quickly.

The Beech Bark Disease, known in northern Europe, is not usually virulent on European Beech and was not caused by an insect acting alone – like the Beech Scale. Once it arrived on the North American continent (1920 in Nova Scotia), things changed when the Beech scale insect spread the disease to epidemic proportions, causing high mortality over a wide area. As mentioned previously, the location of the "killing front" of the disease in now in the Lake States. In stands with a high proportion of Beech (>20% of the total basal area), the disease spread by the scale insect is rapid, first occurring on larger trees and in their absence, to smaller ones. At 24% of the total number of trees forest-wide, Beech in the Hothole Block will continue to suffer. There are some bright spots, though, as there are some trees who show no evidence of the disease. Those should be favored. Also, dense stands of steeper slopes, especially out of the wind seem to have higher levels of disease and thinning these stands to facilitate wind movement may help, since the scale insects are poor fliers.

- ***Birch:***

Generally found mostly on White or Gray birch, the Birch Casebearer first appeared in 1926 in Bar Harbor and spread to the east and north. The small, grayish-brown moths appear in early July and lay their yellow eggs on the underside of leaves. Larvae hatch, mine the leaves, then cut out a piece of the leaf to form a tubular case which is used for protection as they move about to feed on leaf tissue. As they mature, larger cases are formed. The larvae spend the winter in a case on twigs with feeding resumed in the spring. While unsightly, the damage is usually not severe.

Another insect on Birch species is the Birch Skeletonizer which appears in great numbers about every 11 years in episodic outbreaks. This is also a leaf-eating insect which mines the interior on the underside of the leaves. It then emerges, spins a flat web and continues to consume the leaf cells, causing them to turn brown and die.

The Birch Leaf Miner is another insect that damages leaves in the same way as the skeletonizer. This one, however, seems to begin at the center of the leaves and works its way to the outside margins. There are also a couple of leaf-mining sawflies, one of which affects Yellow and Gray birch as well as White birch. Both originated elsewhere.

Perhaps the insect that may have been most damaging in the past was the Bronze Birch Borer. This insect caused a great deal of damage to

both White and Yellow birch in stands throughout New England. The olive-colored beetles appear in June or early July as they feed on the foliage of several tree species in sunny locations. Eggs are laid in bark crevices or lichens on the bark. Young larvae penetrate the bark and create serpentine tunnels that girdle the trees. Healthy trees will actually drown the larvae by their rapid growth and translocation of sap. A severe outbreak occurred during 1939 to 1951 following several years of drought and defoliation of trees that were over-mature.

Overall, planning to remove diseased trees each time a stand is entered and taking special care not to damage the residual trees will help keep the impacts of diseases from becoming more of a factor than they currently are. Identifying the presence, type and levels of infection will remain a stand-level assessment task prior to treatment decisions.

Lastly, the Forest Tent Caterpillar plagues both White and Gray birch and Aspen (Bigtooth and Quaking) as well as other hardwoods in years of severe outbreak. Unlike the Eastern Tent Caterpillar that is found on fruit trees, alders, etc., the Forest Tent Caterpillar does not make a tent or web. Light, inch-long, buff-colored moths with two diagonal stripes on the fore wings lay eggs masses in brown, ring-like patterns and are held together with a grayish substance completely encircling twigs. Sometimes called "army worms" the caterpillars are blue-black, about 2 inches long with two yellowish bands on the sides of the body and cream-colored spots along the middle. During the late 1970's in Northern Maine, an outbreak occurred just as the effects of the Spruce Budworm were declining. A massive population of caterpillars spread far and wide devouring any and all birch or aspen leaves they encountered. I personally have seen masses of these insects moving along the ground as an army and in one place, completely covering the road for a quarter mile. In another instance, they were so thick along a Bangor & Aroostook railroad track that they stopped a train due to their slippery bodies on the rails. A bad character altogether.

- ***Elm and Oak:***

One of the chief insect pests of these species is the Gypsy Moth, a particularly damaging insect. While not always found in our area, the presence of Red oak is an attractant. Populations of epidemic proportions are a regular visitor to the Southern New England states and have been known to pay a visit to Western and Southern Maine. The

brown moths lay buff-colored clusters of about 400 eggs each. Caterpillars are brown, hairy and have a double row of six blue and four red spots. They also enjoy almost any species of pine and have been found on Norway, Blue and White spruce. Peak populations occur about every 7 or 8 years. While American elm is consumed eagerly, the species has been limited due to Dutch Elm disease and there are insufficient trees to support an outbreak. That is not to say that American elm has no other insect pests. The Dutch Elm Disease is spread by the Elm bark Beetle, which has two varieties, the native and the European (arrived in 1904 near Boston). These dark-brown beetles lay their eggs in the crotches of twigs and the larvae bore into the stem beginning their work of creating galleries that radiate out from a central corridor. Two or more generations occur each year, killing trees by eventually girdling along with the growth of the fungus throughout the vascular system of the tree that interrupts nutrient flow, causing the typical yellow leaf "flagging" leading to the eventual death of the tree.

Now we have another unwanted guest in our oak, the Brown-tail moth. This creature eats oak leaves, builds nests in the branches and showers irritable hairs that cause rashes, allergic reactions and all manner of ills. The are so widespread that complete control is impossible, but Tree Surgeons have found a new source of income removing nests.

Since some insects and diseases that attack oak may also impact Chestnut. We now have a substantial number of this species planted (600+) and are depending on their survival and vigorous growth to place them as a permanent addition in some northern hardwood stands with good soils. We don't want to lose any to insects or disease. We shall have to keep an eye on them as time progresses.

- ***Hemlock:***

The most notorious insect pest in current fashion is the Hemlock Wooly Adelgid, a serious pest responsible to basically eliminating Hemlock in the Middle Atlantic States and Southern New England. A small, waxy-colored insect covered with a wool-like substance (similar to the Beech scale) is located on the undersides of needles and twigs or in masses at the axils of twig and branch. As the infection gets worse, the twigs swell and look like gout. It has been found in southern, coastal Maine and has extended its reach into Lincoln County. While Hemlock only makes up 2% of the trees on the Hothole Block and 7% on the Dead River – West Block, it does occur more abundantly in conifer-dominated stands along with Balsam fir and Red spruce. Especially in almost pure stands of old Hemlock in the shoreland zone on both sides o the Dead River. It is these stands of more concentrated Hemlock that are

threatened most. Vigilance is the watchword here and if discovered, remedial harvesting methods are necessary to reduce the adverse impact of this pest. Repeated loss of foliage eventually results in crown dieback and death of the trees infected. Of particular note, is the presence in streamside zones of larger Hemlock left after past heavy harvests. Should these trees be attacked, the crowns will become thinner and the eventual death of these trees will cause an increase in water temperatures that may have serious consequences for fish, especially trout.

There are some silvicultural options that should make our conifer stands less susceptible to attack by this insect. If Hemlock represents greater than 20% of the total basal area in any given stand, it should be reduced to less than that amount. Doing so will make these stands more resistant to destruction. However, pests of other species in the stands need to be considered also.

If this insect wasn't enough, there are two others of note. The first is the Hemlock Borer which attacks Hemlock that are stressed and weakened. A small, dark bronze-colored beetle with yellow spots on its back, this insect appears in late May to lay its eggs in crevices in the bark. Larvae burrow in a fashion typical of wood borers into the cambium layer where it feeds. This insect is a favorite of woodpeckers. Avoiding stress on the shallow-rooted Hemlock by too much exposure or harvesting injury is very important. The second one is the Hemlock Looper, a ravenous defoliator of not only Hemlock, but also of spruce, pine and hardwoods! The moths that lay eggs are light brown to yellowish-gray with a double, wavy line across the wings. Eggs are usually laid on the lower foliage, trunk and twigs. The worms are pale green and marked with numerous black flecks and lines.

- ***Larch (Tamarack):***

The Larch Case-bearer is a defoliating insect that, at times, causes major damage in Maine. The ashy-gray moths lay orange-colored eggs on the needles in July. Young larvae tunnel into the needles until September when they cut off a portion of the needle to use as a cocoon. They then migrate to the twigs, branches and trunk of the tree to overwinter.

Another serious pest of larch is the Larch Sawfly that has caused billions of board feet of larch to be destroyed in the Northeast. Eggs are laid in June and July by a small jet-black fly about three-eighths of an inch

long with a red band around its body and portions of its legs. The eggs hatch in about a week and the larvae feed on foliage for 17 to 24 days. At that time, the black-headed, green worms form pupal cases in the ground beneath the trees.

- ***Maple:***

The key insect pest of Sugar maple is the Sugar Maple Borer. This black, yellow-marked beetle appears in July or August and lays its eggs in slits cut in the bark of the tree. The larvae tunnel beneath the bark and later into the wood itself causing loss of vigor and degradation of the wood in terms of its usefulness. Trees damaged by logging operations are particularly susceptible.

There is also a defoliator of not only all maples (Red and Sugar), but aspen and Beech as well. This one is the Bruce Spanworm, a looper that caused significant damage to 330,000 acres in Northern Maine during 1982 and 1983. The light-brown moths emerge in late October or early November to lay pale-green eggs in bark crevices. The green caterpillars emerge in the spring and head directly to unfolding leaves, where they begin feeding on the undersides, leaving only the veins remaining. The other major defoliating loopers are the Spring and Fall Cankerworms, which, as their names suggest, occur at different times of the year. The looper caterpillars of these species can be either green, tannish or dark, making identification difficult.

- ***Pine:***

White pine is bothered principally by the White Pine Weevil, which attacks and kills terminal shoots, especially if trees are fully out in the open. The thick leaders attract these common small brown insects are egg-laying sites for the weevils that overwinter in the duff layers beneath trees. The hatching grubs then burrow into the last 2 to 3 years of leader growth, killing the tops and creating forked stems that in the open appear to look like cabbages. This weevil also attacks the leaders of Norway and sometimes White spruce. Another weevil that causes damage not only to the terminal leaders, but branch tips as well is the Pales Weevil and its damage occurs on most coniferous seedlings.

Red pine is pestered by three sawflies that strip the foliage of trees in late spring and during the summer. Two species, the Red-Headed Pine Sawfly and the Red-Pine Sawfly, lay eggs in needles for overwintering. The Introduced Pine Sawfly larvae spend the winter in cocoons made in the soil.

White pine can also be infected with a rust called White pine Blister Rust. This disease uses species of currants as its alternate host. Once infected by the spores of this disease, rust-colored sores erupt in the bark and ooze resin. Gradually, this disease girdles the upright stem it's on and kills it and sometimes the whole tree. During the 1950's a great program to eliminate any currant species persisted for a number of years then diminished. Removal of any currant plants might help if they are detected, although they provide food for wildlife.

White pine is also bothered by an aphid called the Pine Leaf Chermid that spends part of its time on either Red or Black spruce. This insect causes galls to form as it feeds on the tips of spruce shoots. The migratory form of this insect then leaves the spruce gall in mid-June to fly to the needles of White pine where they pierce the tissue of shoots and feed. The shoot tips then droop, yellow and die. The second year, some aphids migrate back to the spruce to begin the process all over again. Two or three successive outbreaks may kill understory trees with thin foliage.

❁ ***Spruce and Fir:***

Finally, we come to the spruce/fir group which has a host of insect enemies. The most important two are first, the Spruce Budworm, which wreaks havoc every 17 to 20 or so years in epidemic proportions. There is an indigenous population of all insect pests, but the massive outbreaks that occur in the Canadian Maritime Provinces and Quebec send clouds of dull-gray moths on the prevailing wind to Maine augmenting the local populations. Each of the moths lays approximately 600 to 800 eggs on the underside of needles. These eggs hatch in about 5 days and the larvae pass the winter in small, silken cases tucked in crevices or at the base of needles. In spring, the larvae emerge and devour the needles closest to them to gain energy as they migrate to the newly opening buds and new growth. They continue to feed on foliage (new and older) and web needles in masses, then the foliage turns a dull red, making the trees (Balsam fir especially) look like they are killed by fire. The pupae are formed on the twigs after about 6 weeks. Though the preferred species is Balsam fir, Red and White spruce also support budworm populations. Black spruce is less so since its buds break much later in the spring months. During the previous epidemic outbreak from 1972 to 1981 or so, approximately 40 million cords of spruce and fir were killed. The budworm was found on not only Spruce and fir, but

also on Hemlock, White pine and Tamarack – overstory as well as understory trees. A very serious pest, of which to be aware.

When trees are stressed from defoliation (like that above) it attracts bark beetles and in the case of budworm damage, the Eastern Spruce Beetle moves in to complete the task of total destruction. A small brown to black beetle about ¼ inch long bores directly through the bark to the wood, where it bores along the grain and lays eggs along alternate sides of the tunnel. As the eggs hatch, the new larvae tunnel at right angles along the inner layer of bark and cambium. As the trees die, the foliage drops, often while still green and woodpeckers will flake off the bark in search of the grubs.

Other damaging insects of spruce and fir are: The Balsam Fir Sawfly, Balsam Gall Midge, Eastern Spruce Gall Aphid (the one that makes swollen galls on spruce), the European Spruce Sawfly, Pine Leaf Aphid, Spruce Webworm, the Yellow-Headed Spruce Sawfly and the Hemlock Looper. All these defoliators cause damage in varying amounts depending on the size of local populations. There is one more, though, the Balsam Wooly Adelgid.

Affecting Balsam fir, this insect is similar to both the Beech scale and Hemlock Wooly Adelgid in that the insect is small, hemispherical with a white, cottony covering. In winter, the tiny, black crawlers covered in white lodge in bark crevices or at the base of buds. In spring, they develop into adults covered in a cottony mass. Here, they pierce the thin bark of smaller twigs and buds to suck the juices and in so doing cause the stems to swell and become distorted. As the tree loses vigor, the stem becomes brittle and is more easily broken by strong winds, ice or heavy snow. While it appears to be a coastal phenomenon, there have been instances of insects in the interior of the state.

Reading this section, it may seem like all trees are under relentless attack by more insects than have been listed here, although these are the major ones that would impact trees on the Dead River Block. In reality, there are always insects in the forest, and they are part of the whole ecosystem. Generally, the damage they do is small and limited to periodic defoliation, borer injury and some deformity developing out of those injuries. At endemic levels, we must accept a certain amount of damage. Much of the cause of growing populations of damaging insects is due to advanced tree age, poor growing sites or space and corresponding loss of tree vigor as health declines. A good deal of

damage can be prevented by developing stands of healthy trees that have adequate growing space such that these trees may lead a longer life than would have been possible if left alone to grow naturally. It should be remembered that insects of all sorts are food for several varieties of wildlife species, especially birds. Insect outbreaks above endemic levels will benefit portions of the bird population that feed upon them, although the effect is a bit delayed as it is with all prey/predator relationships. While there is great production in Nature, there is also great waste, especially when conditions of age and decline make conditions ripe for an expansion of insects and diseases.

Of the diseases present in the forest, most consist of foliage or stem molds, bacterial or fungal diseases. The most important group for forest trees are the fungi. In general, a disease may cause one of three possible conditions: Necrosis or death of tissues and, ultimately of the tree itself, Atrophy - where the rate of normal development is slowed or Hypertrophy, a case where an excess of growth of all kinds is possible. This latter condition results from an increase in the number of cells resulting from an abnormal rate of cell division, like cancer.

Fungal spores causing foliage diseases are more common in our area because the coastal climate is much wetter, and moisture is a necessary ingredient for fungi to flourish. Perhaps the best-known disease is Chestnut Blight [*Endothia parasitica* (Murr.)] or Beech Bark Disease [*Nectria coccinea* var. *faginata* (Lohman, Watson & Ayers)]. Both of these diseases are necroses and cause cankers to form that eventually girdle the trees and kill them. While we hope that the Chestnut Blight never shows up in this northeasterly extreme of Chestnut's range, there is always a chance that it may. If it does not, our planted Chestnuts will gradually become a part of the northern hardwood stands in which they have been placed. As a very minor component of the hardwood cover types, it is hoped that they may persist to maturity and gradually form a more widespread component of the Hothole and Dead River – West Block's forest.

E1b) Weather

Heavy rain, snow, ice and wind, excessive sun exposure all contribute to tree damage in some form. The one thing that continuously may work in the favor of the forest is fog, as it provides additional moisture at all levels. Of course, that may mean more opportunity for fungal spores to grow and that could be good or bad, depending on circumstance. But how do we mitigate against weather? How can we protect the forest trees and stands from the damage that may be caused? Let's take these one at a time.

Rain, heavy at times, causes water to move along foliage, down branches and trunks to join that already on the ground directly. Trees soften the impact of rain on soil even if it's covered with leaves. Light rains of little duration have essentially no real effect other than watering the plants. Heavier rains, though, have the potential to overwhelm the soil's ability to absorb and hold moisture and then it begins to travel across the ground – downhill. If hills are steep and the rainfall is heavy the erosive forces of water multiply with speed and distance traveled. Deeply eroded skid trails from previous operations in all weather is ample evidence of the impact made by the movement of surface water. Fortunately on this property, the last harvest 15 or more years ago paid attention and avoided poor skid trail locations and working during heavy rain events. In soils that are a bit moist anyway, trees act as pumps that through transpiration, remove moisture from the soil. Removing too many of these pumps leaves higher levels of residual moisture that can lead to runoff during heavy rains. So, making light silvicultural treatments on a more regular interval can increase growth of root systems that hold soil better. Another protection measure is the layout of forest access trails that move diagonally across slopes, rather than straight up and down. This design cuts off water movement at numerous places all the way down the slope and does a good job of reducing or eliminating erosion in the first place. Keeping forest machinery out of watercourses is another protection measure that pays big dividends. In short, following Best Management Practices (BMP's) reduces or prevents damage.

Heavy rain can also lead to flooding in poorly drained soils at lower elevations. Not operating in such areas until conditions improve helps protect forest resources.

Snow and ice, especially when heavy can and does break branches, tip over trees, and generally raise havoc with the forest. Very dense stands of trees usually are overly slender, developing very small crowns and root systems. As such, they are more prone to tipping and breakage than trees grown in a bit more open setting with larger, healthy crowns and root systems. Another way to protect against ice and heavy snow damage can be found in keeping trees is rather close association – nearer one another. If silvicultural treatments to grow healthier trees open stands too much and trees are spaced too far apart, they can't provide mutual support to one another. This is true for all species. During clearing weather there are usually windy conditions. If trees are spaced too far apart, especially as small to medium poles, the wind can cause excessive bending and result in breakage. In addition, heavy swaying can cause the tops of trees to whip into neighboring ones, damaging the finer branches. That may lead to infection from disease-bearing spores. Hail damage will cause that also. Stands of mixed conifers and hardwoods are

easiest to protect since their different growth habits occupies more "between-tree" space. Conifers have somewhat triangular crowns that can fill in gaps between the hardwoods that have more upwardly conical or spherical crowns. A good mix makes good sense where applicable.

Wind makes trees bend and sway. Gentle wind = gentle sway and that's good. However, in high wind events, excess swaying can lead to breakage or windthrow as mentioned above. Silvicultural treatments should include practices that protect stands from strong winds by leaving a heavier buffer along edges exposed in the direction of prevailing winds-along the Dead River corridor or in open valleys between ridges and hills that run northwest to southeast or northeast to southwest, for example. In our area we often get storm winds off the ocean and those living on coastal islands experience large blowdown events on a regular basis. Where stands are on slopes exposed to prevailing wind directions, treatment should initially be light and in strips beginning at the rear if regeneration is desired. Trees growing in a dense crowd of other trees grow tall and taper little since these trees hold each other up – especially in thin, rocky soils. Research has found that if the ratio of total height to diameter (in units of feet) is 80 or greater, the tree has a good chance of breaking or being blown over. So, one way to minimize damage in windy areas is to make the trees have a heavier taper. More taper on shorter trees (as they grow) makes for a sturdier plant. Regenerating stands from the rear in strips working towards the wind will eventually create a wedge of crowns that lift the wind at the leading edge and send it over increasingly taller trees toward the rear of the stand, minimizing damage.

