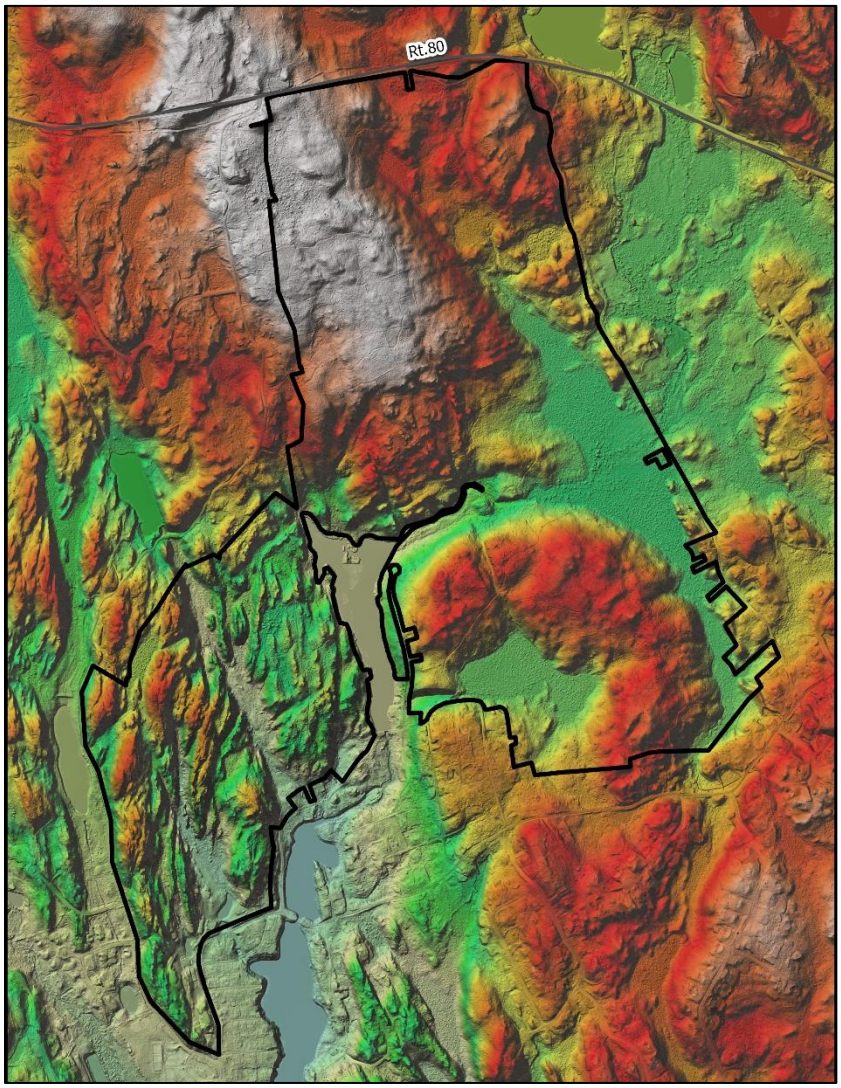
Management Plan for Guilford Timberland Preserve
Town of Guilford
597.91 mapped acres; 2022-2031
Old Toll Road
Guilford, CT – New Haven County



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1 EXECUTIVE SUMMARY

This Management Plan is intended to guide the management the Timberland Preserve in Guilford, Connecticut for the period of 2023-2032. This property is to be managed to maintain vigorous and diverse forest cover, enhance forest resilience, provide recreational experiences for the public, enhance wildlife habitat for a variety of species, help maintain balanced and properly functioning ecosystems, maintain historic features where appropriate, and maintain aesthetic qualities, all while keeping the protection of water quality and soil integrity paramount.

The entire property contains 597.91 mapped acres. The entire property, except for the golf course, was researched and field-investigated by Ferrucci & Walicki LLC in winter and spring 2022. The results of the inventory, along with multiple-use management recommendations for the next ten years from the time of plan development, are included in this plan.

The investigation revealed that the property contains even-aged and two-aged upland forest, forested wetlands, unique geological features, and a wide variety of water features such as vernal pools, seeps, and multiple watercourses. A variety of opportunities to improve forest health, wildlife habitat, and to provide recreational and educational opportunities exist on this property. For all of these reasons and more which will be discussed in this plan, this property is well-suited for a multiple-use land management program. All of the recommendations provided in this document have been carefully considered and balanced within the general overall objectives of the owner's land management goals and other interests.