Most people don't think of sunshine as a bad thing, but in some cases, it can cause excess mortality in trees suddenly exposed to full sunlight when they have spent a goodly portion of their lives in shade. Trees on edges suddenly exposed on the southerly and southwesterly directions will have their surface temperatures raised to levels that can kill the cambium. This effect is all too common in clearcuts that face southward. The same type of edge buffer that reduces wind can also reduce the adverse effects of intense sunlight. Also, making the direction of forest access trails at an angle to the south or southwest can avoid exposure to both wind and excess sunlight. Another factor to take into account when designing a permanent skid trail layout.

E1c) Invasive Species

Species of plants deemed invasive means that they readily occupy space that would be occupied by native vegetation and can rapidly expand and choke out natural plant communities. A good example is a knotweed (*Polygonium cuspidatum*), commonly called "bamboo." Once established, it is very difficult

to eliminate – the very essence of an invasive. Another is Asian bittersweet that climbs native trees and gets heavy enough to pull them over or break them. The list of invasive plants gets longer every day, and it is well to be able to recognize them and plan for their elimination. The current methods for removal is to physically remove them by digging up and burning, or by use of common herbicides like glyphosate, dicamba or trichlopyr in a ground application by spray bottle.

On the lands of the Great Pond Trust, there are some other invasive species that appear from time to time. Buckthorn, both Common (*Rhamnus cathartica*) and Glossy (*Frangula alnus*), Common reed (*Phragmites australis*) in wetland areas, Multiflora rose (*Rosa multiflora*), Autumn olive *(Elaeagnus umbellata*), Japanese barberry, Asian bittersweet (*Celastrus Orbicultatus*), Morrow's Honeysuckle (*Lonicera morrowii*), Tartarian honeysuckle (*Lonicera tatarica*), Purple loostrife (*Lythrum salicaria*), Japanese knotweed (*Fallopia japonica*) and a host of other non-woody plants – See the Maine Invasive Plants Field Guide (2019) by the Maine Agriculture, Conservation & Forestry Department for more species.

E1d) Invasive Species Policy

The current GPMCT policy for invasive plants is to monitor the Wildlands and eradicate any invasive, either by digging up and removing/burning or herbicides as a last resort.

E2: Fire

Wildfire events on the Hothole-North Block have been relatively non-existent in the recent past. There may have been some old fires on this tract, but evidence in the form of charcoal in the upper layers of soil is hard to find. Perhaps there was some previous damage as a result of blueberry field burning-a common practice until recently. Since the vegetation is in the relatively mature stages of development, there is a great deal of fuel to support a fire. Even in the very dry summer of 2016, there were no fires on the property. That's not to say they couldn't happen. Increases in recreational use, dry seasons, lightning strikes, and forest debris from silvicultural treatments can all contribute to the ignition and spread of wildfire. Protecting against this agent of damage must involve the Orland and Bucksport Fire Departments and the Maine Forest Service, whose job it is to protect large, forested blocks beyond the capability of local fire departments. As the forest continues to mature and becomes more valuable, protection from wildfire will become more important, therefore, some planning now is better than leaving fire suppression to chance. It might be a good idea to contact the departments in the adjoining towns and see what it would take to assemble a mutual aid

agreement, much as they have currently for general firefighting within the towns. The Maine Forest Service could be of some help in this endeavor and given the size of the ownership, might coordinate what a proper response should be in the event of a small or larger fire. Much could be done over the next 10 years to improve equipment access with graded gravel roads and log yards that could be used to stage equipment for firefighting. Improvement of water pumping areas for trucks and refueling areas for helicopters with buckets should be considered. Staging some equipment in an equipment barn or another structure could also be considered. This equipment could consist of several backpack pumps, hand tools, pickup or trailer size collapsible water bladder, gasoline pump, 2-inch suction hose with strainer and perhaps 200 feet of 1 or 1½ inch fire hose with connections that are compatible with both local and Maine Forest Service connections. The amount of equipment available should meet the needs of the number of volunteers that could be assembled quickly and the value of the resource that is to be protected.

As the forest continues to mature and treated areas develop into more mature, valuable trees, the need for fire protection becomes acute and a fire plan should be developed. The most dangerous times for fire are from April to June and again from October to December, when material is exposed, dry and green vegetation to impede fire spread is unavailable. Dead River, Alamoosook Lake, Craig Pond, Hothole Pond, Heart Pond and Rocky Pond could all be considered water sources for firefighting.

E3: Climate Change – Considerations for Mitigation and Adaptation

Over the years we have seen both wet and dry weather in all seasons and each time the climate has an impact on forest vegetation communities. It is felt by many that a warming trend is underway and speculate that winters will be wetter and summers drier than has usually been the case. Changes occurring to the vegetation within the Trust ownership will be a slow process but could have major long-term impacts on the essential character of the resource.

The most general effects wrought by a warming climate tend to push temperatures higher by one or two degrees per decade (at last prediction). With temperature increases a concomitant effect is an increase in solar radiation, unless weather patterns shift towards more frequent storms, where cloudy weather would prevail. Increased temperatures may increase the growing season somewhat and may increase the rate of growth through transpiration, provided that sufficient moisture in the soil is present. Precipitation shifts in winter from snow to ice and freezing rain might increase and along with it, there is a greater chance of damage to tops and branches of species present on the Hothole-North Block. With the Atlantic Ocean's influence in our coastal

area, changing seasons may bring more fog-laden days that would increase precipitation to benefit the tree species present. Changes to wind direction, frequency and duration could have a drying effect during rain-free periods, or a wetting effect if rain occurs.

Orland and Bucksport receive more precipitation (49.94 inches annually) than the rest of Maine by about 3.44 inches and 28% more than the national average over the last 30 years. This is due to the coastal effect and provides more moisture through rain, snowmelt, and fog as an additional resource to support tree growth. Additional available moisture is a good thing unless increased drying negates its positive effect. However, since this area receives more moisture, there may be some ability to buffer the drying effect of increasing temperatures longer than other parts of the state.

From a species basis, some of the more southerly species may move northerly with temperature increases and longer growing seasons. Our mix of species contains many whose best development occurs further north, and these may decrease and withdraw northward with increasing temperature and dryness. Depending on the magnitude of changes during the next 70 to 100 years, we may not see as many White birch, Red spruce, Balsam fir, Black spruce, Northern White cedar or Mountain maple if the change turns out to be mild. If the change is more severe, we can add Tamarack, Balsam poplar, Quaking aspen, Striped maple and Yellow birch to the list as these species retreat to the northward.

Again, if the change results in mild warming, we may see more of the following species: Red pine; American elm (unless Dutch Elm Disease kills them); Black cherry; Black locust; Black willow; Silver maple; White ash, Beaked hazelnut and Witch hazel. If great warming occurs, we can add to the list above: Jack pine; Basswood; Red oak, Burr oak, Slippery elm; Sweet birch and White oak to the list of newcomers. Additionally, there are some species who could move north as new habitat is available. These are Butternut, Shagbark hickory, Scarlet oak, Sassafras, Swamp white oak, Sycamore and Yellow poplar. Those species that can weather a severe change in climate are Pitch pine, Scotch pine, Alder and Red maple (our most ubiquitous species). If the change is mild, then we'll still see most of our familiar species except those mentioned in the previous paragraph. Chestnut should be fine.

In the end, trees are adaptable, and we must be also. There are three areas where we can plan for changes and specific tactics we can employ as part of our ongoing forest management to build our future forest, keeping the GPMCT goals in mind. The first area of focus is ***Resistance*** to adverse changes. Two strategies to combat negative changes to the landscape are:

- **Continue to prevent the introduction of invasive species** and remove those found. We're already doing this, though we probably could put more effort into keeping an eye out for invasive species.
- **Protect sensitive or at-risk species and communities**. Through the Resource Inventory of Natural Communities and recommendations of Cathy Rees (2022), we can safeguard these areas by making the most sensitive ones a refugia for the species of plants that are found. Along those same lines, I would recommend that we set aside several Strategic Reserves of existing forest types to assess possible change on unmanaged stands. Perhaps a total of 10% of the Wildlands forested acres, proportionally allocated among the natural communities identified by Cathy Rees. Where this might be done is suggested in Section F3, Page 108 under Management Recommendations.

The second area of focus is ***Resilience*** to adverse changes. Some of the recommendations to apply tactically and help increase resilience to climatic change could be:

- **Promote diverse age classes**. Having multiple age classes present in each stand as well as across the forest is the best way to mitigate against damaging changes from climate shift.
- **Maintain/restore diversity of native tree species**. This happens to be one of our primary forest management objectives using specific silvicultural regimes to accomplish the task. Some enrichment planting of species no longer seen might be in order as opportunity and budget allows.
- **Retain biological legacies**. There's not too many legacy stands or trees from the original forest left after cutting over the decades, but as we locate untreated areas or even large, old remnant individuals, we can and should easily retain them. Any unharvested stands where the trees are quite old could be part of the Strategic Reserve area mentioned above.
- **Maintain/Restore soil quality and nutrient cycling**. Also part of the forest management direction, this tactical response should consist of making small openings through light thinning to assure regeneration when necessary and to allow additional sunlight to penetrate portions of each stand's canopy. Such sunlight will accelerate decomposition of fine and coarse woody debris which will improve nutrient composition, water absorption and retention, while speeding up nutrient cycling. The result will be better growth of better trees.

Third, and last of the three focus items is ***Transition***. How we go about making a climatically induced shift from present forest community structures

to those better suited for future stability. This task can be easily incorporated into our recommendations for forest management. Matching the right species with the right growing conditions and sites will ensure that treated stands will be adjusted towards future stability of both species' composition and structure. Specific strategies and silvicultural regimes for adapting to climate changes can be found in Section F6, page 129. Two key tactics for adaptive management are:

- **Favor those native species that are expected to be better adapted to future conditions.**
- **Emphasize drought and heat-tolerant species and populations.**

One item that cannot be forgotten, regardless of the cause of changes in a forest, is long-term monitoring. Planning for the implementation of a monitoring system can be as simple or as complex as financial resources are able to bear and the owners are willing to spend. Either of these factors (design and installation) can be a long-term burden and are often abandoned after a few cycles of measurement. However, one way of supporting a monitoring effort is to make our stand-level sampling do double duty as it serves another function. As new stands are treated, there will be a return sampling in 10 to 12 years as we see if another practice is necessary. Then, the same plot locations could be used for the second assessment of condition. Most of the data recommended by the U. S. National Climate Assessment Indicators System is already being collected on a coarse scale (county, region, etc.). At a finer scale, a periodic review of overall forest condition can be assessed using the color-infrared image data offered by the USDA National Aerial Imagery Project (NAIP) image data in digital form.

The 2023 inventory system produced a set of baseline data. A "Rolling Inventory" process (see Section F2, page 105) has been described to keep the inventory current by both replacing/adding new inventory plots as stands are treated and growing plots in untreated stands forward. In this way, the emphasis is where it should be – to see how the forest is responding to treatment and to track changes that may be occurring to the forest from other influences.

E4: Forest Security

Ensuring the security of the Hothole-North Block forest means knowing more about the GPMCT land base than anyone else and making sure that access to the Wildlands is controlled in some fashion. Having a secure forest means that any attempt at willful trespass and associated timber theft is eliminated. While the existing resource is valuable now, it will gradually

become more valuable, and it should be protected. Paying attention to renewing boundaries and corner monuments, keeping gates operational and secure and reducing or eliminating uncontrolled access points may pay huge dividends in the future. This would include access points through the forest by snowmobile/ATV where some trails exist.

The forest management strategy of improving the forest health and condition of growing stock will lead to a great deal of high-quality material. Part of this strategy is the continued extraction of forest resource material from adjacent lands and woodlots around our core area and beyond. The more we become a noticeable "treasure trove" of valuable timber commodities, the more we become the "only game in town" for large, high-quality sawtimber and veneer. Security of the forest means keeping this forest asset intact and useful to GPMCT.

Timber theft or property damage can be done by anyone who knows that the owner isn't paying any attention. They can cross from operations on an adjacent property and set up a logging operation if the Wildlands isn't watched with regular entries to inspect the property. Cultivating good relationships with adjoining property owners helps a great deal, too.

Buyers of timber can often make an absurdly low bid for existing timber and unless an owner knows how much volume and value there is, it's a real threat. Having good knowledge of volume by species and value is a real asset and the 2024 Forest Inventory and Valuation has provided great value. This can be kept up to date by adjusting for areas changed due to silvicultural treatments and adjusting map data for where those changes have taken place.

When a harvest activity has been approved, it needs to be inspected, and the volumes of removals needs to be accounted properly so that all removed timber matches with removal volume. Lots of value has been lost by not paying attention to the monitoring of harvest operations and trucking. Having trip ticket copies for every truck load to its final destination is essential. We are fortunate, indeed, to have a good contractor whose honesty is impeccable.

Another area of concern for uncontrolled access points is unlawful dumping of refuse of all kinds. It has been this major factor that led landowners in northern and western Maine to establish a system of locked or manned gates.

F. FOREST MANAGEMENT & ORGANIZATION

This section on forest management provides more detail on what has been done to organize the Hothole-North Forest area so that management activities can focus on the best opportunities for improvement. Work done prior to mapping and inventory work has been added to the mapping data.

This section is where recommendations at the general forest level are further refined toward the definition of specific silvicultural practices to be applied to a range of forest stand types. Since the timing of stand improvement activities needs to be accountable to a budget, a schedule of activities, where they should be applied and the timing of a sequence of treatments for those places is also provided.

Forest management efforts have long been directed towards the production of volumes in forms desired for pulp, paper, and fiberboard along with the traditional product mix from sawmill industries. Now, we see the number of outlets for low-quality wood fiber diminishing and the focus has once again returned to the historical demand for sawtimber, often thought to be the highest and best use for forest yields. That view is changing and now, in many instances, a broader picture of what a forest must be includes amenity values, wildlife, non-marketable plant species, scenic views, etc. Now the forest becomes something else altogether and it is expected to contain a lager basket of benefits to a wider audience. It doesn't make forest management more difficult – just wider focused and a bit different. There is a tension that now exists between "value" as seen by financial interests and "values" such as natural beauty, tranquility, ecosystem services, recreation and educational opportunity, etc. All these things bring more demands to the forest that must be addressed. Oh, yes, there's also the need to make sure that anything done to the forest results in it being "sustainable," depending on the definition of what must be sustained (see the State of the Forest -2014 report, Appendix B, page 150). Satisfying myriad demands calls for a pathway that first must succeed in maintaining the landscape in forest, as well as the following (underlined items are also explicit GPMCT goals):

- ✓ <u>Provide habitat for wildlife</u>
- ✓ <u>Offer recreational and educational opportunities</u>
- ✓ Be adaptable to any changes to climate
- ✓ <u>Produce clean air and water</u>
- ✓ Grow more useable wood than in an unmanaged condition
- ✓ Help create local jobs and cultivate new businesses
- ✓ Provide more wood for building
- ✓ Help reduce the dependence on foreign oil
- ✓ Grow as much as we use (be sustainable).

This is a tall order, but if all these things improve the quality of life and economic competitiveness for our local core area, then it's time to get started. The road will be long and fraught with pitfalls, but in the end the new forest will be better, more visually appealing, and more useful than any previous old ones that were here before the Pilgrims landed or since!

Any privately held enterprise, whether it be a large, family ownership, land trust, industrial, or conservation organization must deal with whatever existing markets are available to take material produced from forest improvement operations and hope to do a little better than "break-even." This is a difficult task when an untended reasonably mature forest is subjected to forest management efforts and a nearly impossible task if nearly all the merchantable material has been extracted prior to current ownership and the bulk of forested area is supporting young stands from 17 to 30 years old. In this latter case, the standing new forest can be the result of actions that may have had a deleterious effect spanning more than a single rotation of tree growth. Putting things to rights in such a forest is more a project of long-term rehabilitation than short-term improvement to an existing, manageable forest. Seeking a balance among the multiple functions of a forest is the purpose of a forest management plan.

F1: Forest Classification and Mapping

During the spring and summer of 2023, the core forest area of the Hothole-North ownership was aerially mapped. This mapping identified forest stands that were classified by a primary and secondary species, a development class (seedlings, saplings, poles and sawtimber) and a stand density based on the percent of crown closure across the area of each stand. There are 25 polygons mapped on the Hothole-North Block, some of which are non-forest types like wetlands, alders, ledge outcrops, clearings, etc. These non-forest types account for only 19 acres of the Hothole-North Block total acreage. The remaining forest cover types, though quite specific, are grouped into larger categories called strata for general summarization of both land area distribution and for inventory results (see G2, below). The resulting digital map data was organized into a Geographic Information System (GIS) as a series of explicitly related data tables so that area summation by other commonly used classifications was possible. Thus, the delineation of areas during the Rees Natural Resource Inventory project according to Natural Community types is now possible. In addition, linkages were made to the following classification systems:

- Landscape Position
- Forest vs. Non-forest
- NatureServe Ecological System

- Broad Cover Group
- Habitat Type
- Maine Natural Community
- Society of American Foresters Cover Type
- National Vegetation Class
- Inventory Stratum
- Mapped Stand Phototype
- Computed Stand Cover Type
- Soil-Site Productivity Class

Keeping this data current can be a daunting task, but it is made easier by the ability to change stand cover type assignments based on sample field data. This is usually the case when a stand of some type designation has been treated and an adjustment to the cover type becomes necessary. As the forest grows, changes may occur to species mix, development stage and density. These changes may be incorporated as updates to the GIS database as they occur or on a regular planned basis.

In addition to forest and non-forest cover types, additional mapping was done to identify roads, and water features present on the Hothole-North Block. Road features have been classified as to their use and condition and will soon add another database for culverts and bridges that will be related to specific road segments. Each culvert and bridge have been mapped and the size, condition and placement information has been recorded and will make road maintenance planning much easier. Mapped stream features have corrected, where necessary, those originally mapped by the U. S. Geological Survey.

F2: Forest Inventory – Hothole-North

In early 2024, an inventory of the entire forest was completed as an effort to fully describe the condition and quantitative characteristics of the resource. This inventory consisted of a sample design that first, organized the forest lands of GPMCT into strata that contained forest stands defined by their broad forest type (**IH** - Intolerant Hardwood; **TH** - Tolerant Hardwood; **PH** - Pine/Hemlock; **SF** – Spruce/Fir and **LC** – Lowland conifer). Further stratification consisted of organizing stands by a combination of development class (Seedling, Sapling, Poles, Sawtimber) and density of cover measured by a range of crown closure. The design also specified that 62 randomly located, variable-radius plots would be employed using Basal Area Factor - 15 glass

prisms to select trees to be measured. These plots were randomly distributed to all stands greater than 5 acres. Data compiled in the field captured forest characteristics as of the completed 2024 growing season before the start of the growth period for 2025. Some highlights that cover this new acquisition to the land base are:

- *Total GPT land area has increased 4.2%.*
- *GPT Forested area has increased by 4%*
- *14 tree species are found on the lands of Hothole-North. (33% of all trees listed in the Trees of Maine publication).*
- *6 natural communities are found on the lands.*
- *5 cover types described by the Society of American Foresters are present.*
- *3 vegetation types from the National Vegetation Classification are present.*
- *3 distinct terrestrial ecosystems recognized by NatureServe are present.*
- *Unmanaged (A-Line) growing stock levels are 99% of what they should ultimately be.*
- *Only 27% of the total growing stock basal area consists of healthy trees acceptable for continued growth and quality improvement.*
- *The value of standing inventory merchantable volume is $949/acre.*

From a forest management standpoint, the fact highlighted above represents a serious condition that needs attention. This evenaged forest (with rare exception, most stands are within 20 years of age) is generally well stocked, largely because it is quite mature, but the fact that the quality of the growing stock is low and if left untended, well produce a surfeit of material that isn't worth much at all. Data on the existing condition of the forest resource in the Hothole-North block (Section D4, page 52) underscores the need to begin rehabilitating this somewhat depleted forest.

The Hothole-North Block inventory consisted of 62 sample plots where data was collected for tree species, DBH, Product potential, Crown position, Defect percentage, and Merchantable product limiting height. All these sample points were variable-radius plots using a BAF 15 factor prism or angle gauge. This type of sampling selects trees to be measured in a way that the probability of selecting an individual tree is proportional to its size (basal area). This method of sampling is much more efficient than using fixed-radius plots where the tree selection is proportional to tree frequency, so the more trees there are in a plot of fixed radius, the longer it takes to collect the data. These sample points generated an average total basal area value of 131 square feet that varied ±8.47% at a probability level of 90%. Another way of saying this is that, with a similar sample, 9 times out of 10 the new estimate would not exceed 8.47% of the new average total basal area. This is a very good, reliable sample.

This conforms to the NRCS requirements for a total tract estimate of ±15% of total basal area at the 90% confidence level. Five small, forested stands were not sampled, but only represented 0.02% of the total forested area. Part of the process in treating any stand is to resample any candidate stand to obtain an estimate that conforms to the stand-level NRCS requirements (±30% on basal area at the 67% confidence level). For individual strata for which silvicultural recommendations were developed, the following standard errors on total basal area were obtained at a higher confidence level (90% CI) than the NRCS-specified 67% confidence interval (two times out of three):

- Hardwood Mix – Avg. basal area of 132 sq. ft. ±16.3%
- Mixed Hardwood/Conifer – Avg. basal area of 120 sq. ft. ±8.6%
- Lowland Conifers – Avg. basal area of 167 sq. ft. ±25.1%

Volumes for each tree measured in the inventory sampling were computed based on total height, diameter at breast-height (DBH) and current limits of merchantability in our area for commercial products within broader species groups. Computations were based on total height equations for this region (Greene, 2009) and tree taper functions developed for our species, regionally (Honer, 1968). These equations allow for computing inside bark diameter at any point along the stem, so that as merchantability specifications change over time, volumes may be adjusted to these new specifications. All volumes are computed in cubic feet and commonly accepted conversions are used to generate volumes in cords and green or dry tons. Board foot volumes are computed by determining log lengths that minimize non-merchantable residual segments and applying a direct application of the International ¼ log rule values to the computed top-end, inside-bark diameters of each log. Log volumes were summed for each tree and then further processed to generate inventory volumes on a per-acre basis for each stratum and for all strata combined.

Keeping a forest inventory up to date is a task that is usually completed at the same time as updating the GIS database. Inventory updates are also a part of the State of the Forest report, and these updates are accomplished by a "Rolling Inventory" process (Greene, 1999). For long-term forest management, the need for revised estimates of current standing inventory has been satisfied by either a periodic re-inventory, or by the remeasurement of a network of permanent sample plots. Estimates of the amount of area represented by each stratum typically have come from forest mapping efforts that may or may not have coincided with periodic inventories. In the latter case, the number of plots in each stratum has been taken to be representative of the actual distribution of stratum acreage.

F2a Rolling Inventory

The *Rolling Inventory* method relies on the use of successive sampling to validate the projection of an original inventory. Using GIS to keep track of changes in stratum acreage (numerically and spatially), and a growth model specific to the forest types involved, a small sample from stand-level plots can be used to validate the original projections by stand and focus on portions of the forest, if desired. Stands not treated have original sample plots that will be grown forward to a current period and added to as necessary. Generation of statistical data to evaluate the reliability of comparison between the projected sample and the smaller, *Rolling* sample is an essential component of such a system. The effects on overall sample error of multiple successive samples are reported in clear, concise form.

Use of this approach aids managers at all levels in focusing on methods to make stand and forest level decisions (and their effects) more understandable. For this method to work properly, sufficient data and information on growth and yield of various forest types must be obtained and formulated for use in the widely used model formulation known as the Forest Vegetation Simulator or FVS. Such a system of monitoring and updating can be applied to the GPMCT forest land base.

In a test of the effectiveness of the Rolling (annualized) Inventory approach over a 7-year period in North-central Pennsylvania on an ownership of approximately 65,000 acres, a comparison with an intensive re-inventory showed that the prediction of total volume from the Rolling Inventory was within 2.8% of the new inventory. For those species comprising 95% of the total volume, the difference between the Rolling Inventory and the new field inventory was 1.3%. Differences among species groups varied from 1.5% to 25%, depending on the species frequency of occurrence and overall variability in volume. Several medium and large companies are now using an annualized inventory process to keep costs down and to improve stratum estimates over time.

F3: Management Recommendations – Strategic and Tactical

It has been previously stated that the current GPMCT Hothole-North Block forest is mature, of mixed ages but in relatively fair condition. General forest management recommendations made in Section C3b, page 36, consist of several tasks that, if fully applied, should address each of the 5 ownership-level goals. These recommendations, taken as a whole, deal with the following:

- Rehabilitating the forest to improve forest health, stability, tree quality, ecological functionality and productive capacity.

- Establishing a balance among the multiple functions of the forest by improving diversity of species and structures while creating and maintaining a natural "High Forest" appearance.

- Providing for sustainability of forest and non-forest communities without adversely impacting other attributes of the landscape.

The best way to approach meeting all these and ownership goals is to rebuild the forest in a different manner than it would ordinarily develop without intervention. Developing a continuous high-forest cover seems to be an essential desired component for most of the forest. So, how should we go about doing this – changing a mature, even-aged poor-quality woodland to a majestic forest of healthy trees of all species, both large and small, with all sizes in between? The direction, or form of management that may be most suitable to apply has many descriptions:

- Continuous Cover Forestry
- Close to Nature Forestry
- Natural Disturbance Silviculture
- Near-Natural Forestry (Europe)
- Unevenaged Forestry (North America)
- Plenter System Forestry
- Irregular Forest Management

All these types have one thing in common – a continuous forest cover. The focus is on individual trees and groups of individual trees. Selection of trees to remove as well as to retain is made by evaluating risk of loss, overall health and vigor, crown development, rooting firmness, presence of defects, etc. In the past, most large, forested tracts owned privately tended to be managed for either a continuing supply of raw material or to generate a continuing source of revenue or return on investment (ROI). The easiest way to accomplish these management objectives was to grow forests in even-aged stands, where ages would vary across the landscape and provide a steady flow of either wood or income. Plantation forestry in the Southern Forest is a good example of this approach, where stands of a single species were planted and grown for a specific period, then completely harvested and replanted. This is a monoculture and often exposes the forest to devastating attacks by insect or disease pests. If one planted and grew a crop of trees for a given time period, say 35 years, then if one acre was to be cut each year, 35 acres – each a year apart, would be necessary to provide a sustainable yield. It's simple and sustainable if done properly.

In the Northern Forest, it's a bit more difficult in that the mix of species is greater and very prolific. Even-aged plantation management has difficulties which, while the costs of establishment are similar, produce different results. The result of planting allows other native trees to seed into the plantation, sometimes overwhelming the planted trees and slowing the growth on all of them. Removing sufficient extra trees (volunteers) costs money and if done a few times in the length of growing time planned (the rotation), may make planting trees cost prohibitive. That is not to say that managing stands in the Northern Forest should not be done in an even-aged manner. It does work nicely with native species that are intolerant of shade and have a shorter life span, but the regeneration process of harvest often creates large openings and a dramatic change in appearance. The ownership goals and conversations with GPMCT Board members and others have expressed a preference for more of a continuous forest cover approach, which brings us to something referred to as "unevenaged" management. In this method, stands always have trees standing. There are, however, periodic gaps in stands as measures for regeneration are applied. Even in natural, undisturbed unevenaged stands, openings are created where large trees fall and create spaces with more light.

Efforts to mimic this natural disturbance process consists of making smaller openings in the forest whose size is adjusted to the light requirements of the desired species to regenerate. Both the existing and newly regenerated growing stock have several simultaneous objectives:

- *Manage the present condition* before seeking an ideal composition and structure. The current growing stock is still developing in both size and volume but is also at the point at which the transition from evenaged to unevenaged, irregular structure can be made. This time it should cover about 40 years with some 5 to 6 light thinnings spaced from 10 to 15 years apart. *For this property, a goodly portion of the forest is in the correct stage of development to begin this process immediately.*
- *Protect and encourage younger stems of good quality* by maintaining older trees of moderate value. Using older trees of acceptable quality and vigor to help train the smaller, younger trees that will eventually replace them will provide for the earliest income of more valuable products and ensure a continuing supply.
- *Create a healthy forest*, resistant to diseases, insects, and extreme weather events.
- *Increase species diversity and adaptability* of stands to better respond to market demands and in a response to climate changes while enhancing wildlife opportunities.
- *Control costs* by making the best use of biological automation and available funding.

Growing stock treatments will vary, depending on the species mix that occurs in each stand. Silvicultural treatment regimens should recognize differences in composition that will change naturally or with treatments as stands develop. Present combinations of species are artifacts of past disturbances and assigning a correct SAF cover type is difficult and may have to be changed as these stands become more stable. How and where certain combinations will appear, and flourish will depend on monitoring the effects of silvicultural treatments as stands are guided towards conditions of species mixes that may be perpetuated more easily. In the meantime, it is easier not to apply hard and fast composition labels to what we see before us, but rather, to allow broad labels to define a range of species mixtures that, treated or untreated, develop into more sustainable groups. The grouping possibilities most useable come from preparations for the forest inventory stratification and consists of the following combinations in the figure below.

Figure 22 - Species Group Mixtures for Silvicultural Regimes

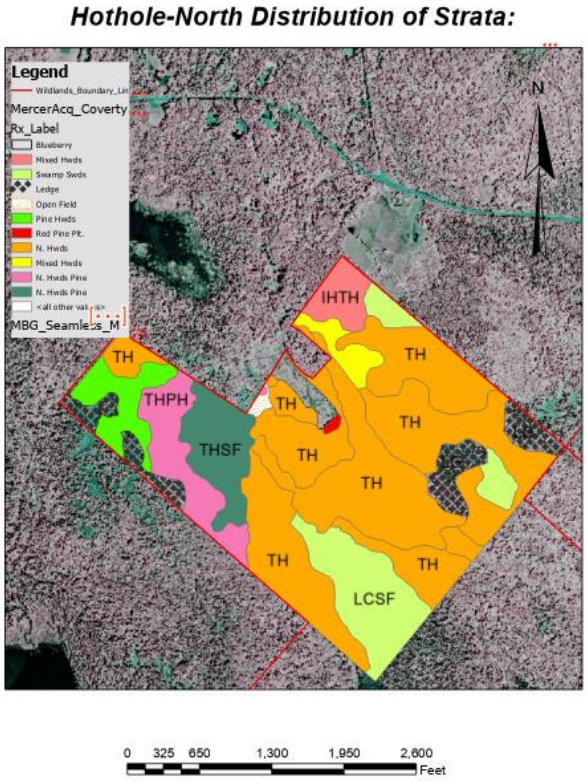
	Primary Spp Group				
Secondary Spp. Group	*Spruce-Fir*	*Pine-Hemlock*	*Lowland Conifer*	*Tolerant Hwd.*	*Intolerant Hwd.*
Spruce-Fir [SF]	**SF**	PHSF	LCSF	THSF	IHSF
Pine-Hemlock [PH]	SFPH	**PH**	LCPH	THPH	IHPH
Lowland Conifer [LC]	SFLC	PHLC	**LC**	THLC	IHLC
Tolerant Hwd. [TH]	SFTH	PHTH	LCTH	**TH**	IHTH
Intolerant Hwd. [IH]	SFIH	PHIH	LCIH	THIH	**IH**

The above strata used for the forest inventory can be reduced to six broad groups that can be useful in diagnosing existing conditions and developing an appropriate silvicultural prescription. Each of these strata shows a list of individual species that may be present as they are grouped by the degree of shade tolerance. Since tolerance to endure shading governs how trees of a given species adapt to shaded or open conditions, the various methods of prescriptive treatments rely of the type of response expected, depending, of course, on the location in a tree's crown position, length of live crown, rooting habit, etc.

F3a) Recommendations for Broad Forest Types

The map below (Figure 23) shows the distribution of the existing broad forest cover Strata listed in Figure 22 (above) for the Hothole-North Block.

Figure 23 - Broad Forest Cover Strata for Hothole-North



Recommendations for each broad forest type include targeted species-specific objectives to improve wildlife habitat and diversity. Treatments described below are intended to manage the density, vigor, and composition of sapling, poles and small sawtimber stands to promote food and cover for specific wildlife species or species guilds and/or to diversify habitat structure, species composition, and arrangement to increase wildlife species diversity as well as protect, improve, or restore forest health. Recommended thinning treatments are prepared according to a design and operation and maintenance plan in accordance with NRCS standards and specification Code 666 and others that may be available.

The list of wildlife species (birds, mammals, reptiles and amphibians) is long and with the exception of a few from each group, are found in various habitats throughout the forest. The key fact to remember is that a particular species of interest may be found in numerous habitats that might offer shelter, food or nesting opportunities. Thus, specific habitats created for a certain target species may or may not have as many as might be possible. The best approach is to have as much diversity in composition and structure as possible to attract greater numbers of any species that might find them desirable. Recommendations for managing wildlife populations are, therefore, broad and

apply also to broad definitions of what makes a habitat unique. Each stand within a broad forest type will have the same target species upon which to focus. However, stand conditions with a particular type often differ substantially, especially in the number of tree species present and mixtures of hardwoods and conifers. These conditions will be considered for initial and subsequent treatments while managing to sustain populations of the target species. These target species have been identified by several wildlife biologists as those representing additional species that are usually found with the species that are the focus of management. All this is documented well in a publication by Maine Audubon (***Focus Species Forestry*** – *A guide to Integrating Timber and Biodiversity Management in Maine, 2007*) along with the Small Woodlot Owners of Maine (SWOAM) and the Master Logger program of Maine. Practical technical recommendations supporting those found in the Audubon publication are taken from DeGraff et al (2006). The Trust intends to follow the recommendations for the listed Focus Species for each type. Here are the recommendations and target species by broad forest type. To help relate wildlife habitats to our broad forest strata, applicable habitats are shown in parentheses below.

Intolerant /Tolerant Hardwoods (Aspen-birch)

In cases where the majority of the stocking consists of **Intolerant Pioneer Hardwoods** like Aspen, White or Gray birch, Pin cherry and sometimes Black cherry or Red Oak combined with lesser amounts of other, more moderately tolerant hardwoods like Red maple, Striped or Mountain maple or other similar species, these stands should continue to be managed on an evenaged basis. Also, some stands possess conifer components like Spruce and Balsam fir, White pine or Hemlock in varying amounts, but insufficient to occupy more than 30% of the stand total basal area. 6% of this type (IHTH) contains a conifer component. The Aspen-Birch type occupies about 5% of the forested area and the goal of a more diversified distribution of forest cover types (DeGraff et al, 1992) directs us to keep approximately 5 to 15% of the area in this type group. Only Stand 525 is in this group with its 17.5 acres in the far southwest corner of the property. It may take a while to get there, but being somewhat driven by market availability, it might be sooner. We will be managing stands of this type in an even-aged fashion and regenerating stands (when it is time, at around age 50 or 60) will generally be by the small patch cut method where patches are 2-5 acres in size. In this manner, we will encourage White pine and maybe some Red oak along with a regeneration of intolerant hardwood with some tolerant hardwoods, too, depending on the proximity of a seed source.

Focus Species – *Early successional stages*

Snowshoe hare (where a conifer mix is found)

Ruffed grouse and Woodcock (in wetter areas)

Chestnut-sided warbler

More mature development stages

Northern goshawk

Ruffed grouse

As the Aspen-Birch broad type is a prime habitat for several wildlife species and in order to maintain sufficient area in this type (about 11 acres) efforts should be made to encourage a mix of various development stages within each stand. This can be accomplished by thinning in irregularly shaped strips or patches until such time as an effort to regenerate these stands is required. At that time, regeneration efforts will require more light for seeds of Aspen and Birch species to become established, so openings in the stand will need to be in a series of open patches of three or four acres in size, irregularly shaped to conform to the landscape. The schedule of regeneration patches should cover a period of 10 years between treatments. Larger stands will have a greater range of patch ages than smaller stands. Adjacent stand conditions, especially of the same broad type group should be considered for treatment at the same time or maintained to offer more cover and protection to the regenerated patches. Current characteristics of this stratum are shown in the following table. These tables show composition and structure attributes for all material 5 inches DBH or greater as they are recognized as the most dominant vertical component.

Table 4 - Characteristics of the Intolerant/Tolerant Hardwood Stratum

						Merchantable	Merchantable
BROAD STRATUM	***HABITAT***	**SPECIES**	**T/A**	**BA**	**QMD**	**Cu. Ft./Ac**	**Bd. Ft./Ac**
IHTH	Asp/Birch	RM	25	6	6.7	104	0
		HM	170	9	3.1	26	0
		BE	668	27	2.7	127	0
		QA	465	45	4.2	959	619
		PO	455	42	8	0	0
		RO	121	42	8	876	2769
	TOTALS/AVG:		1904	132	3.6	2092	3388

Other species in these Intolerant Pioneer Hardwood stands in lesser amounts (primarily northern hardwoods) may be an indication that the more realistic

management direction may be to encourage these other species (especially if there are abundant conifers present in an understory) towards dominance of the site. This will involve a species conversion over a period of time and in areas where the possibility of managing an evenaged stand of Aspen-birch species exists, it should be applied. Site quality will be the most important factor in the decision of whether or not to encourage a species conversion.

From a wildlife standpoint, the creation of irregularly shaped patches every 10 to 15 years will assure that early successional trees and brush offer cover, food and nesting habitat on a continuous basis as stands regenerate.

Tolerant Hardwoods (Northern Hardwoods)

This mix of predominant species that are shade tolerant. Typically in the Beech-Birch-Maple cover type the birch referred to is Yellow birch. Red maple also in part of the component along with Sugar maple. Red oak is also a major component of this stratum and for those stands where it is dominant, the habitat would be "Oak-Pine." The intolerant White ash is also found on the moister portions of this type, as can White or Gray birch but in minor amounts on the Hothole Block. Striped and Mountain maple, along with Eastern hop hornbeam occur in the understory, usually dominated by succeeding smaller Beech. Usually found on the more northerly-facing slopes, Characteristics of this stratum for trees 0.6 inches DBH or greater are shown below.

Table 5 - Characteristics of the Tolerant Hardwood Stratum

						Merchantable	Merchantable
BROAD STRATUM	***HABITAT***	**SPECIES**	**T/A**	**BA**	**QMD**	**Cu. Ft./Ac**	**Bd. Ft./Ac**
TH	N. Hwd.	RS	6	2	7.9	21	39
	Oak-Pine	BF	2	1	6.4	9	0
		HE	1	1	11.5	15	0
		WP	36	6	5.7	113	244
		CE	1	0	10.3	8	0
		WA	1	1	11.9	36	110
		RM	31	11	7.9	207	193
		HM	4	2	9.2	39	122
		WB	0	0	7.5	2	0
		GB	7	2	8.1	26	0
		BE	313	21	3.5	156	10
		QA	0	0	12.4	3	7
		PO	4	2	9.1	40	119
		RO	52	32	10.6	654	2130
	TOTALS/AVG:		458	81	5.7	1329	2974

Of particular interest is a species that is found rarely but can be very useful in selected habitats. This species is American basswood (sometimes called American linden), which may have been more widely distributed in a

predominant mixture with Sugar maple. Found on deep, moist sites, this species prefers lower slopes and there was some found, but not encountered on any inventory plots. If by some stroke of luck, as any Basswood trees are found, this species should be an encouraged associate of the Tolerant Hardwood types. Basswood is also an additional species that supports pollinator habitats. White ash should serve as an indicator of where Basswood could flourish. As limited species are found in greater abundance due to treatments designed to increase them (like Basswood), wildlife will benefit. In the case of Basswood, the flowers are very good sources of nectar for pollinators, as is Chestnut, once they begin flowering. One surprise has been that no Sugar maple were encountered in this stratum. With the slopes facing the north and mostly easterly direction, I would have expected to find Sugar maple in relative abundance but did not. There were some found, but mostly in the conifer-dominated stands on moister sites. What I suspect is that along with White pine and Red oak, Sugar maple was a target of opportunity as it's a good wood for just about anything and over the last couple hundred years has been extracted and used until it's almost gone.