1.1 Goals

The Timberland Preserve provides numerous benefits to both the Town of Guilford and surrounding communities. This large property provides wildlife habitat, watershed protection, aesthetic backdrops, recreational opportunities, and many other ecosystem services. If properly cared for and responsibly managed, forests can provide multiple-use benefits in perpetuity. It is the purpose of this plan to provide management recommendations that, if followed, will help this valuable property continue to provide diverse wildlife habitat, water quality protection, enjoyable recreational experiences, and sustainable, local forest products for the future.

The goals laid out below, the conditions of the property's resources, and the relationships between all of the elements of the forested ecosystem were considered while developing this Plan. Such a comprehensive program involves many elements and actions, including the active management of forests to improve habitat, diversity, and overall forest health, and the potential to maintain some other areas' forests as "reserves". The recommended mixture of actively managed "woodland" areas and reserved "wildland" areas is intended to generally observe concepts in the landscape-wide management strategy recommendations in the 2010 Harvard Forest report "Wildlands & Woodlands – A Vision for the New England Landscape".

Woodlands: "Well-managed forests of diverse age, species, and structure that are permanently protected from conversion to development and fragmentation and provide a wide array of economic and environmental benefits."[1]
Wildlands: "Large forest landscapes permanently protected from development, shaped by natural processes and the prevailing environment to promote conditions largely free from human impact."[2]

Goals for the Timberland Preserve
Multiple-Use Management Program

1. Protect soil and water resources and enhance water quality where feasible
2. Engage in sound, sustainable stewardship of the land.
3. Maintain and improve forest and ecosystem health and resilience including enhancing carbon sequestration and storage.
4. Maintain and enhance diverse habitat for wildlife (especially birds).
5. Maintain current network of recreational trails
6. Protect identified and important cultural resources and species of special concern.
7. Provide a variety of safe and enjoyable recreational opportunities.
8. Produce forest products using sustainable management techniques.

1.2 Summary of Resource Concerns

- High density of overstory trees in places reducing tree vigor/inhibiting regeneration.
- Dense populations of invasive plants established in some areas.
- Lack of diverse tree regeneration in many places.
- Erosion in some parts of the road/trail system.
- Some mortality and decline due to spongy moth defoliations.
- Decline of beech from beech leaf disease

1.3 Summary of General Recommendations

Area specific recommendations can be found on page XXX
Natural Resources

[1] Foster, D.R. et al., *Wildlands and Woodlands: A Vision for the New England Landscape*, 13.

[2] Foster, D.R. et al., *Wildlands and Woodlands: A Vision for the New England Landscape*, 17.

1. An active forest management program, including wildlife habitat work, should be continued on this property. Efforts to maintain and improve forest health and resilience, wildlife habitat diversity, ecosystem health and diversity, water quality, and soil stability while keeping personal safety on the property in mind should be the focus of management activities. Manage across boundaries, especially with the Cockaponset State Forest to the north, if possible.
2. Engage in projects to improve species, age class, and size class diversity of vegetation.
3. Invasive plants should be controlled/removed to encourage regeneration of native vegetation and to improve wildlife habitat. Native alternatives may be planted to replace invasives if conditions are suitable.
4. Protect vernal pools and known amphibian breeding areas by establishment of a no-cut buffer and by maintaining trails upslope that may erode into pools.

Recreation

1. Continue the maintenance, and if desired, expansion of the trails that currently provide access to the property.
2. Ensure the preservation of historical features (stonewalls, foundations, wolf trees, etc.).
3. Encourage hunting of deer to reduce browse pressure on vegetation. Given the recreation pressure on this property, an archery only program may be appropriate.
4. Conduct an inventory of road and trail conditions on the property to codify their locations and identify places where erosion control is needed.