Stands of predominantly long-lived tolerant hardwoods should be managed towards developing an irregular structured unevenaged condition. Currently, the present stands are all evenaged and should be lightly thinned at a 10-to-15-year interval to first adjust species composition and improve basal area growth by reducing poor-quality Beech, then by retaining better, more vigorous, Red maple, Beech, Yellow birch, White ash, Red oak and understory Hop hornbeam. For any sites that would be favorable for hardwoods, Sugar maple should be retained, regardless of their condition. In this way, they may contribute to the annual seed crop and gradually claw their way back to a condition of higher abundance. As the stands have reached an age of from 50 to 70 years, the transition to the unevenaged condition may begin by initiating a series of small, irregular openings no larger than perhaps 3/4 acre in size and limited to 10% of the stand's area at each entry at the same 10-to-15-year interval. As maximum basal area stocking of 100 sq. ft./acre or more, management as an irregular stand may begin by conducting light removals to afford more crown expansion room in all development classes from poles to large sawtimber. Small, regenerated patches should also be treated, but largely to make adjustments to species composition.

Where scattered conifer species like Red spruce, White pine and Hemlock are found in the stand, some of these better-quality trees should be carried to maturity in order to increase diversity and offer habitats that only tolerant hardwoods do not. A mix of scattered conifers offers nesting or roosting habitat for birds such as turkey, partridge and Neotropical songbirds.

Since these stands will have species that will last longest, rotation ages with associated maximum size should be in the neighborhood of 100 years to a maximum of perhaps 125 years. As stands of healthier trees mature, there should also be an increase of both hard and soft mast as healthier trees produce large seed crops on a more frequent basis. Numerous species of wildlife will benefit.

Focus Species –

Early successional stages

Snowshoe hare (where conifer understory is present)

Ruffed grouse

Chestnut-sided warbler

More mature development stages

Fisher

Pine marten

Northern goshawk

Pileated woodpecker

Barred owl

Wood thrush

Black-throated blue warbler

Redback salamander

Tolerant Hardwoods, Conifer Mix

This broad stratum is usually and eclectic mix of predominantly tolerant hardwoods and a loosely scattered association of Red spruce, Balsam fir, White pine, occasionally Cedar and often Hemlock.

Table 6: Characteristics of the Tolerant Hardwood/Mixed Conifer Broad Stratum

BROAD STRATUM	*HABITAT*	SPECIES	T/A	BA	QMD	Merchantable Cu. Ft./Ac	Merchantable Bd. Ft./Ac
TH/S	N. Hwd/Conifer	RS	134	30	6.4	523	881
		WP	47	27	10.3	647	1840
		RM	33	9	7.1	166	0
		HM	20	6	7.5	117	0
		GB	99	12	4.7	53	0
		RO	101	45	9.1	998	1467
	TOTALS/AVG:		434	129	7.4	2504	4188

Very often, this stratum is found on lower slopes where the site is moist. The stands are all dominated by hardwood species, but there is usually a non-uniform scattering (in pocket, patches or small groups) of conifer species. White pine and Red spruce and maybe a few Hemlocks are widely scattered, but in small portions of the stand can be rather uniform, especially in the understory. At only 7% of the total area (12 acres) this broad stratum is often found where past disturbance in predominantly conifer stands has reduced the conifer component and allowed the regeneration of both hardwood and residual conifers. From a wildlife habitat perspective, this type affords varied types of shelter and forage for a number of species.

This stratum and its habitats are quite productive unless the soils are shallow or with a hardpan layer less then 10 inches deep. The species present are capable of very long life, often exceeding 200 years for the more tolerant hardwoods or White pine. As they develop, these stands form a natural vertical stratification as the more tolerant species occupy lower crown positions while the Red oak and White pine soar upwards to a position of dominance. From a forest management point of view, intermediate to mature stands (Stand HHN 617, for example) can be managed by thinning in all crown classes as the stand ages. High-value species that are also long-lived can be carried to larger sizes, provided they are healthy and free from defects. Given the stocking level of this stratum in terms of numbers of trees, basal area and current structural development (medium to large poles), a light thinning in all crown classes would be most appropriate. This would likely be a free thinning, concentrating removals in Red maple and Gray birch of poor quality. The current spacing averages 10 feet between trees and could be increased to 12 feet for better growth. However, there is no hurry, this stand is in the zone of best growth potential and can grow for another decade before thinning is begun, if necessary. The number of stems (trees per acre) is now at 55% of the maximum for this stratum and can appreciate in value rapidly while its structure continues to differentiate by species. Red maple, Sugar maple and Gray birch

contain most of the undesirable growing stock, while Red oak contains 79% of its total basal area in defective trees. Initially, the first thinning might concentrate on just Red maple and Gray birch, while leaving the lesser numbers of Sugar maple to retain this species in the mix. A more detailed prescription will require more samples in this stand to be effective.

This habitat provides the utility of both the Northern Hardwood and Spruce-Fir habitats. Also, due to the amount of Red oak found on this property, the Oak-Pine habitat can also be included. Possible species that utilize this habitat are grouped by any particular stand's stage of development.

Focus Species-

Early Successional Stages

Chestnut-sided warbler

Snowshoe hare

Ruffed grouse

Magnolia warbler

More Mature Development Stages

American marten

Fisher

Northern goshawk

Pileated woodpecker

Barred owl

Wood thrush

Black-throated blue warbler

Redback salamander

White-tailed deer

Black-backed woodpecker

Pine-Hemlock (White pine, Hemlock, Red Oak)/along with IH, TH, LC and SF spp. groups

Stands dominated by White pine and Hemlock are very abundant, occupying 53% of the forested area as a primary component. In riparian areas, Hemlock is generally the major component, rather than White pine, which has always been a preferred species to remove. The White pine now usually occurs as a scattered overstory that developed from residual trees too small to harvest during the last major cutting by the previous owner. It is most abundant in the PHTH and THPH strata where it occupies 35% and 25% of total basal area, respectively. Where it is found, it is as larger trees (11 to 28 inches DBH) scattered among hardwoods of either tolerant or intolerant species or a minor stand component where spruce and fir are the more dominant conifers. Red oak is often a scattered residual. Characteristics of this stratum for trees greater than 0.6 inches DBH and larger are shown below.

Table 7: Characteristics of the Pine-Hardwood Broad Stratum

						Merchantable	Merchantable
BROAD STRATUM	***HABITAT***	**SPECIES**	**T/A**	**BA**	**QMD**	**Cu. Ft./Ac**	**Bd. Ft./Ac**
PHTH & THPH	Oak-Pine	RS	23	5	6.3	75	81
		BF	75	2	2	0	0
		WP	126	30	6.6	598	1463
		CE	3	2	9.8	28	0
		RM	68	10	5.2	147	0
		GB	5	2	8.2	29	0
		BE	84	12	5.1	108	0
		PO	21	12	10.1	197	0
		RO	133	46	8	820	1114
	TOTALS/AVG:		538	121	6.4	2002	2658

Where White pine is present, it should be encouraged to take a more prominent place in the stand, along with Red oak and any Sugar maple or Yellow birch that are discovered. This can be done by releasing subordinate trees with live–crown ratios of at least 40% and of good quality during early light thinning treatments while the stands are still evenaged. As the transition to the unevenaged, irregular structure begins and small patches of regeneration are created, the openings must be large enough to allow White pine to become established in greater numbers along with Hemlock and other species. This should begin with the first silvicultural operations on this property and a sustained effort until the amount of White pine increases to about 40% or more of the total basal area in these 4 strata. Keeping the newly regenerated patches dense, but with a moderate residual overstory will discourage weevil damage to pine leaders and allow the accelerated height growth characteristic of the species. Using other species (intolerant hardwoods) as a “nurse crop” will further protect the White pine from weevil

damage and produce healthy, straight stems rapidly. Using Hemlock along with any hardwoods present (tolerant or intolerant) to encourage self-pruning until the pine reaches 40 feet in total height with a 40% - 60% live-crown ratio could be the point at which a heavier thinning of other trees to adjust both species composition, diversity, spacing and individual tree quality might be made. Further thinning to increase growth rates in individual trees should be made based on the latest thinning guides for White pine and mixed species stands. Vertical dimensionality will increase rapidly at this point as pine becomes a "super-story" above the main crown canopy and the remainder of the species coexist between and beneath the White pine.

In terms of maximum age carried, White pine and Red oak can live well beyond the 100-year mark and some individuals could be carried to 150 years and very large size to occupy a semi-permanent place in the stand until they succumb to old age (400+ years). Hemlock present in the stand could be carried as long but in fewer numbers as its value has been historically low. This is largely due to the propensity of Hemlock to develop "ring shake) where growth rings separate due to environmental stresses throughout the life of the tree. If the delivered value improves, there could be more of it in the maturing stand. Once these trees increase beyond 80-100 years of age, their financial return through additional growth becomes lower, but since financial return is not an immediate priority, it can be ignored for the next 50 years. For some level of revenue to be generated from all managed stands, the limit on the largest diameters to be grown by species should be specified as it relates to the availability of equipment designed to handle and process larger diameter stock. The maximum DBH could vary from 14 to 16 inches for Quaking aspen, Balsam poplar and Black spruce to 25 or more inches for White pine, Hemlock, Sugar maple, Yellow birch and Red oak. Much depends on the growing site and how the trees are developing, along with tree vigor and risk of loss.

Some of the stands encountered during the inventory process are truly dominated with Hemlock where the trees are large pole to sawlog size with completely closed canopies. Vegetation in the dark understories we essentially non-existent. These stands should be treated to begin the regeneration process by creating some openings whose size will depend on the needs of the other coniferous species we hope to reestablish in greater numbers (White pine, Red spruce, White cedar and hardwood species to improve the mix, where present). The largest (and often, poorest quality) trees of Hemlock should be removed to begin the gap creation. Respacing the remaining Hemlock should be a priority that should remove approximately 30% of the total basal area in those species that should be reduced (Balsam fir, Gray birch, Red maple and Beech). Residual basal area should be held to between 100 and 120 square feet. Where valuable species other than Hemlock are present, they should be retained to

add growth and provide seed for gap openings. If Hemlock occupies less than 15%o the total basal area, residual stocking could be on the lower side of the range but it higher than 15%, greater stocking of residuals (up to 120 square feet could be used to protect shallow-rooted species like Red Spruce, while still providing sufficient opening for foster the establishment and development of more valuable species that need more sunlight.

Where White pine and Red oak make up the majority of the stocking, the requirements of the following Focus Species should be kept in mind when designing treatments.

The Red oak component of the above strata makes up between 9 to 13% of the total basal area in two strata – PHTH and PHSF. These mixtures occur on 41% of the forested land base and efforts to expand its representation should be made.

Focus Species –

Early successional stages

Ruffed grouse

Chestnut-sided warbler

Eastern towhee

More mature development stages

Fisher

Northern goshawk

Pileated woodpecker

Barred owl

Wood thrush

Pine warbler

Redback salamander

Where Hemlock is the more dominant component, these Focus Species should replace those previously mentioned above.

Focus Species –

Mature development stages

Pine marten

Fisher

White-tailed deer

Pileated woodpecker

Barred owl

Wood thrush

Redback salamander

Lowland Conifers (Spruce-Fir & Cedar with both Intolerant & Tolerant Hardwoods)

Stands in these two strata are usually found on poorly drained sites where growth is slow and stocking is high. Especially in riparian zones along both the Dead River and the many brooks that drain the landscape. Species like Northern white cedar, Tamarack, Red and Black spruce and some Balsam fir predominate. Hardwood associates like Red maple and the occasional Yellow birch along with alders, winterberry and other shrubs may be found. Summary of trees 0.6 inches DBH and larger are shown below for each stratum.

Table 8: Characteristics of the Lowland Conifer Stratum

BROAD STRATUM	*HABITAT*	SPECIES	T/A	BA	QMD	Merchantable Cu. Ft./Ac	Merchantable Bd. Ft./Ac
LCSF	White Cedar	RS	88	17	5.9	247	715
		BF	136	5	2.6	36	0
		HE	17	8	9.6	122	191
		WP	6	12	19.6	372	1970
		CE	174	73	8.7	990	1027
		RM	19	12	11	232	361
		GB	7	3	9	60	0
	TOTALS/AVG:		447	130	7.3	2059	4264

Having been almost depleted from past harvesting, Northern white cedar can be found as a scattered component and is 5th out of 19 species found on all forested acres based on total basal area. Remnants are found in riparian and wetter sites. As this species is critical to White-tailed deer for winter prosperity, the GPMCT is planning to increase its abundance wherever possible, but progress will be slow in making improvements. Depending on stand composition and the type of site, many of these currently low stocked

areas could become prime quality deer wintering yards if managed towards that end. Only stands that have regenerated to a preponderance of Red or Black spruce and Balsam fir with some Hemlock would suffice for an attempt at "rebuilding" an adequate deer wintering area. Managing these stands for forest products is a lesser priority due to the low productivity of the sites upon which they are found and are better off as maintained wildlife habitats. With sufficient stocking, these stands can withstand heavy snow and ice storms while providing good cover. Currently, though, their stocking has been reduced by past excesses and it will take time for them to increase to the point where they can be managed properly, even though the management will be limited and extensive, rather than intensive. Treatments that encourage an increase in both Northern white cedar and hardwood species palatable to White-tailed deer can be encouraged by larger patch cuttings where the abundance of browse will be greater than the current population of the deer to deplete it. Slash should be left in place to protect new seedlings (especially of Cedar) and browse species. Where hardwoods like Red maple dominate the stand, with few Cedars present, no treatments should be conducted.

Focus Species –

Early successional stages

Snowshoe hare

Magnolia warbler

More mature development stages

Pine marten

Fisher

White-tailed deer

Black-backed woodpecker

Redback salamander

Late-successional development

Gray horsehair lichen

Conifer stands composed of Red spruce, Balsam fir and Hemlock should be transitioned to the desired unevenaged, irregular structure with a sequence of light, low thinnings that should begin at age 30 to 35, or when the stand

reaches 4.5 inches and has a minimum total basal area of more than 85 sq. ft. Removals (focusing on both fir and hemlock) should not be greater than 25% of the total cubic foot volume. These thinnings should continue on a 10 to 15-year interval until a mean stand diameter of 7 inches is reached. At that time, the transition to the unevenaged, irregular structure can be initiated by making small openings no larger than ¼ acre by group selection methods. Like the hardwoods, the number of openings made in each entry period should not exceed 10% of the stand area.

Since these conifer species on poorer sites are subject to windthrow during extreme weather events, thinning treatment in all diameter classes should seek to develop trees with at least 40% live crown ratios and a height to DBH ratio of less than 80%. The object here is to avoid trees that are too slender to resist the forces of moderate winds (Kamimura et al, 2008; Wonn, 2001; Gardiner et al, 2008; Ruel, 1995; Canham et al, 2001). Also, those areas near the blueberry and old fields where the open area is wide and exposed should have a buffer zone on the windward side to protect any work that is done in the interior. This buffer zone should be a full 100 feet inside the exposed edge.

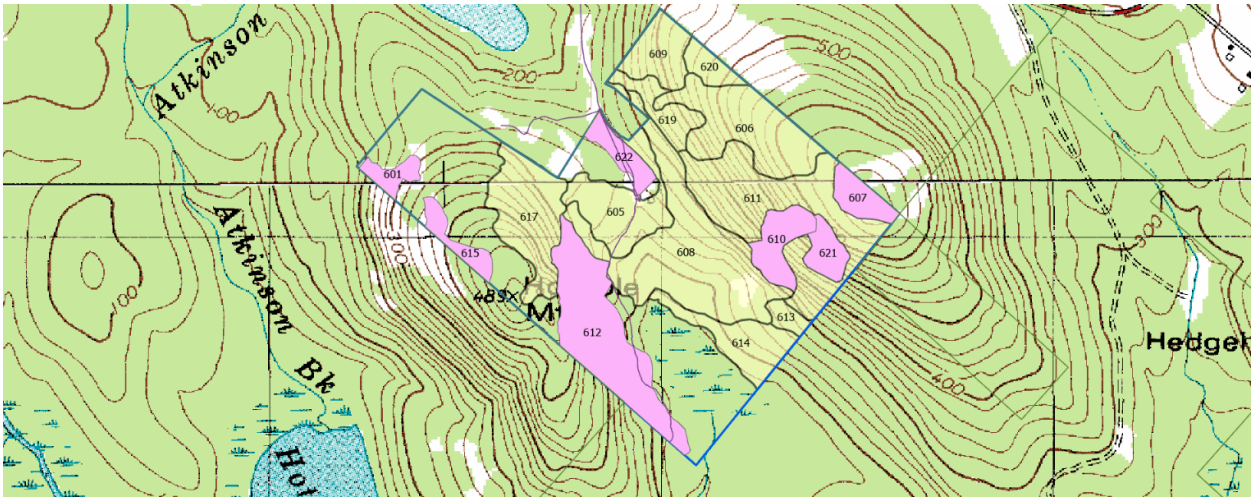
Areas on the Hothole-North Block have a good showing of White pine, Red spruce, and Cedar with some Hemlock, too. The hardwoods also present are dominated by Red oak, Beech and Red maple with minor amounts of Aspen and Birch. Due to the previous heavy cutting, the composition of these stands has changed and in time, many of these sites will produce the typical softwood sites mentioned above. For the time being, if we look at the Soil/Site Productivity map, the Fair to Poor sites should develop into primary softwood sites regardless of what is present now. The Good to Better sites, on the other hand, could become secondary softwood or mixed hardwood species sites, depending on a variety of factors which should be assessed as they become candidates for treatment. From a wildlife standpoint, stands of pure or mixed spruce-fir support high numbers of species during the regeneration phase and lower numbers as stands reach the dense pole stage. However, they regain the higher numbers (typically due to tree bole users) as stands reach maturity and old age. Pure spruce stands contain fewer species, so mixtures are better for wildlife. In any case, though, Red spruce and White pine should be favored for retention as a seed source to increase the numbers of these important species.

F3b) Operable Area for Forest Management

Where does managing the forest make sense? There are obviously places where trees grow poorly, slopes are too steep, too wet, near riparian zones or other places with unique characteristics that should not be disturbed. Areas

identified as non-forest Natural Communities, slopes at or exceeding 25%, bald summits, streamside zones of 100 feet on each side and areas of highly erodible soils, should be avoided. The result has been the identification of an area in which to concentrate forest management activities towards rehabilitating the Hothole-North Block forest. This operable portion is approximately 148 acres, or 80% of the total area. What this means is that sensitive areas, adverse slopes, and the other features mentioned above, do not materially impact the ability to practice rehabilitative forest management. Forest management operations should regard any features in areas to be treated that need to be avoided or receive special care due to their location or condition. Such examples would be the areas that are very poorly drained and wet most of the year. Those areas surround the large Stand 600 wetlands on the ownership. There is good reason to apply some light, individual tree selections for removal allowed within this stand, based on tree health and risk of toppling from excessive wind events. The use of heavy machinery within these areas will be limited. The figure below shows the extent of the manageable forest area (light yellow shading) for the next 5 years as well as those areas deemed inoperable due to steepness, boulder fields, etc. (shaded lilac).

Figure 24 – 5-Year Plan-Operable, Managed Forest Area – Hothole-North



F3c) Critical or Sensitive Areas

There are areas that have been identified by the Rees study (2024) that were felt to warrant special attention due to their sensitive nature, collection of unusual plants and infrequency within the forested landscape. A large portion of sensitive area occurred in steeper locations on hillsides where soils might be subject to erosion if disturbed greatly. Operating in the Hothole Mountain area of the Hothole-North Block and following Best Management Practices (BMP's) for forest operations, we suggest that orienting access trails (designed to be permanent) at a crossing angle of 60 degrees to the prevailing slopes offered

good protection to the soils that even a 9.5-inch rainfall failed to disturb. Placing forest debris in the trails during thinning operations helped cushion machinery and prevent rainfall directly contacting the soil surface. These practices should also be applied during silvicultural treatments. A report of located natural areas in need of protection from the Maine Natural Areas Program is attached in Appendix C, page 153.

Wetland areas along streams should be protected and the buffer zones recommended by Rees should be adequate at 250 feet for wetlands and 100 feet for streams on moderate slopes. Where small, unmapped streams are present on more steeply sloping mid to upper slopes, the water runs faster and poses an erosion threat if disturbed. These should be buffered according to the slope percent and if necessary, a 100-foot buffer should be placed around the entire portion of the upslope drainage basin.

There are also other areas where the use of forest machinery is either difficult, or impossible and while not mapped, these areas, usually with a high concentration of large boulders, will be avoided and left to develop on their own as they are encountered.

Areas of Inland Waterfowl and Wading Bird Habitat are present along the margins of Hothole Pond and another small pond to the northwest and not on this property. These areas should be respected and avoided as the soil is wet and the areas tend to be swampy. Patches of Smooth Sandwort (Minuartia glabra), an endangered Maine species can be found on the mid to upper easterly slope of Hothole Mountain and is listed in the Natural Resource Inventory by Rees (2024).

Other marshes, swamps and wetlands, including the presence of vernal pools should be avoided and protected where found adjacent to stands undergoing remedial treatments.

F4: Silvicultural Regime Development

The development of remedial silvicultural regimes specific to existing conditions as part of the management recommendations of each broad type group discussed above are continuing to be developed. An example is the “high stumping” to reduce diseased Beech and keep it from dominating hardwood stands found on all properties. Included with the regime descriptions, timings and intensities is a decision key to determine under what circumstances and objective stand criteria each regime should be applied. As these are developed, they will be incorporated into this management plan as a normal 10-year revision made when appropriate.

Some initial treatments that could be incorporated into complete regimes could be made during the beginning of the 2025 operating season. Conducted entirely on the Hothole-North Block, these initial treatments can be designed to install what should become permanent access trails and to make reductions to Beech within a 20-foot band on each side of an access trail. A variation has been designed to completely remove the Beech/Striped maple understory where it dominates the lower stratum of vegetation. In this treatment, the remaining overstory will remain for 10 years, at which time the second entry will seek to remove the worst of the pole-sized trees. The residual basal area is planned to be kept at between 75 and 90 square feet. At the present time, the practice of Beech understory reduction has been halted as we wait to see the cumulative effects of the Beech Leaf Disease (BLD).

It will take a good deal of time to make the final adjustments to each stand such that treatments will be consistent (in both methods and income flow) and familiar to all. This is called the ***adjustment period,*** and it applies to any situation where purposeful forest management is initiated in a relatively unmanaged forest. At present, we expect initial treatments to begin at current ages from 50 to 75 as stands are available as an initial step to begin the transition to unevenaged, irregular structures. This transition should take an additional 40 or so years to complete the structural adjustments and enter into a maintenance phase that will be consistent and lasting, at which time the job of rehabilitation of the Hothole-North Block forest will be nearly complete. As specific treatment methods are tried, combined and applied again, their value for a coordinated treatment approach will become clear in time to be of use to the other parts of the ownership. We suspect one regime for mixed composition stands will consist of the placement of regeneration openings by the irregular shelterwood method, coupled with a free thinning that seeks to lower unacceptable growing stock and make species adjustments. As growing stock values improve, tree marking will become a larger part of operations.

In the meantime, unless the treated stands are monitored for their progress towards the ultimate goal, the small adjustments to treatments or the need to make revisions will be unknown. Monitoring the process of change will help to validate the changes that are made and the way in which they are applied. A discussion of the planning necessary to monitor progress can be found in Section I, page 133.

F5: Establishment of Strategic Reserves

A final recommendation for forest management includes the identification and creation of **Strategic Ecological Reserve** areas where no active forest management will occur, unless some catastrophic event occurs,

requiring remediation efforts. For this management block, we recommend that the stands deemed inoperable be substituted as strategic reserve stands. Their location and characteristics that make then inoperable now will surely persist into the future.

These set-aside forest stands can be designed to provide locations within the interior of the Hothole-North Block that can be left to develop without efforts at rehabilitation. In that way, there should exist some basis of comparison with those similar stands on similar sites that have undergone the full regimen of rehabilitative treatments to create an irregular, unevenaged forest structure.

It is most certain that forest cover types will change composition as treatments achieve their desired objectives for composition modifications. As they do, the acreage by broad forest type will change somewhat and the Oak/Pine type may decrease in area due to changes in dominant species. The White pine, Red spruce, Red oak, Sugar maple, and Yellow Birch where it is found in some stands is now a secondary or tertiary species but should rise to greater prominence in a few decades.

F6: Stratum Management Strategies

These strategies are in order of treatment priority for each stratum. Total stratum acres and the stands containing them will be examined in the field prior to final selection for treatment design, installation, operations, and checkout. As full silvicultural regimes containing several treatments are developed and tested, the regimes may be applied to any and all stands within each broad forest type. How specific treatments will be applied will depend on the development class and density of chosen stands. The intensity of treatment will vary but remain light and conservative to avoid major changes that would expose any stand to damage by wind and weather.

Priority for treatment is a combination of broad forest type and soil-site quality as shown in Table 10 (below). Stands on good to better sites should be treated first as their response on good sites will be more rapid and lasting.

Table 9 - Treatment Priority by Site Quality and Type

Broad					***Soil-Site Productivity***	
Cover Type	**No. Stands**	**Acres**	**Excellent**	**Good**	**Avg./Fair**	**Poor-V. Poor**
TH	11	113		7	42	0
IH	1	11		1	0	0

PH	2	24		0	1	1
SF	0	0		0	0	0
LC	3	27		0	2	1

Note: Count of stands by Site-Productivity Type varies as some stands have more than a single assignment

There are no really excellent sites on the Hothole-North Block, which is not unusual for forest soils in an area of extensive agriculture. As such, the first priority is to treat stands in the Tolerant Hardwood and Pine/Hemlock strata on Good or Average (fair) sites, but also those Intolerant Hardwood stands on good sites. Immediate efforts and rehabilitating stands in these categories will concentrate on improving stands with a higher percentage of high-value acceptable growing stock in stands of small to medium poles in moderate to high densities. Spruce/fir stands (either pure or mixed) should be allowed to develop further before treatments shift to include them (at least 15 more years). Lowland conifer stands should be left to grow until higher priority stands have been treated at least once or twice. Current product market prices will determine treatment timing.

F6a) Tolerant Hardwood Stands:

Tolerant hardwoods (without Red oak) make up 11% of the growing stock basal area and stands selected for treatment should be at least 50 to 70 years old and contain at least 100 sq. ft. of total basal area. They should also contain a higher proportion of high-value (from both forestry and wildlife habitat views) species that can provide tangible benefits to wildlife populations and income from increasing growth sooner than other candidates.

Among the initial treatments available for chosen stands are:

- ✓ *Understory removal if largely diseased Beech.*
- ✓ *Light, free thinning in all crown classes to reduce diseased Beech and competition from poor-quality trees of all species. The focus should be to increase the proportion of higher value, longer lived species. The residual basal area should be no lower than 75 sq. ft.*
- ✓ *To initiate the 100-year regeneration plan, small openings should be made, whose area should be adjusted to favor the species to be increased, but in keeping with the limits for sustainability by regenerating 10% of the stand area every 10 years (100-year rotation). Desirable species of acceptable growing stock should be left as reserve trees to accelerate growth within patches. During future entries, trees in all stages of development will be thinned.*
- ✓ *Regenerating about 10% of stand area every 10-year cycle should be by irregular shelterwood methods where opening size (with reserves) should be varied towards the conditions necessary for regenerating preferred species.*

F6b) Intolerant Hardwood Stands

Stands chosen in this category (11% of growing stock) should be on good sites so they can respond rapidly. Habitat considerations will lead decision-making as these stands need to be managed on an even-aged basis. Recommended proportion of short-rotation intolerant hardwoods needs to have about 9 acres (ultimately). Since we have one stand of 19 acres that meets the criteria. This single stand (609) is on an Average site and will have a site index value of at least 45 or 50 (trees reach 50 feet in height in 50 years) and these sites should be treated first. The importance of treating this stand first will depend on product prices for sawlog-size Aspen. If this stand has a high proportion of well-established conifer species as either an understory or midstory treatment could be sooner, rather than later. The consideration for advancing succession towards conifer species before treating as a short-term aspen or birch stand should be most important, as this site will produce conifer species better than hardwoods.

Thinning from below should commence when stands reach a total basal area of over 100 square feet and leave a well-spaced residual of dominant and codominant trees of acceptable growing stock that is no lower than 75 square feet. Successive thinnings should follow similar guidelines but leave a higher residual basal area of perhaps 80 to90 square feet. Any high-value species should be retained if they are of acceptable quality, healthy, and vigorous and free from defects. These individuals can be released during the second thinning.

F6c) Oak-Pine and Pine/Hemlock Stands

This forest type possesses the greatest number of acres (55%) and will produce much of the more valuable material over time, due to its generally average or good sites. Selected stands in this broad forest type should be at least 50 or more years of age and of moderate to high density with a mean stand diameter of at least 6 inches. By this time, there should be a relatively clear delineation between the total height of white pine and Red oak of the same age in the stand as the pine will have emerged slightly above the oak. Invariably, these stands will contain other species including Red spruce, Balsam fir, Red maple, Hemlock, quaking and Bigtooth aspen, White or Gray birch and others. Managing this as a mixed-species stand would be desirable to offer an abundance of habitats, while growing high-quality pine, Red spruce, Cedar, Yellow birch and ash (Black and White) sawtimber. Thinning should seek to lower the proportion of Fir, Hemlock and Aspen as much of the undesirable, poor-quality growing stock of all species. Also, to release White pine and Red oak while using intolerant hardwood species to provide some protection from weevil damage and to train the pine to shed branches cleanly at an earlier age. Other species in these stands should be managed for high

value sawtimber products and thinning to remove lower value trees should be initiated and continued. These thinnings could be any combination of Free thinning (all crown positions classes), Low thinning, Crown thinning (if poor quality material is in the overstory), Selection (or group selection) for mature trees of moderately high risk, etc. Irregular shelterwood methods should be applied to regenerate preferred species in smaller patches for tolerant species and larger patches for intolerant species where 10% of the stand area is regenerated each cycle.

In mixed stands like these, basal areas will be high and a reduction to perhaps 90 to 120 square feet should be the goal of an initial treatment. In future thinnings for tree quality, Red maple could be used as a placeholder and should be the first species to remove to add growing space, unless other species of unacceptable growing stock are in abundance and crowding acceptable growing stock trees of any species. If White pine is in abundance, future thinnings can concentrate on releasing pine such that the residual basal area is between 75 and 90 square feet to provide room for the pine to accelerate in both height and diameter growth. Intolerant hardwoods should be completely removed first to create better spacing of residuals.

Since the acreage of this type is large and is found on the better sites, converting the type to predominantly Red oak and White pine could add acres to the total, if both of these species are favored.

F6d) Lowland Conifer/Spruce/fir Stands

Entering these stands once the higher-priority types have been nearly completed will offer stands that are more highly stocked than they currently are. Provided markets improve, these younger stands should be entered when they reach 45 to 55 years of age. There will be more merchantable-sized trees to help pay for thinning and favoring Red spruce at the expense of Hemlock and Balsam fir will improve the growth and income potential for these stands on good to fair sites. On better drained sites, Balsam fir does not grow well and is subjected to internal rot more than in the species' preferred moister locations.

Initial entry into these stands should be to apply a conditioning treatment to remove poor-quality, high-risk trees of all species and to retain a residual basal of 85 to 90 square feet or more as long as the removal volume does not exceed 28 to 30% of the total initial growing stock. Future thinnings should be from below to improve the quality of growing stock in stands that are at transition age. Techniques could then switch to the unevenaged single tree or group selection system. Residual basal area in the latter thinnings should leave 90 to 95 square feet. This is of prime importance to these stands (600, 620, 621) are to provide some benefit to wildlife, especially deer.

No stands in this broad type should be selected for treatment for at least 10 years as stands on better sites have been completed. Remedial work to improve the health and habitat diversity of these stands could then be done during periods of frozen ground and in a limited way with extremely light thinning. The goal in these stands should be to increase the proportion of Northern white cedar and other conifers while reducing hardwoods that are less palatable to White-tailed deer. Many of the stands in this group border the shoreland zone of the Dead River, where restrictions on removals are in place.

Many stands in this type have subtle differences in site quality and these should be recognized during preparation for silvicultural treatments. The goal of silvicultural practices will be to remove undesirable material (UGS) within limits and to favor healthy trees of those species that can do reasonably well on these sites.

F7: Treatment Scheduling

For the first 5-year planning period, annual plans are to begin the improvement process at a rate of 20 acres per year. An initial suggestion would be to complete these acres of light thinning (NRCS practice 666-Forest Stand Improvement) in the Oak-Pine Stratum beginning in 2026. Stand candidates have been selected for this first 5-year planning period and are listed below.

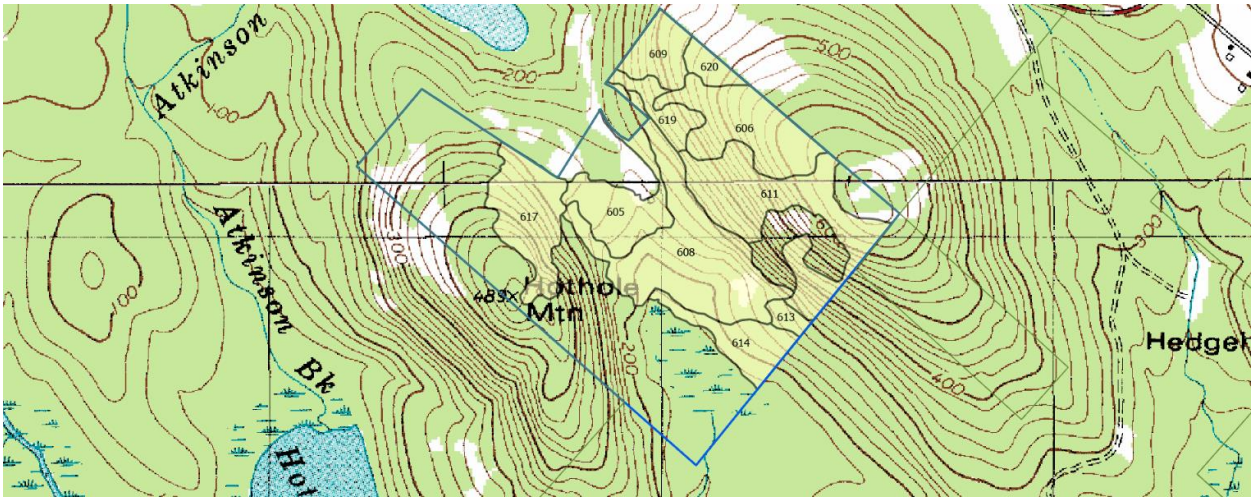
Table 10 - Planned Dead River Forest Stand Improvement 2022-2026

	Hothole-North Block First 5-Year Silvicultural Plan						
Stand No.	**Acres**	**Thinned Ac.**	***2025***	***2026***	**2027**	**2028**	**2029**
605	12	12			4		8
606	14	14			14		
608	25	25	11	14			
609	11	11					11
611	21	21				21	
613	2	2	2				
614	7	7	7				
617	12	0					
619	6	6		6			
620	2	2			2		
TOTALS:	112	100	20	20	20	21	19

This forest stand improvement work should be conducted under a new NRCS contract for practice Code 666, Forest Stand Improvement. Work on design plans and installation will commence upon contract execution. Specific silvicultural prescriptions will be developed from additional sample data for each stand. Stands scheduled to receive treatment are shown in the following

map. The map (Figure 29, below) shows the location of stands included in this 5-year program to improve the health and vigor of all stands by adjusting species composition, horizontal and vertical structures and increasing the diversity of wildlife habitats.

Figure 25: Hothole-North Five-Year Silviculture Plan



F8: Access Recommendations

At this point there needs to be some activity on the Hothole-North Block to locate and construct main access skid trails prior to beginning of operational silviculture. In order to keep forwarding distance at or under 1,500 feet for operational efficiency, there will eventually have to be some form of truck road constructed to access the operable portion of the property. Funding assistance for such a project should be sought from NRCS. While there are several old, existing skid trails crisscrossing the property, many of them have focused on convenience, rather than proper location to avoid rutting, washouts, and erosion. To avoid problems in the future, a permanent network of skid trails should be designed to make use of good stretches of existing trails and minimize distances traveled for logging machinery. If operations are scheduled for late fall and the winter months, rutting and erosion problems should be much reduced. We would recommend that direct access eventually be changed from the current (terrible) unmaintained access road from the Bald Mtn. road to new access from the Hothole Pond road, perhaps a winter road. This would locate the access point within GPT ownership where it can be secured. Making the shift soonest would avoid any major expenditures to the existing access point that passes in front of a residence, where issues from truck and other traffic may cause problems.

A road maintenance plan that includes culvert repairs, along with an annual budget needs to be prepared for a main gravel road access also. Since there are plans to extract saleable forest products, it is anticipated that some repair will be necessary post-logging to ensure that travel by GPT personnel. Trucking of forest products from late fall and winter operations should be confined to frozen ground conditions.

Each year, conditions should be evaluated to schedule maintenance activities in the following categories:

- Culvert replacement based on improper sizing and condition.
- Removal of brush encroaching into the right-of-way.
- Rip-rap of steeply sloping culvert outflows.
- Grading and ditching of roads prior to commencement of forestry operations.

All road data in the GIS system has been segmented in such a way that each road segment between connection points has a unique number. This data can be used to record places where work is needed during pre-season planning. The culvert inventory and GPS data on their location needs to be converted to a geographic database for use in planning and the production of maps for planning and field use.

G. Best Management Practices [References]

In the course of forest management activities, care should be taken to avoid creating damage to not only residual trees, but all other aspects of the forest. Attention is directed to a number of helpful references that should be consulted before, during and after making changes that can adversely affect water quality, erosion and sedimentation, wildlife populations, riparian habitats, roads and other infrastructure. The following is a list of relevant publications that should be on every forest manger's bookshelf.

Bentrup, G. 2008. *Conservation Buffers*. Gen. Tech. Rpt. SRS-109. USDA For. Serv. So. Res. Sta., Asheville, NC. 110 pp.

Forest Biomass Retention and harvesting Guidelines for the Northeast. 2010. Forest Guild Biomass Working Group, Santa Fe, NM. 17 pp.

Hunter, M. L., Jr. 1990. *Wildlife, forests, and forestry: principles of managing forests for biological diversity*. Prentice-Hall, Englewood Cliffs, N. J. 370 pp.

Importance, Preservation and Management of Riparian Habitat: A Symposium. 1977. Gen. Tech. Rpt RM-43, USDA For. Serv. Rocky Mtn. For. Exp. Sta. Fort Collins, CO. 217 pp.

Moesswilde, M. 2004. *Best Management Practices for Forestry: Protecting Maine's Water Quality*. Maine Dept. of Conservation, Maine Forest Service, Augusta, Maine. 93 pp.

Murphy, A. A. 1982. *Forest Transportation Systems – Roads and Structures Manual*. Seven Islands Land Co., Bangor, Me. 55 pp.

Permanent Roads for Better Woodlot Management. 1973. USDA For. Serv. State and Private Forestry, Northeastern Area, Upper Darby, Pa. 45 pp.