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3 BACKGROUND

3.1 Landowner Goals and Purpose of Plan

The Town of Guilford is interested in establishing a sustainable forest land management program that strives to maintain and enhance resilience, vegetative health and diversity, wildlife habitat diversity, and structural complexity[3], allow for safe and enjoyable recreational use, allow for nature study, enjoyment, community use and engagement, and maintain water quality and soil integrity. Additional goals include

[3] Structural complexity is the presence of diverse species mixes, multiple strata (i.e., layers of vegetation in the forest), age, and size classes of vegetation in combination with other physical features such as large standing snags/cavity trees and down woody material. Certain silvicultural techniques that create these conditions can mimic natural disturbances, increase complexity and provide quality, diverse habitat conditions for a variety of plant and wildlife species and communities.

preserving historic/cultural features, protecting species of special concern and Critical Habitats, and sustainably producing wood and other forest products.

Over the next twenty years, management within the Timberland Preserve should:

- Codify location and condition of recreational trails and access
- Remove potential risk trees near frequently used infrastructure including open areas, roads and some trails
- Reduce invasive plant populations
- Maintain and enhance habitat conditions for a variety of suites of wildlife species
- Maintain and increase overall species diversity of vegetation
- Increase species, size and age class diversity of trees, especially in the portions of the canopy lower to the ground (i.e., midstory and understory)

The words “resilient” and “sustainable” are used throughout this document. Occasionally, the two words can be considered fungible, however the word sustainable is more focused on outcomes of management and human-related activities. Sustainable management aims to achieve desired outcomes to maintain or improve current conditions which can be considered strengths of an area without sacrificing long term productivity. For example, sustainable trail systems are those that are well-suited to ground conditions, well-placed on the landscape, and are in sufficient numbers and areas to accommodate expected amounts of and types of traffic comfortably and while maintaining a high quality of user experience and not having outsized negative impacts on ecological features. As another example, sustainable forest management is conducted in a way that maintains or enhances vegetative species diversity, structural complexity, adaptive capacity, and does not degrade site quality of areas in which it is conducted. Sustainable management (of which there is a gradient from significant disturbance to little to no intentional disturbance) can help maintain and enhance resilience.

While there are no perfect definitions of what the word resilient means in the context of forests (forests in general, nor forests in southern New England specifically), it is used in this plan to describe the ability of the forest to survive (persist) and thrive (with vigor) when faced with challenges both known and unknown.

A critical part of resilience is continuing to be able to provide the valuable suite of ecosystem services to humans (i.e., clean water, clean air, temperature regulation, aesthetics, recreation, forest products, etc.), and breadth of habitat conditions for vegetation, wildlife, and others. Some of the major known challenges that are impacting the forest at this property and are likely to continue to have impacts in the future include some human activity (scattered dumping of household debris has occurred in the past but doesn’t appear to be a current issue), invasive plants, insect pests and other biotic risks, and increasing intensity of storms that damage trees. Less clear, but equally real challenges that may have an impact here include shifting and less predictable climatic patterns such as precipitation and temperature fluctuations among other unknown threats.

There are a variety of forest conditions that help maintain and enhance resilience over the long term. For the purposes of this plan a resilient forest is one that contains a variety of:

- Tree species in all strata (overstory, midstory, and understory);
- Size and age classes of trees and other vegetation;
- Structural conditions; and
- Habitat conditions

Forests with a diverse species mix are better able to withstand and respond to threats both biotic and abiotic. Part of the reason is that diversity reduces the likelihood of massive loss of any one species or suite of species to a given perturbation. The likelihood of catastrophic and simultaneous tree failures in an area is significantly reduced by the presence of many species and sizes of vegetation. Similarly, size and age class diversity increases resilience because oftentimes younger and smaller trees are less impacted by severe weather events and even insect and disease outbreaks than older, more established trees. Regardless of tree size, healthy, vigorously growing trees are generally able to withstand insect and disease attacks and physical damage from storms better than trees that are struggling to survive.