I. Monitoring Changes & Trends – Adaptive Management

"In the case of trees and forests, as well as other living systems, improving on nature does not mean ignoring or distorting natural laws, but helping nature to express potentialities that enrich human life and increase ecological diversity, but that would have remained unexpressed in the state of wilderness." - Rene Dubos

I1: Long-Term Monitoring [Keeping up with changes]

Every time a tree falls, whether from wind and snow, old age, or from the axe, it changes the characteristics of the stand of which it was a member and (though the impact may be small) the whole forest. Many such changes occur every year and as the years pass the forest takes on a new look – hopefully better. But, how do we know if it IS better, compared to the original condition? The answer is to keep track of changes being made by man or nature that results in the current condition as seen by all. If the process is relatively simple, inexpensive and straightforward, it will be easier to find commitment to continue the process and that must be kept in mind.

The most objective way to keep track of the dynamic nature of a forest is to measure it – the parts that have been changed purposefully and those that have changed naturally. Sometimes keeping track of things is done on a periodic basis, like every 3 or 5 years. The danger with this approach is that it will be forgotten when it's time to do it and most likely, won't get done. The other way to do it is on a regular periodic basis when the stand is reexamined to determine if and when another prescriptive treatment is warranted. This way, the updating of important data and information becomes a regular part of the organization's effort. Expense also enters into the approach chosen – whether it's better to budget for a regular annual cost, or to incur a periodic cost that may not be budget friendly. Let's take a look at the types of changes that occur and some suggestions on how to keep track of them.

I1a) Appearance

This is perhaps the first indication that something's different than what it was. Appearance will change sometimes subtlety or more dramatically, it depends on who's doing the looking. Since appearance is one of the elements that is important (see Section C4e, page 41), the best way to keep track of changes in this category is to simply take a picture. One way to do this in repeatable fashion is to establish "picture points" that ensures that subsequent photos are taken in the same spot, direction, and field of view. A series of picture points that highlight areas of interest and the rate of visual change can be a welcome addition to discussions about changes that have taken place and what their visual impact has been.

I1b) Mapping

It's important to keep maps up to date to show the most current condition of not only forest stands, but roads, boundaries and other features of importance like forest openings, plantings, water features changes (like beaver influences) and the condition of planned vistas. Since the map data is contained in a Geographic Information System (GIS), changes in stand labels or minor changes to stand boundaries or property boundaries can be made easily to make the updated map information available rapidly.

I1c) Growing Stock Yield, Volume & Value

Trees grow and change along defined patterns of development that depend on how, when and with what intensity of silvicultural treatments are made over how long a time. The product of tree growth is a yield, over time, of possible products by species and quality. Keeping track of the current status of forest stands and the forest as a whole show how it is changing and adapting to new circumstances. Judgements can be made at regular intervals as to whether the changes made have produced a desirable effect, or not. In this way, alterations may be made in future treatments to make "mid-course corrections" for changing circumstances, much like a spacecraft. As explained in Section F2a, page 105, updating an original inventory can be handled more easily by the "Rolling Inventory" process. This process can, and should, be done at the same time as mapping updates.

Since products have value in the marketplace, standing trees containing products will also have value. That value (standing timber) called "stumpage" (Delivered Product price at a mill minus the costs of Cutting, Yarding, Loading and Trucking to a mill is an important characteristic of a forest asset. Larger tracts of forest land (several hundred acres or more) reflect a total land value better than real estate value for bare land. In Orland, however, since it sits right smack in the developed corridor to Acadia, land has a development value that is reflected in the price of either bare or forested parcels. In the case of the Hothole-North Block, since there will be no development, the trees in the forest offer an estimate of asset value that cannot be ignored. How this value changes over time is a direct reflection of what has been done to improve it, so the effort and capital necessary to make improvement adds value to the forest asset as well, since in the absence of purposeful changes made, the forest asset may not be as valuable. Another aspect of value assessment depends greatly on the method of sale. If the sale of trees is as they are found standing (stumpage), at the roadside or delivered to a particular market has a huge effect on value received. When products are of low quality, stumpage sales can avoid the cutting and handling costs associated with getting the trees out of the woods and delivered to a market. As the Hothole-North Block's products become larger, better and more valuable, a shift to either roadside or delivered

sales might make sense. In this latter instance, costs of felling, loading and trucking to either a roadside yard or a market are borne by the landowner, but the revenue gained from controlling all aspects of the market process should more than offset the costs of extraction and delivery. From a stewardship aspect, recognizing and keeping track of the forest asset value is a real, fiduciary responsibility.

I1d) Markets and Prices

Whether the trees and the products they contain have value and how much depends on the number and kinds of markets available that turn raw trees into useful products. Keeping track of existing markets in close proximity to all management areas is very important, as well as understanding what changes to markets and prices mean to the forest.

I2: Treatment Effectiveness

A key reason to keep track of stand changes is to see how well the silvicultural treatments (in whatever combination) are performing over time. One of the reasons we see for monitoring some treated stands is that at some point in time, someone will want to know if managing the forest is worth the expense. Demonstrated improvements in species composition, health, tree vigor, product value, diversity, rates of growth (by any measures), etc. can all be available from repeated measurements. Measuring on a regular basis (every 5 or 10 years, for instance) does have a cost, but it can be kept at a minimum by restricting the focus on measurement to that which is most important.

Keeping the design relatively simple and numbers of plots to be measured low enough to relate to the GPMCT's ability to accomplish the work is important. We would recommend a series of sequential variable-radius plots to meet this need. Using a variable-radius plot instead of a fixed-radius one might be more efficient, but the computations to properly assess the components of growth are a bit trickier and as a result, the measurements might be discontinued. An alternative to this dilemma is to use the same method of sampling as that done to determine the most appropriate silvicultural treatment based on stand characteristics. This would entail the use of a BAF 15 variable-radius plot in sufficient numbers to provide a statistically valid estimate of stand conditions. Since each stand is on a 10-to-15-year schedule for a repeated measurement, in sequential sampling the original GPS located sample points can be used to repeat the data collection, then easily compare the changes in key variables of interest.

If this approach is used to assess the stand before and immediately after treatments are applied, an idea of what improvement in health and quality has

been made can be gained immediately. Then again, every 5 or 10 years to monitor development progress, but also to determine the timing of the next treatment when conditions are optimum to do so.

I3: Forest Records

What records should be kept, what should they look like and how many should there be? Besides budgets, GIS and other convenient, relational databases, there should be a few items that give a complete picture of the treatment/development history for each stand. Bearing in mind that there are 25 individual forested stands on the Hothole-North Block, it may be useful to create a new file on a stand that is scheduled for its first treatment. Beside the GIS data and the inventory database, there are two spreadsheets that I keep. The first is used to assess the development history of the stand and it looks like Figure 30 (below). This will print on a standard 8½ x 11 sheet of paper. Each time a treatment or remeasurement occurs, the summarized information can be presented clearly on this sheet. What condition the stand is in, how renewal is planned and what harvests have yielded can be seen quickly.

Figure 26 - Stand Development Record

GREAT POND MOUNTAIN CONSERVATION TRUST

Orland, Maine

RECORD OF STAND DEVELOPMENT FROM FOREST MANAGEMENT

STAND DEVELOPMENT — **STAND NUMBER** — **Dead River - West All Stands Combined**

GROWING STOCK (Basal Area (Ft²)/Acre > 8.6" DBH)

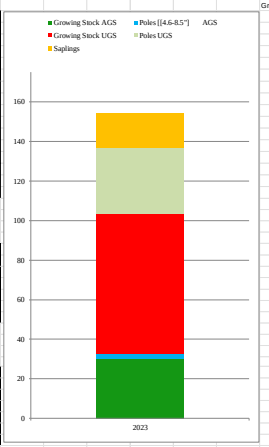
Growing Stock	2023	2028	2033	2038	2043	2048
Volume (Ft³/Acre)	2320					
Basal Area (Ft²/Acre)	101.8					
Percent Cover	88%					
Quality						
% AGS	30%					
AGS (Ft²/Acre)	30					
UGS (Ft²/Acre)	71					
BA/Ac Hi Value A+B	48.0					
Structure						
% Small Wood [8.6-11.5"]	24%					
Medium Wood [11.6-15.5"]	32%					
% Large Wood [15.6+]	40%					

Understory (Ft²/Acre)	2023	2028	2033	2038	2043	2048
Saplings [0.6-4.5"]						
Total	17.4					
High Value Intol. Hwds.	0.3					
High Value Tol. Hwds.	0.2					
High Value Conifers	1.2					

Poles (Ft²/Acre)	2023	2028	2033	2038	2043	2048
Poles [[4.6-8.5"] AGS	2.4					
UGS	33.4					
High Value Intol. Hwds.	5.2					
High Value Tol. Hwds.	2.8					
High Value Conifers	6.7					

Stem Distribution

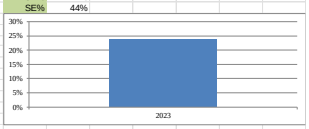
Growing Stock Stems per Acre



Spatial Variation

Basal Area (Ft²/Acre) [Main Crown Canopy]

Plots	2023	2028	2033	2038	2043	2048
1	60.0					
2	120.0					
3	135.0					
4	75.0					
5	150.0					
6	120.0					
7	135.0					
8	135.0					
9	75.0					
10	105.0					
11	75.0					
12	150.0					
13	75.0					
14	45.0					
15	45.0					
16	90.0					
17	120.0					
18	60.0					
19	165.0					
20	90.0					
Avg.	155.0					
SD	37.02329					
SE	68.53618					
CV%	24%					
SE%	44%					



RENEWAL

Regeneration

	Number of Seedlings per Acre						Cover Percent					
	2023	2028	2033	2038	2043	2048	2023	2028	2033	2038	2043	2048
High Value Intol. Hwds.												
High Value Tol. Hwds.												
High Value Conifers												
Other Intol. Hwds.												
Other Tol. Hwds.												
Other Conifers												
TOTAL												

PAST MANAGEMENT

Harvested Growing Stock

	2023-2027			2028-2032			2033-2037			2038-2042			2043-2047		
	Volume	*Value*	*Unit Price*	*Volume*	*Value*	*Unit Price*	*Volume*	*Value*	*Unit Price*	*Volume*	*Value*	*Unit Price*	*Volume*	*Value*	*Unit Price*
Biomass															
Firewood															
Boltwood															
Pallet/Ties															
Studwood															
Sawlogs															
Veneer															

Volume by Product

Harvesting Rate	Biomass	Firewood	Boltwood	Pallet/Ties	Studwood	Sawlogs	Veneer	Total Vol.
	G. Tons	*Cords*	*MBF*	*MBF*	*G. Tons*	*MBF*	*MBF*	*Cu. Ft.*
Year								
2023	0	0	0	0	0	0	0	0
2024								
2025								
2026								
2027								
Five-Year Period Totals:								
2028								
2029								
2030								
2031								
2032								
Five-Year Period Totals:								
2033								
2034								
2035								
2036								
2037								
2038								
Five-Year Period Totals:								
2039								
2040								
2041								
2042								
2043								
Five-Year Period Totals:								
2044								
2045								
2046								
2047								
2048								
Five-Year Period Totals:								

The second spreadsheet is used to provide an economic record by recording what events have occurred in a stand, the profit and loss from the event and the current vs. potential standing value. This latter item provides an indication of how a potential value is being realized by the management strategy. Figure 31 on the next page shows the form for the entire Hothole-North Block, with an example thinning that may actually occur next year (2024).

Figure 27 - Economic Record

Great Pond Mountain Conservation Trust

Management History and Economic Record

Stand No.: DR-West Entire

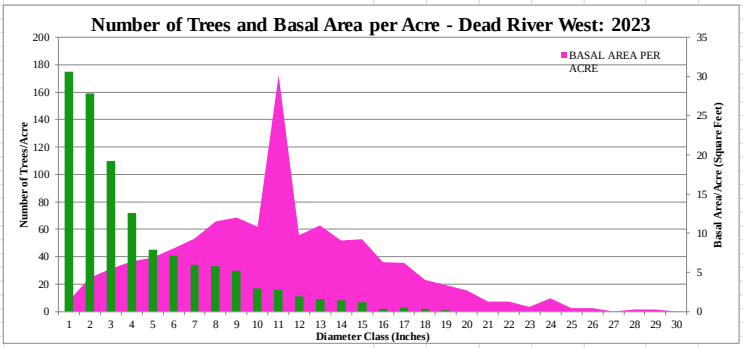
Stand Area (Acres): **336**

Initial Year of Management: 2023

Type of product sale: Precommercial/Commercial

Treatment Cycle: 10 Years

Management initiated in 2022 with mapping, inventory sampling, Forest Mgt. Plan



Stand characteristics (following initial sampling in 2023)

Total Stand 0.6"+

Trees/Ac.:	**785**	Stems
Basal Area/Acre:	**155**	Square Feet
Volume:	**2876**	Cubic Feet (Gross)
Average Age:	**55**	Years

Details of Silvicultural Operations

Year	Species	Volume [Ft³]	Units	Unit Price	Observations	Yield Ft³/Acre	Yield Tons/Acre	Yield $/Acre
2023	All	2771	Tons	$ 8.00	Initial entry to balance species composition & remove UGS	633	19	$ 153.45
					Remove 22% of current standing volume- approx. 7.67 cds/ac			

Economic Monitoring

Profit and Loss (breakdown of revenues/expenses):

Costs ($/Acre/Yr):

Operations set-up & layout -	$ -
Harvesting Cost -	$ 500.00
Marking -	$ 50.00
Forest Maintenance-	$ -
Management Costs -	$ 35.00
Infrastructure -	$ -
Insurance -	$ 2.00
Taxes -	$ 7.00
TOTAL COSTS:	**$ 594.00**

Revenues from cutting 10 cords of firewood/year @ $20/cord
This would come from 1 acre/yr of improvement cuts in hardwood stands.

Revenues ($/Acre/Yr):

Timber Sales:	$ 153.40
NRCS Practice Reimbursement:	$ 615.96
Miscellaneous Income:	$ -
TOTAL REVENUES:	**$ 769.36**

NET PROFIT/LOSS: $ 175

Capital appreciation (standing value and potential value):

	2023			
Standing Value (SV/Acre):	$ 721.80	Current annual Increment at 40.70 cubic feet/Acre/Year.	**Standing Value Increment:**	$ 13.12 $/Acre/Yr
Potential Value (PV/Ac):	$ 813.03	Current annual value increment/4.5% long-term value yield	**Potential Value Increment:**	$ 36.59 $/Acre/Yr

Balance Sheet (Profit & Loss + Capital Appreciation)

Standing Value Balance Sheet (Net Profit & Loss + SV):	$ 897.16 $/Acre/Yr
Potential Value Balance Sheet (Net Profit & Loss + PV):	$ 988.39 $/Acre/Yr

A closing thought to keep in mind, stay the course and have faith in the future…

Nature is often hidden,

Sometimes overcome,

Never extinguished.

Francis Bacon

Respectfully submitted,

R. H. Greene, LPF #23, TSP 13-9363

Kevin Allcroft, LPF #984, TSP 12-8450

Malcolm Richardson, FI #4189

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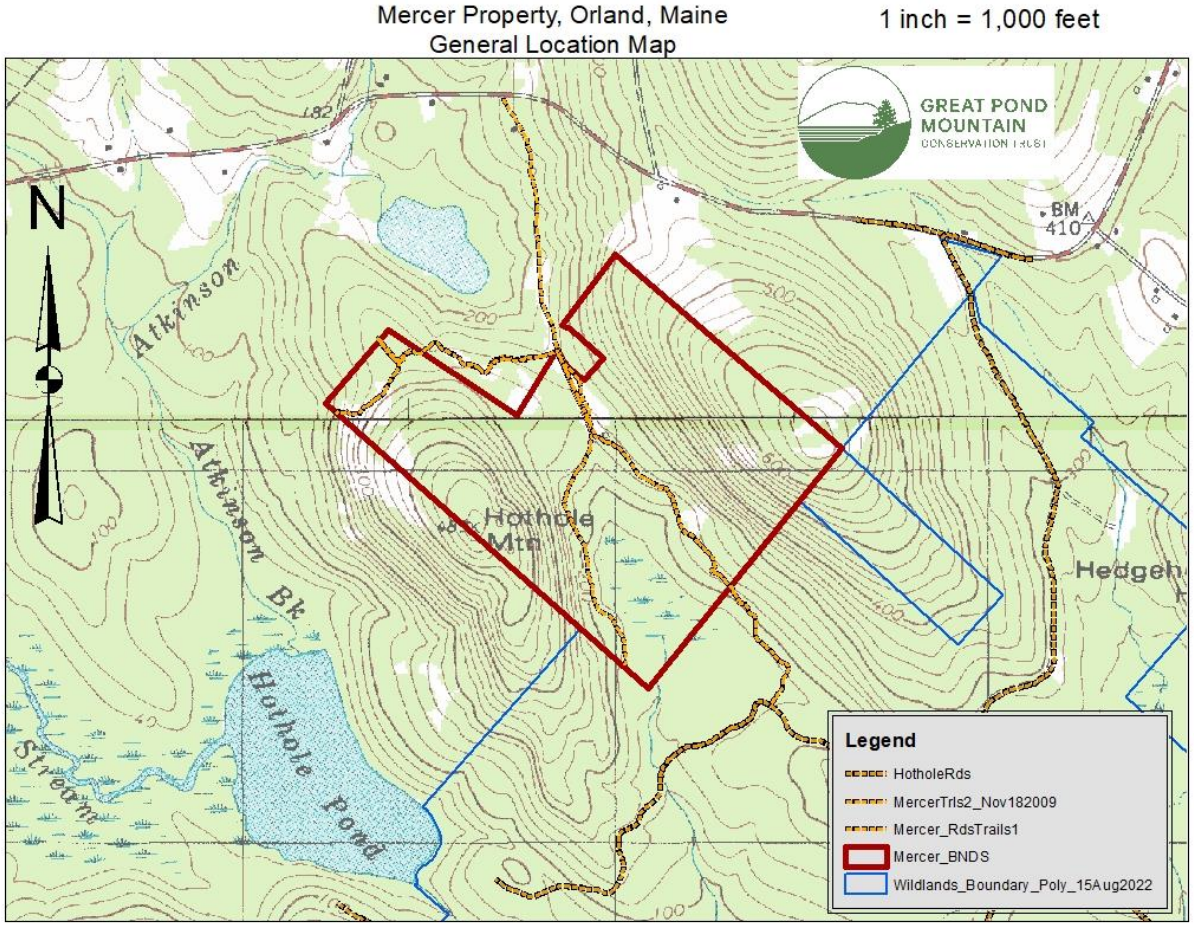
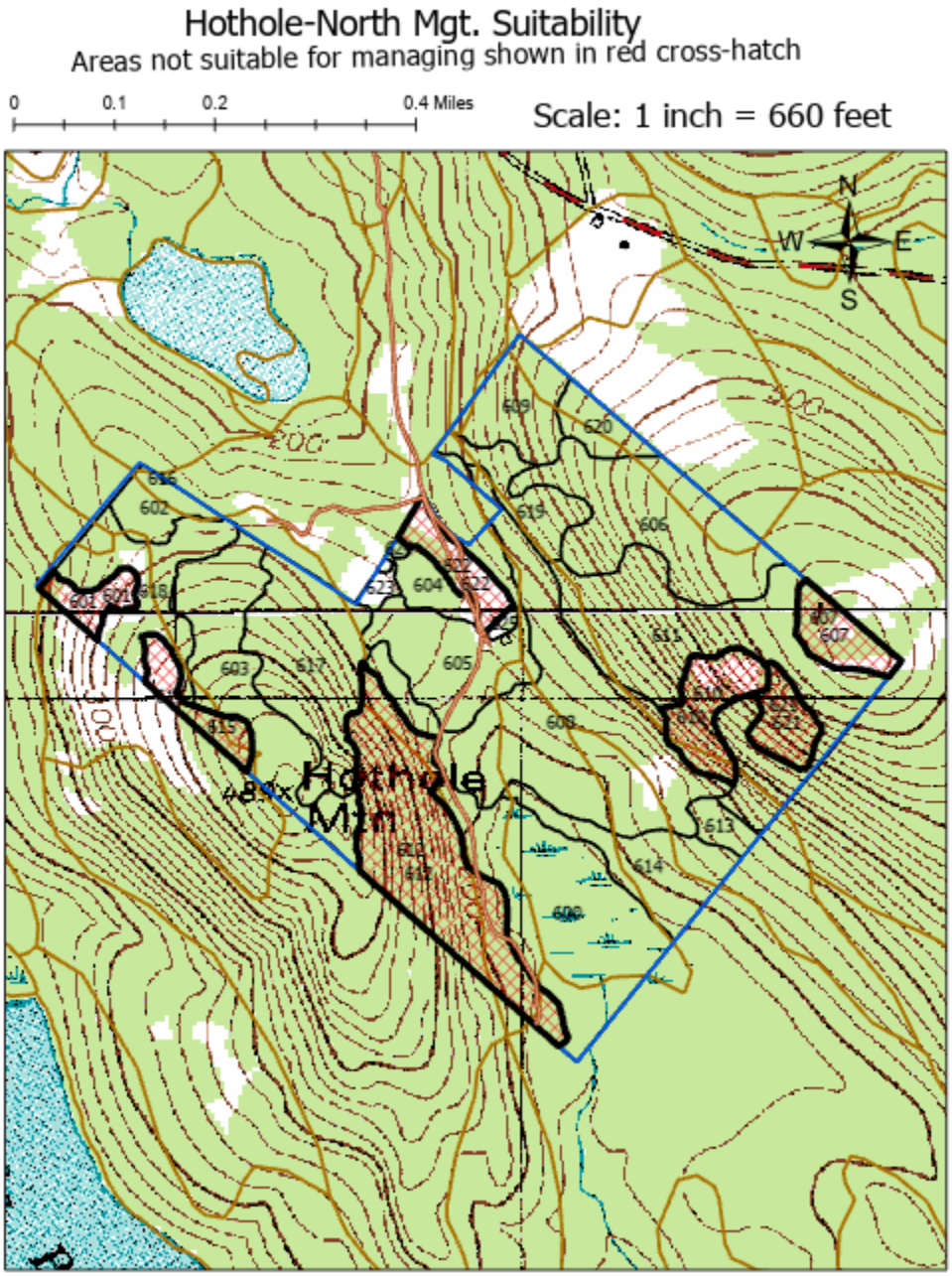
APPENDIX A: MAPS

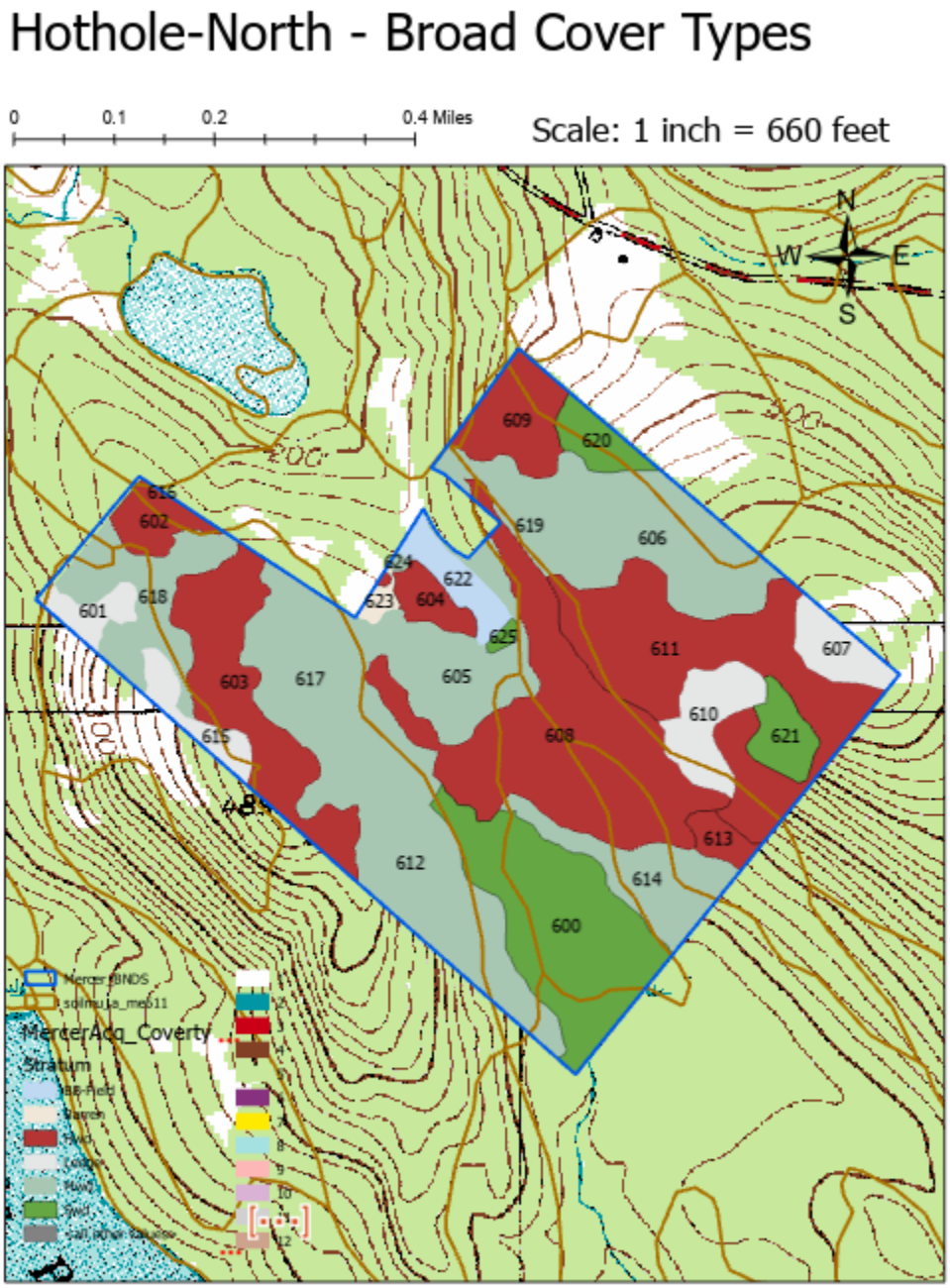
1. Location map



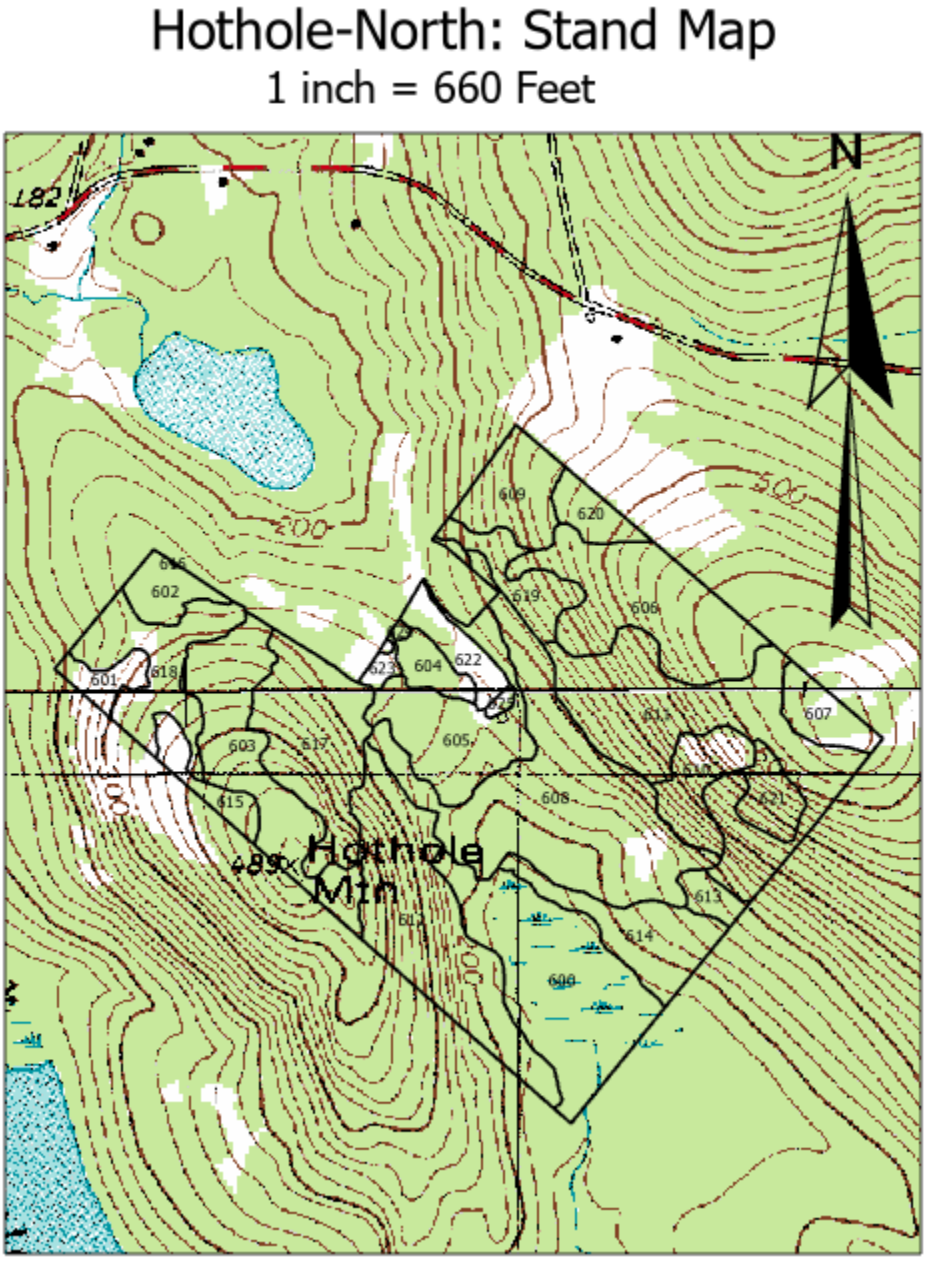
2. Area Suitable for Forest Management



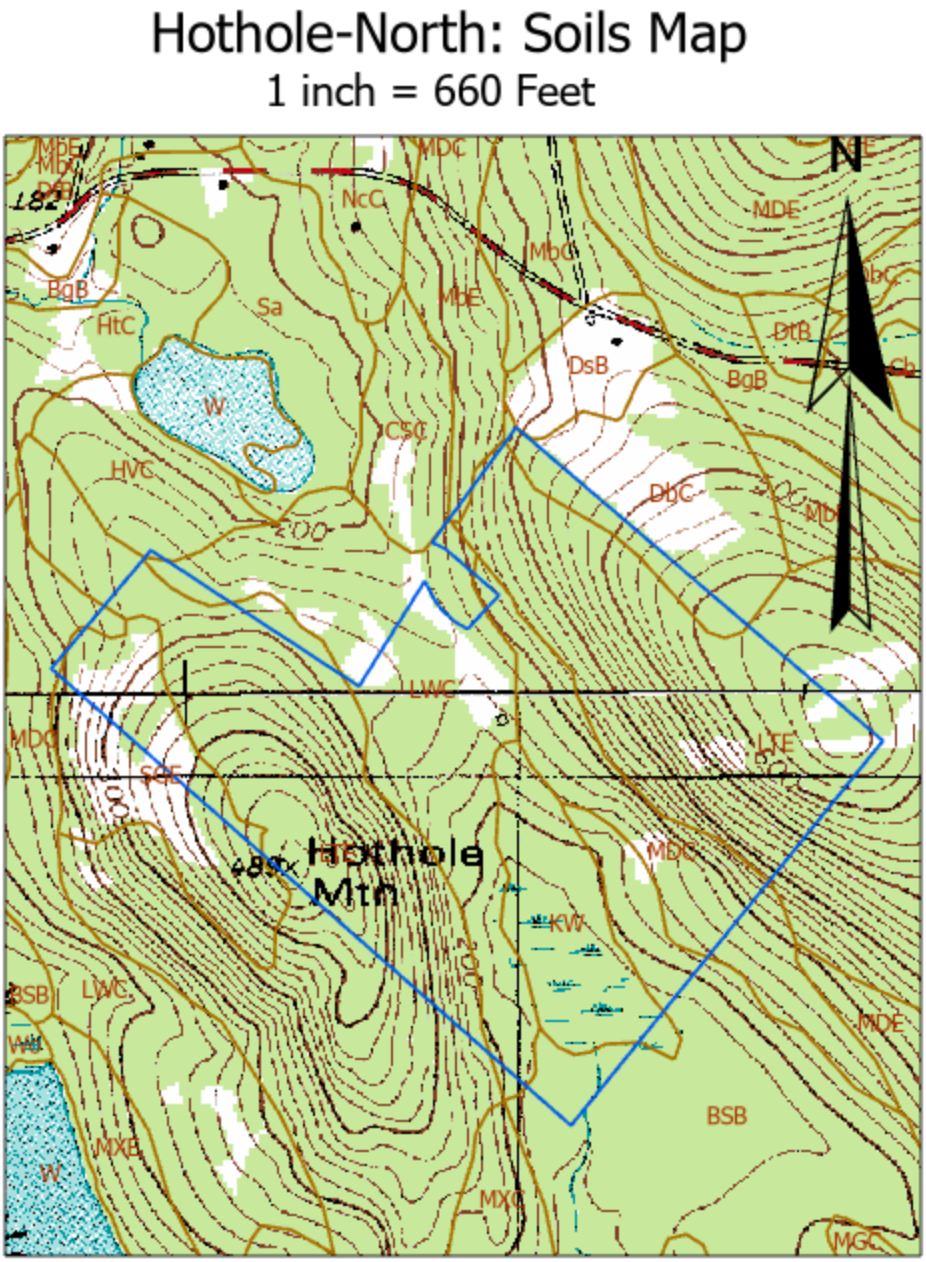
3. Broad Forest Cover Types



4. Forest Stands



5. NRCS Soil Types

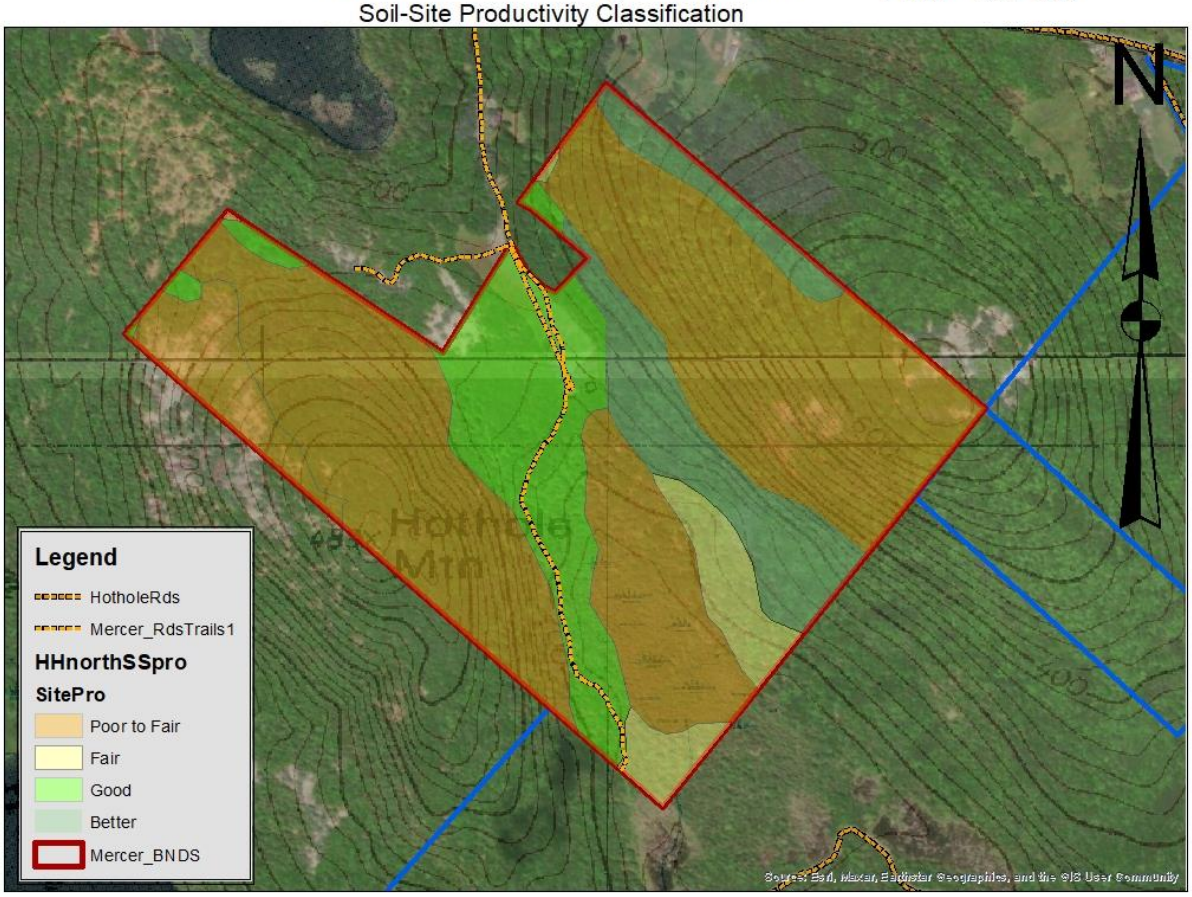


Soil and wetland descriptions can be found in: (Rees, 2023)

6. Soil/Site Productivity for Forest Tree Species

Hothole - North n/f Mercer], Orland, Maine
Soil-Site Productivity Classification

1 inch = 600 feet



APPENDIX B: INVENTORY INFORMATION

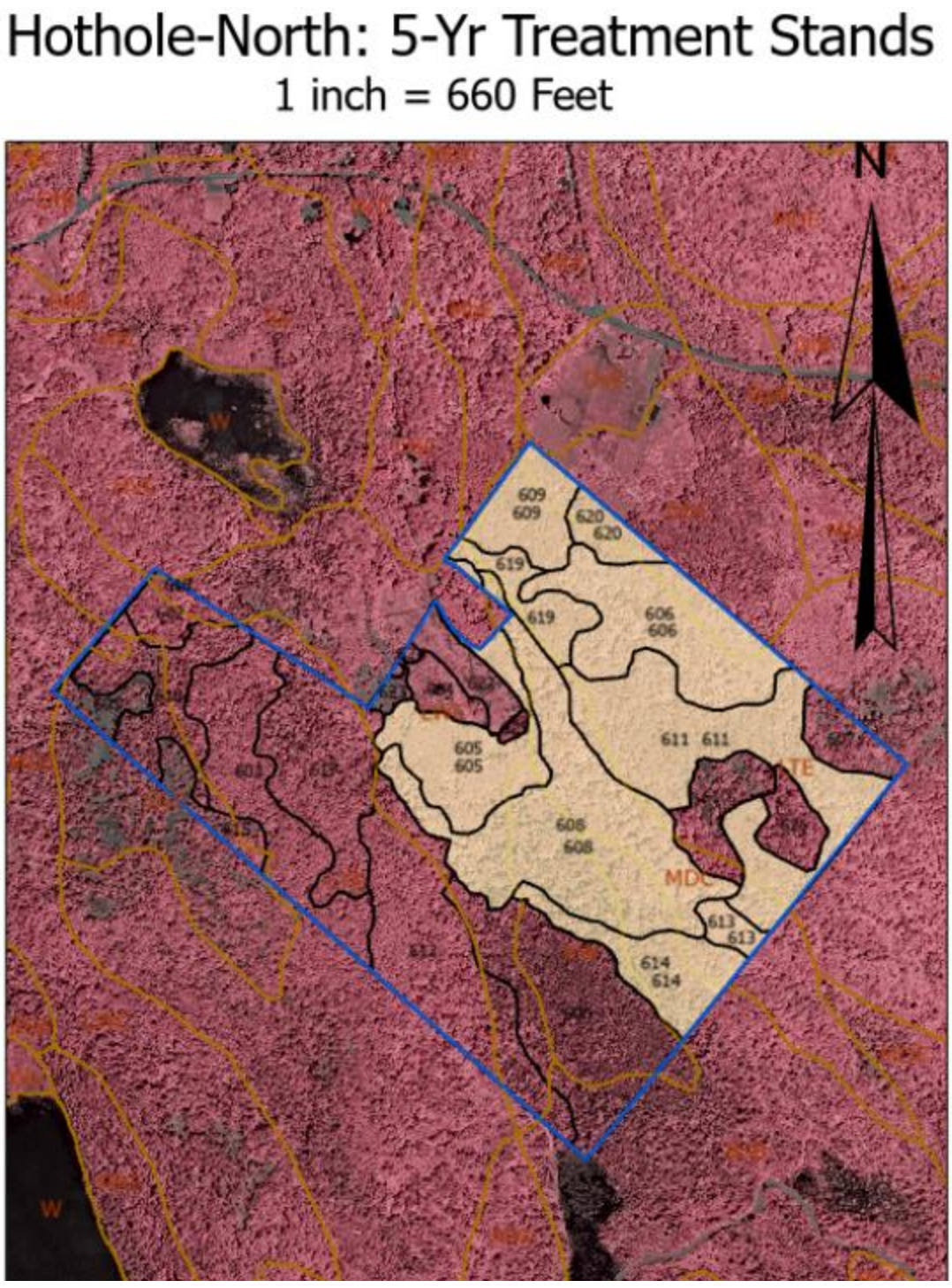
1. Forest Inventory Summaries by Broad Strata & Combined Strata

APPENDIX C: HABITAT INFORMATION

1. Federally Protected Habitat map
2. Maine Natural Areas Program review of Hothole-North Block
3. State Protected Habitats
4. Wildlife Habitat Evaluation Form (NRCS)
5. Habitat Species List Example

APPENDIX D: FIVE-YEAR SILVICULTURAL TREATMENT INFORMATION

1. NRCS Record of Decisions
2. Design Plan
3. NRCS Forest Stand Improvement Practice Standards
4. NRCS Job Sheets for 2024-2028 as appropriate
5. Treatment Areas map



FOREST TERMINOLOGY

(Forest Ecology, Silvics, Silviculture)

Silviculture Generally, the science and art of cultivating (i.e. growing and tending) forest crops, is based on a knowledge of silvics. More particularly, the theory and practice of controlling the establishment, composition, constitution, growth and quality of forest stands.