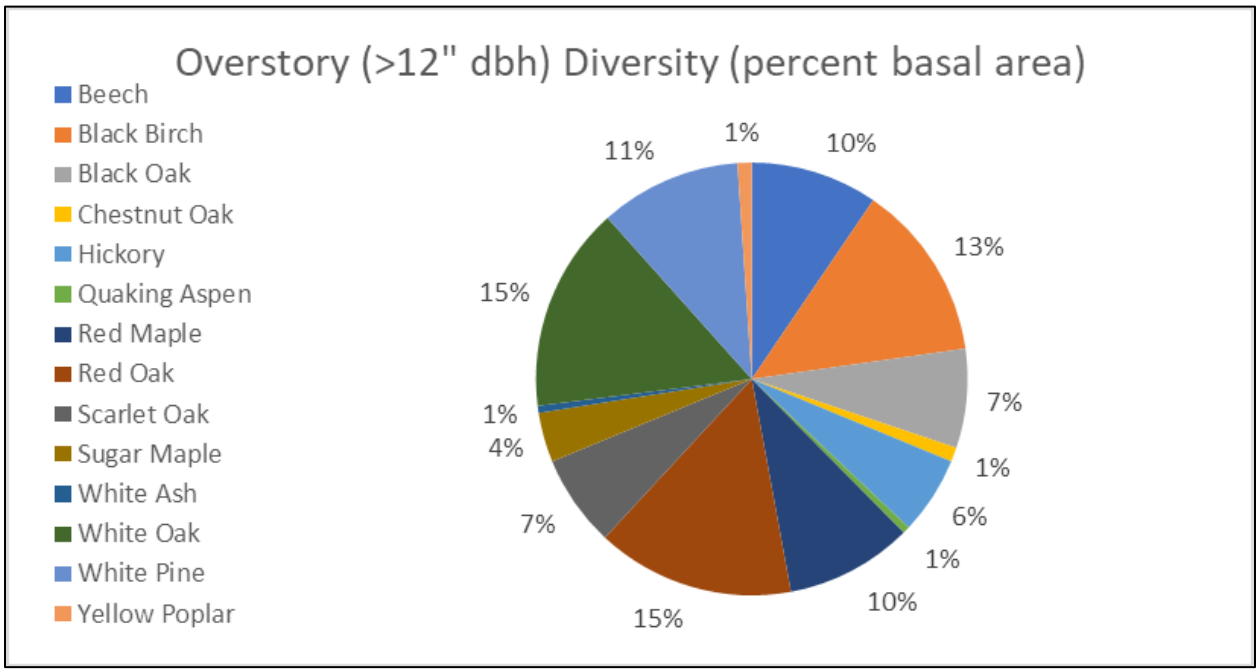
This property contains a diverse mix of tree species in the upper canopy, but is much less diverse in the small and younger age classes in the lower canopy (midstory and understory). The lack of understory and regeneration diversity is largely due to a generally closed canopy combined with excessive deer browse. The lack of sunlight reaching the forest floor (due to the mostly closed canopy) limits the species of trees and shrubs that can regenerate to those that are fairly tolerant of shade. This lack of diversity in younger age classes creates a forest that is less diverse over time, in effect reducing the forest's long-term resilience.

Active management that includes the cutting of trees individually and in groups is recommended for parts of this property in this plan to achieve stated goals. Among the reasons for tree removals discussed are:

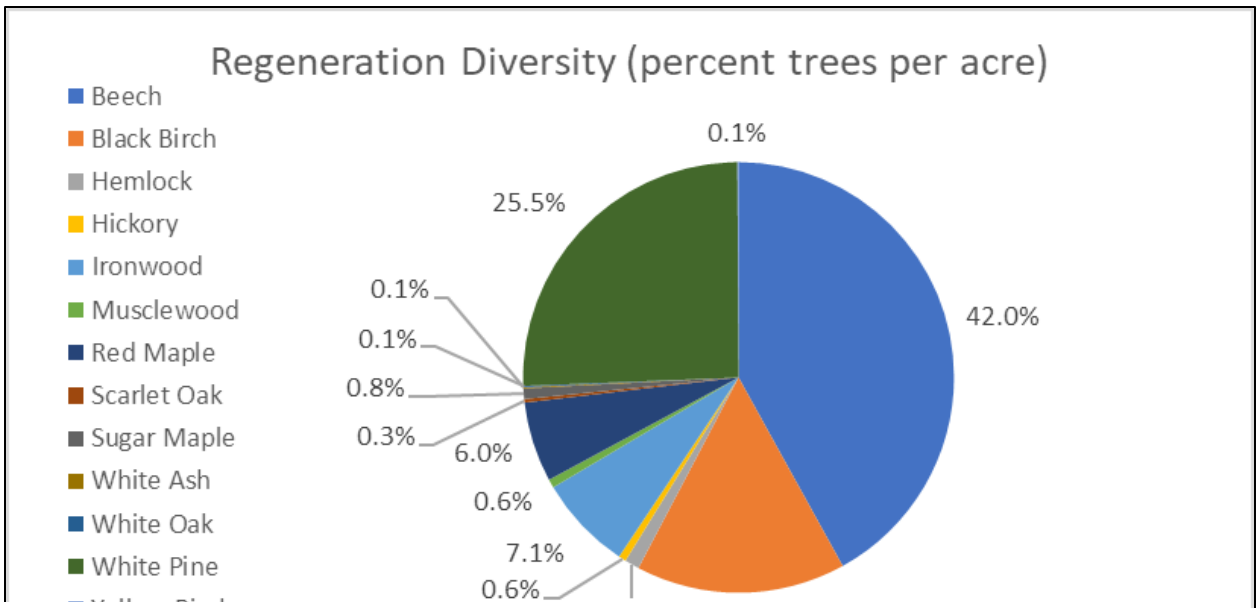
- To improve roosting opportunities for bats
- To remove potential risk trees
- To assist in controlling invasive species and encourage occupation of the site by more desirable native alternatives
- To help shift tree regeneration from mostly shade tolerant and potentially less desirable species such as American beech (which currently dominates the lower canopy classes) to a more diverse mix of species including oaks, pine, hickory, tulip poplar and other species which are somewhat less shade tolerant.
- To increase structural complexity and species diversity, both to improve wildlife habitat and increase the forest's resilience to disturbance.

A desirable species is one that has high ecological, economic, or cultural value. For example, white oak hosts an extraordinary number of insects which provide biodiversity in their own right in addition to being a food source for birds and small mammals. White oak wood is also very valuable, which makes managing around red oak economically feasible and desirable. Finally, red oak is culturally representative of the forests of this region and maintaining red oak on the landscape helps to perpetuate the unique aesthetic and recreational values of these forests. Hemlock is an example of a tree that is desirable for its ecological and cultural characteristics despite having limited economic value. Black birch, on the other hand, is not often actively managed for because it already comprises a significant amount of our future forests, and has lesser ecological and economic value than oaks. hemlock. etc.

Forests are dynamic and change over time. Some of these changes occur rapidly such as when a weather event or insect infestation breaks or kills trees or when trees are cut for specific purposes. Other changes can be much more gradual. Change can have positive or negative long-term implications for forest resilience. One of the most important metrics that will be discussed in this plan is species diversity, especially trees. This is examined from the forest floor to the top of the canopy. This property has a good diversity of trees in the canopy but is severely lacking diversity in younger trees. Oak species, for



instance, currently combine to make up approximately 46% of the trees in the overstory, but only 0.4% of the regeneration (seedlings and saplings). Beech, on the other hand, makes up 10% of the overstory and 42% of the regeneration. The relevance and importance of these figures will be discussed in detail later in the plan. Cutting, removing, and ideally utilizing wood from some of the cut trees is included as a recommendation within the plan, both as a tool to achieve objectives such as those just listed and also to assist with the economic viability of the project as a whole.



Top: Diversity of overstory trees in the Guilford Timberland Preserve. Bottom: Diversity of tree regeneration in the Guilford Timberland Preserve.

The specific recommendations that include tree cutting in this plan aim to enhance forest resilience primarily by enhancing vigor of residual trees by increasing the amount of available sunlight reaching their crowns, and by creating conditions closer to the ground that will facilitate the regeneration of tree and shrub species with diverse shade tolerances, not just the most shade tolerant species. Although parts of the Timberland Preserve have been managed in the relatively recent past (late 1990s and mid 2000s), the areas that were managed in the north block (Stand 1) are relatively small; there was somewhat more management in the south block (Stand 2) but supplemental treatments will still be necessary to achieve intended outcomes.

About Beech

Beech is a native tree species. Beech is projected to do well in a variety of climates including ours according to climate change predictions. They can provide useful habitat in the form of densely growing regeneration which serves as cover and potential nesting area for a variety of species of wildlife. When they are produced, beech nuts provide a useful source of lipids (i.e., fats) for birds and mammals. Beech are very shade tolerant. Another advantage beech have is that deer do not prefer them as a source of winter browse. Because of this, beech is often able to outcompete other native species where deer populations are high or in excess of carrying capacity. They frequently regenerate from root suckering (i.e., sprouting from roots) and stump sprouting which creates very dense thickets. The combination of their shade tolerance and their tendency to sprout make them very able competitors in the understory of closed canopy forest. In our area this often results in monocultures of beech.