Forest Type A descriptive term used to group forest stands of similar character as regards composition and development due to certain ecological factors, by which they may be differentiated from other groups of stands. The term suggests repetition of the same character under similar conditions. A type is temporary if its character is due to passing influences such as logging or fire; permanent if no appreciable change is expected and the character is due to ecological factors alone; climax if it is the ultimate stage of a succession of temporary types. A forest cover type now occupying the ground, no implication being conveyed as to whether it is temporary, permanent or climax.

Recognized forest types of North America are named following the principle of using species names which are descriptive of the composition of the type, e.g. Red Spruce Type, White Pine-Hemlock Type, Red Spruce-Balsam Fire Type, Sugar Maple-Beech-Yellow Birch Type. Furthermore, species that appear in the type name generally account in aggregate for 50% or more of the total number of trees occupying the main crown canopy.

Tolerance Ability of a tree species to become established and to grow satisfactorily, in the shade of and in competition with, other

trees. Tree Species are classified according to their degree of tolerance as being very tolerant, tolerant, intermediate in tolerance, intolerant, or very intolerant.

Establishment Process of developing a forest crop to the stage at which the young trees may be considered established, i.e. safe from normal adverse influence e.g. frost, drought, weeds, or browsing and no longer in need of special protection or special tending, by only routine cleaning, thinning and pruning.

Forest Stand A community of trees possessing sufficient uniformity as regards composition, constitution, age spatial arrangement or condition to be distinguishable from adjacent communities so forming a silvicultural or management entity.

Composition Relative representation of each tree species in a forest stand expressed quantitatively as a percentage of either the total number, volume or basal area of all tree species in the stand.

Pure Stand A stand in which at least 75% of the trees in the main crown canopy are of a single species.

Mixed Stand A stand in which less than 75% of the trees in the main crown canopy are of a single species.

Constitution Distribution and representation of age and/or size classes in a forest stands.

a. Even-Aged Applied to stands composed of trees having no or relatively small differences in age. The maximum difference admissible is generally 10 to 20 years, though where the stand will not be harvested until it is 100 years or more of age, larger differences up to 25% of the rotation

(period of years required to establish and grow timber crops to a specified condition of maturity) may be admissible.

b. Two-Aged Applied to stands in which trees of two distinct age classes are represented. The term is not applicable to a forest stands in the process of reproduction in which the appearance of two age classes is the temporary result of an incomplete process.

c. Uneven Aged Applied to stands in which there are considerable differences in the age of trees and in which trees of three or more age classes are represented.

1) All-Aged Applied to uneven-aged stands in which trees of all ages up to and including those of felling age are represented.

2) Balanced Uneven-Aged Applied to uneven-aged stands in which three or more different age classes spaces at uniform intervals all the way from seedlings to trees at or near rotation age are represented and in which the age classes represented occupy approximately equal areas.

3) Irregular Uneven-Aged Applied to uneven-aged stands in which three or more different age classes are represented by in which the age classes represented are not spaced at uniform intervals from seedlings to trees at or near rotation age and/or in which the age classes represented do not occupy approximately equal areas.

Stand Density Density of stocking expressed in number of trees, basal area, volume, or other criteria, per unit area.

a. Basal Area The area, usually expressed in square feet of the

cross-section at breast height (point on the bole of a standing tree 4.5 feet from the ground) of a single tree or all trees per unit area.

Stocking An indication of the number of trees, basal area, or volume per unit area as compared to the desirable number of trees, basal area or volume needed to attain given objectives of management.

1) Fully stocked Applied to a stand in which all growing space is effectively occupied but having ample room for development of the crop tree.

2) Overstocked Applied to a stand in which overcrowding results in retarded growth of the crop trees.

3**) Understocked** Applied to a stand in which the growing space is not effectively occupied by crop trees.

Site Sum of the effective environmental conditions (climatic, edaphic, physiographic, and biotic) under which a plant or plant community lives.

a. Site Quality Relative potential productive capacity of a specific area to produce forest stands of a given species or combination of species.

b. Site Index An expression of site quality based on the average height attained by trees occupying the main crown canopy of a stand at an arbitrarily chosen age.

Stand Development Growth of even-aged stands and small even-aged groups in which trees in uneven-aged stands are seedling, sapling, pole and sawtimber development stages, to the stage of overmaturity.

a. Seedling Stage Stage extending from the time of germination or planting up to the time of canopy closure (the progressive reduction of space between the crowns of individual trees as they spread laterally) is complete. The boundary between the seedling and sapling stages is indefinite but may be fixed arbitrarily e.g. in North America usually a stand composed of trees averaging less than 1.5 inches DBH (diameter at breast height). Breast height is defined as being a point on the tree bole 4.5 feet from the ground.

b. Sapling Stage Stage beginning with the closing of the seedling stage and ending with the elevation of tree crowns well above the ground and with the death of many lower branches. During this stage, competition among trees for light, water and nutrients intensifies resulting in the death of many of the weaker trees. Trees' ranging in size from 0.6 to 4.5 inches DBH are classified as saplings.

c. Pole Stage Stage beginning with the closing of the sapling stage and ending when the growth in height of trees occupying the main crown canopy begins to decline. It is during this stage that growth in height, canopy density, natural pruning, and reduction in the number of trees per unit area resulting from suppression and natural mortality reaches a maximum. Trees ranging in size from 4.6 to 11.5 inches DBH are classified as poles.

d. Mature (Timber) Stage Stage beginning when the growth in height of trees occupying the main crown canopy begins to slow down and continuing until a decline in their health, vigor and/or soundness marks the beginning of the over mature stage.

During this stage, the stand continues strong and vigorous. A closed canopy is maintained. Seed production per unit area reaches a maximum. Natural pruning and reduction in the number of trees per unit area continues to occur but at a less rapid rate than previously.

e. Overmature Stage Stage beginning with a decline in the health ,vigor, and/or soundness of trees occupying the main crown canopy, usually accompanied by the death of occasional trees and the appearance of marked openings in the crown canopy.

From this time on even-aged stands suffer a gradual reduction in vigor and become progressively more susceptible to insects, diseases, wind throw, and other injurious agencies. Individual trees may remain vigorous and continue to grow and increase in value for extended periods of time beyond the beginning of the overmature stage. However, the integrity of an even-aged stand or group of trees steadily deteriorates and is soon entirely lost as mature trees die and are replaced by a young growth of trees, shrubs, and/or herbaceous plants.

Crown

The upper part of a tree carrying the main branch system, foliage and surmounting at the crown base a more or less clean stem.

a. Crown Cover The ground area covered by a crown as delimited by the vertical projection of its outermost perimeter.

b. Crown Density The thickness, both spatially (i.e., depth) and in closeness of growth (i.e. compactness) of an individual crown.

c. Crown Diameter A mean figure derived from two (when maximum and minimum) or more measurements of the span of the crown cover.

d**. Crown Diameter Ratio** Ratio for the crown diameter in feet to the DBH in inches.

e. **Crown Height Ratio** The vertical distance from the ground level to the base of the crown, measured either to the lowest live branch whorl (upper crown-height) or to the lowest level branch, excluding epicormic branches, i.e., a shoot arising spontaneously from either an adventitious or dormant bud on the stem or on a branch of a woody plant (lower crown height) or to a point halfway between (mean crown height).

f. **Crown Length** The vertical distance from the tip of the leader to the base of the crown measured either to the lowest live whorl (upper crown length) or down to the lowest live branch (lower crown length) or to a point halfway between (mean crown length).

g. **Crown Length Ratio (Live Crown Ratio)** The ratio of crown length to tree height.

h**. Crown Form** The general shape of the crown sometimes quantitatively assessed as the ratio of the crown length to crown diameter.

Canopy

The more or less continuous cover of branches and foliage formed collectively by the crowns of adjacent trees and other woody growth.

a. **Canopy Closure** The progressive reduction of space between crowns as they spread laterally, increasing the canopy density.

b. **Canopy Density** The compactness of the canopy dependent upon the canopy closure and the crown density.

Crown Class A designation of trees in a stand having crowns of similar development and occupying a similar crown position relative to the crowns of adjacent trees and the general crown canopy.

Differentiation into crown classes results from intense competition for light, water, and nutrients among trees growing in even-aged stands and within the small even-aged groups in which trees in an uneven-aged stand are often arranged. Four crown classes commonly recognized and widely used as criteria of relative tree vigor in the practice of silviculture are defined below.

a**. Dominant Trees** with crowns extending above the general level of the crown canopy and receiving full light from above and partly from the sides; larger than the average trees in the stand, and with crowns well developed but possibly somewhat crowded on the sides.

b. **Codominant Trees** with crowns forming the general level of the crown canopy and receiving full light from above but comparatively little from the sides; usually with medium-sized crowns more or less crowded on the sides.

c. **IntermediateTrees** shorter than those in the two preceding classes but with crowns extending into the crown canopy formed by codominant and dominant trees; receiving a little direct light from above, but none from the sides; usually with small crowns considerable crowded on the sides.

d. **Overtopped Trees** with crowns entirely below the general level of the crown canopy receiving no direct light either from above or from the sides.

Overstory That portion of the trees in the forest stand forming the upper or main crown canopy, usually considered to include trees in both the dominant and codominant crown classes.

Understory That portion of the trees in a forest stand below the overstory, usually considered to include trees in the intermediate and overtopped crown classes.

Increment The increase in diameter, basal area, height, volume, quality, or value of individual trees or forest stands during a given period. Gross increment refers to values uncorrected for losses by mortality or deterioration. Net increment refers to values to values corrected for losses by mortality or deterioration.

a. **Current Annual Increment** Increment for a specific year.

b. **Mean Annual Increment** Total increment divided by the total age.

c. **Periodic Increment** Increment for any specified period, commonly from 5 to 20 years.

d. **Periodic Annual Increment** Increment for specified period divided by the number of years in the period.

e. **Ingrowth (Recruits)** The volume or number of trees that have grown past an adopted lower limit of measurement during a specified period.

Mortality Death or destruction of forest trees as a result of competition, disease, insect damage, drought, wind, fire or other factors.

Stand Table A table showing the number of trees by species and diameter classes, generally per unit area of a stand.

Volume Table A table showing, for one or more species, the average cubic contents of trees (tree volume table) or log (log volume table) for one or more dimensions.

Yield Table A table showing for one or more given species on given sites the progressive development of a stand at periodic intervals covering the greatest part of its useful life. It usually includes average diameter and height, basal area, number of trees, and final yields and may include volumes of thinnings and other data. An empirical yield table is prepared for actual average stand conditions; a normal yield table is prepared for fully stocked stand conditions.

Intermediate Cuttings Silvicultural treatments undertaken in immature even-aged forest stands and immature even-aged groups of trees in uneven-aged forest stands between the time of formation and the time of the first regeneration cutting. The two principal objectives of intermediate cuttings are:

To enhance the future value of existing forest stands by eliminating defective trees, wolf trees, weed trees, and surplus trees thereby improving the vigor, resistance to injury (insects, diseases and wind) growth and wood quality of the trees that remain.

To increase the total yield of stands by utilizing all of the merchantable wood produced during the rotation. Intermediate cuttings differ from regeneration cuttings in that no effort is directed toward obtaining regeneration and the creation of permanent openings in the crown canopy is carefully avoided. Eight different kinds of intermediate cuttings, each designed for a particular purpose and each applicable to either immature even-aged forest stands or immature groups of trees in uneven-aged forest stands are defined below.

Weeding A cultural operation performed in a forest stands not past the sapling stage and usually not past the seedling stage, for the purpose of releasing potential crop trees from the competition of other plants irrespective of whether they are woody plants or herbaceous plants or whether their crowns are above, beside, or below the crowns of the crop trees.

Cleaning A cutting made in a young forest stands, not past the sapling stage, for the purpose of releasing potential crop trees from other individuals of similar age but of less desirable species or from

which are overtopping or are soon likely to overtop them.

Liberation Cutting A cutting made to release a young forest stands, not past the sapling stage, from the competition of older overtopping individuals which because of species, form, or defect are less desirable than the young growth.

Thinning A cutting made in an immature forest stand with the two fundamental objectives of:

i) maintaining and/or stimulation the growth of the trees that remain.

ii) utilizing all the merchantable material produced by the stand during the rotation.

In making thinnings, trees are selected for removal or retention on the basis of crown class. Among trees equal in form and quality, dominant trees are favored over codominant trees; codominant trees, over intermediate trees; and intermediate trees, over overtopped trees. Trees removed in a thinning represent a surplus when compared to the number required for optimum stocking.

Improvement Cutting A cutting made in a forest stand past the sapling stage for the purpose of improving its composition and quality by removing trees of undesirable species, form or condition from the main canopy (dominant and codominant crown classes).

Salvage Cutting A cutting made in a forest stand to remove trees killed or injured by fire, insects, disease or other harmful agencies for the specific purpose of utilizing merchantable material before it becomes worthless.

Sanitation Cutting A cutting made in a forest stand to remove trees killed or injured by fire, insects, disease or other harmful agencies for the specific purpose of preventing the spread of an insect or a disease.

Pruning A cutting in which live or dead side branches are removed from crop trees with the objective of producing knot free lumber on rotations shorter than those that would be required in the absence of pruning. Trees may also be pruned to improve access to stands during thinning operations, to prevent the spread of disease from branches into the boles of trees and to improve the appearance of forest stands.

Regeneration The renewal of a tree crop, whether by natural or artificial means.

a**. Natural Regeneration** The renewal of a tree crop by self-sown seed or by vegetative means e.g. coppice, sprouts, root suckers and layers.

b. **Artificial Regeneration** The renewal of a tree crop by planting seedlings, sowing seed, or setting cuttings.

Regeneration Method A silvicultural treatment undertaken near the end of the rotation with the purposes of :

- Harvesting mature even-aged forest stands or mature trees occurring singly or in small groups in uneven-aged forest stands.

- Replacing them with young stands established either naturally from seed or vegetative regeneration or artificially by planting tree seedlings or sowing seed.

- A regeneration method includes not only the harvesting of mature trees but also any subsequent cultural treatment that may be required to insure the rapid replacement of the trees harvested by adequately stocked stands of desirable tree species.

Numerous methods of regenerating a high forest (i.e. a forest stands originating from seed) and low forest (i.e. a forest stands origination vegetatively from coppice sprouts, root suckers or layers) have found application. However, any given method can usually be classified under one of six standard regeneration methods, each of which denotes distinctly different principles. The six standard regeneration methods are defined below.

a. **Clear Cutting Method** The removal of all trees on an area to be regenerated in one cutting with regeneration of desirable species being subsequently obtained either naturally from seed disseminated over the cutting area from adjacent forest stands and/or from trees removed in the harvesting operation and/or from advance regeneration or artificially by either planting tree seedlings or sowing seed on the cutting area.

b. **Seed-Tree Method** The removal of all trees on an area to be regenerated in one cutting save for a small number of seed-bearing trees, usually from one to ten trees per acre, retained either singly (single seedtree method) or in small groups (group seedtree method) to provide seed for the subsequent natural regeneration of the area. Following the establishment of adequate regeneration, the seed-bearing trees may be removed in a second cutting or left indefinitely.

c. **Shelterwood Method** The removal of all trees on an area to be regenerated in a series of cuttings extending over a period of years equal usually to no more than one-quarter and often not more than one-tenth of the rotation with the establishment of natural regeneration of desirable tree species

being obtained under the partial shelter of the trees remaining after each cutting. Regeneration of a mature forest stand by the shelterwood method may involve a series of different kinds of cuttings applied in the order given below.

1) **Preparatory Cuttings** Cuttings made to prepare dense mature forest stands under which regeneration of desirable tree species has failed to become established for regeneration by;

Removing defective trees and trees of undesirable species improving the vigor, seed production and windfirmness of desirable tree species and/or increasing the rate of decomposition of thick humus layers that tend to preclude the establishment of natural regeneration.

2) **Seed Cutting** Cutting make in a mature forest stand to create permanent openings of sufficient size in the crown canopy to permit heat, light, and moisture to penetrate to the forest floor in amounts required for germination and seedling establishment of desirable tree species. The seed cutting should be made during a year when the desirable tree species bear seed in abundance, remove the least desirable trees in the stand, be confined to a single operation to secure uniformity of the regeneration in age and size.

3. **Selection Method** The removal of mature timber usually the oldest and largest trees, either as single or scattered individuals (single tree selection) or in small groups (group selection) from areas rarely exceeding 1/4acre in size in relatively short intervals, repeated indefinitely, by means of which the continuous establishment of the regeneration of desirable tree species is encouraged and an uneven-aged forest stand is developed and maintained.

4. **Coppice Method** Any type of cutting in which dependence is placed primarily on vegetative regeneration

(coppice sprouts, root suckers and layers).

5. **Coppice-With-Standards Method** The production of coppice and trees of seedling origin on the same area with selected trees of seedling origin being carried through much longer rotation than those of vegetation origin.

Rotation The period of years required to establish and grow timber crops to a specified condition of maturity.

Cutting Cycle The planned interval in years between regeneration cuttings in the same stand.

Silvicultural System A process following accepted silvicultural principles, whereby tree crops are tended, harvested and replaced, resulting in the production of crops of distinctive form.

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