The presence of densely growing beech midstory and understory trees can result in the reduction of diversity of tree, shrub, and herbaceous species, which is occurring in many parts of this property. The reduction of diversity in beech-dominated areas results in reduced resilience. In addition, slowly growing and diseased trees sequester (capture) and store less carbon with reduced likelihood of long-term climate change mitigation benefits. This is especially the case where beech bark disease affects beech. In these cases, not only are the beech dominant, but they are not healthy. Beech bark disease is common on this property, and it is possible or even likely that beech leaf disease will be coming if it is not already present. This creates an urgency to attempt to enhance diversity of regeneration in some parts of the property where appropriate.

Besides attempting to enhance species diversity by reducing some beech and the shade they cast, one additional potential benefit of cutting some of the midstory beech is to help facilitate the ingress and egress of foliage roosting bats such as the red bat in the upper canopy of the larger trees.

In addition to the reasons discussed above for intentionally attempting to increase the amount and diversity of tree regeneration, another reason is carbon. Carbon dioxide is one of the greenhouse gasses known to contribute to detrimental effects of climate change. Vigorously growing trees are very effective

at removing atmospheric carbon from the air (i.e., sequestration) and storing it in wood fibers (storage)[4]. Large and long-lived trees have the ability to sequester and store significant amounts of carbon. This property is currently trending away from a diverse mix of species (many of which are mature and long-lived) currently found in the overstory to a much less diverse mix of species of regenerating trees. The beech and black birch which dominate the understory (combined these two species constitute almost 60% of regeneration on the property) and therefore represent the future forest are both impacted by insects and/or disease complexes that are already resulting in shorter lived, smaller, less vigorous trees. In order to maintain the potential to continue the sequestration rates and storage potential that the current mature trees possess, some work will need to be done to help ensure the diversity of the future forest is enhanced.

Locally used forest products

The awareness of the benefits of purchasing and consuming locally grown food has increased substantially in public consciousness, discourse, and practice in recent decades. Supporting local farmers, keeping land in agricultural production, reducing carbon footprint of transporting food long distances from where it is produced to where it is sold and consumed, and knowing where food comes from, who is growing it, and how it is being grown and harvested are just some of the many reasons that the local food movement resonates with many people.

The Connecticut Grown label (pic ct grown label) associated with locally grown and produced food also applies to wood grown in our forests. Locally grown and utilized wood has many of the same benefits as locally grown food, including helping to keep forests as forests. Regardless of where the wood is ultimately processed and used, when wood products are a result of sustainably managed forests, there are many benefits. These include benefits that are seen and felt hyper-locally (i.e., to the forest or stand-level where resilience, vigor, and/or habitat goals are being met) and globally (i.e., the sustainable production and use of wood products can substitute for more carbon intensive products such as steel and concrete, simultaneously reducing carbon footprints and continuing to store carbon in the wood fibers utilized in long-lived, durable wood products).

3.2 Overview of Property

3.2.1 Land History

This property contains two units of bedrock[5], Monson gneiss and the Middletown formation. Both of these bedrocks are metamorphic, and the substrate that was metamorphosed into the Monson gneiss was

[4] There are other "pools" of forest carbon in addition to the carbon stored in the aboveground woody biomass of a tree. An excellent resource for learning about forest carbon and how it moves through forest systems is: Forest Carbon: An essential natural solution for climate change.

[5] Bedrock is the rocky parent material of which the tectonic plates are made, and on top of which soil forms and plants grow. Because mineral soil is initially formed by the weathering of this rocky parent material the fundamental chemical characteristics of a soil are largely a function of the bedrock from which it was formed, and it is these chemical characteristics that frequently determine what vegetation will grow, and how well.

intrusive igneous rock. Most of the soils on the property are in the Charlton-Chatfield and Hollis-Chatfield-Rock Outcrop groups, although locally enriched pockets exist, most notably in the western and southwestern portions of Stand 1. The Charlton-Chatfield complex soils are fairly productive and have a site index[6] of 65 at base age 50 for northern red oak. There are also significant pockets of poorly and very poorly drained soils in the wetland portions of the property (Stand 5[7]), as well as some areas defined by rock outcrops. For more detailed soils information see the soils maps in Appendix H.1.

Evidence of previous glaciation exists throughout the property. Many glacial erratics[8] and other interesting geologic features including sheer ledges, knife-edge ridges, and boulder fields remind us that the land has not always looked the way we currently see it.

3.2.2 Land Use History

In addition to the geo-physical history of the land, people have had (and continue to have) substantial impacts on the forests, fields, and water bodies that exist today. For thousands of years prior to the arrival of European settlers in the early- to mid-1600s Native Americans used the land for agriculture, hunting, gathering and to provide them everything they needed to live. Part of their management tools included clearing land and periodically burning portions of the understory[9] for a variety of purposes. A map showing tribal boundaries in Connecticut circa 1625 is on page XXX with the Timberland Preserve property shown in bright red for context. The Timberland Preserve is mapped as being primarily in Menunkatuck territory with a small part of the southeastern portion in Hammonasset territory.

This area of Connecticut and the area on and around this property have been settled by for some time. Once the land began to be cleared by the settlers, very little of it remained intact. Stonewalls found throughout the property indicate that the forests we see today were cleared in the past for agricultural purposes and may have also been used for charcoal production, though no charcoal mounds were noted on the property. Pockets of multi-stemmed trees are a tangible reminder of how fortunate we are in the northeastern United States that the soils and the climate are such that when a tree is cut, other trees can and do grow back. For a visual representation of the location of some of the historic features on the property, see the Historic Features map on page XXX.

Aerial photos from 1934 indicate that the entire property was forested at that time. However, it appears that much of the forest present in the 1934 images is relatively young forest[10], indicating that agricultural

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[6] Site index is a measure of a soil's productivity and describes the expected height of a given tree species at a certain age on those soils. In this region, 50 years is commonly used as the base age for site indices. A soil with a site index of 65 for red oak would be expected to have red oak that are 65 feet tall at age 50 under normal growing conditions. For red oak, 40-50 is poor, 50-60 is fair, and above 60 is good.

[7] The stand boundaries used in this plan were intentionally kept mostly uniform with previous plans to ensure continuity of data, treatment history, and location.

[8] Glacial erratics are large rocks deposited by glaciers. Because glaciers often carry debris for many miles before depositing it, the chemical composition of erratics is usually different from the bedrock of the area in which they are found.

[9] For the purposes of this plan, there are three layers (strata) of live vegetation and foliage that will be discussed. Understory refers to the layer of vegetation that grows between ground level and 5 ft. above the ground. Midstory is between 5-30 ft. above the ground and the overstory is > than 30 ft. above the ground. Each layer means something different ecologically and from the perspective of wildlife habitat.

[10] Although interpreting aerial photos from 1934 can be imprecise due to the image quality, it appears that there were more, smaller tree crowns present at the time, indicating a younger forest with more, but smaller trees.

abandonment may have occurred only shortly before then. It also appears that there may have been a more significant softwood component in 1934. Though there was forest in 1934, a massive and very destructive hurricane swept through New England in 1938 destroying many of the mature forests, and there may have been damage to these forests in that event as well. It is likely that many of the larger and less pliable trees present at the time were damaged in some way or another. For more detail see the 1934 aerial photo on page XXX.

Not all of the management activities on this property have occurred in the distant past. Stumps of different ages can be found in places throughout the property indicating varying levels of previous management activity. A firewood program in which residents were issued permits to cut firewood on specified tracts of the Timberland Preserve existed for approximately 3 years in the early 1980s but was stopped because of declining public interest. For this program, trees to be cut within those tracts were marked by foresters from Ferrucci & Walicki, and the prescriptions were mostly improvement thinnings (removal of poor quality trees to concentrate resources on more desirable trees). The total volume of firewood removed was approximately 60-90 cords. During this time, a contractor hired by the town also filled in some test pits that were dug in the 60s and 70s when the property was being considered for development.

The forest management plan completed in 1997 for the property laid out six broad goals:

1. Creation of a natural preserve by setting aside a substantial amount of the Timberlands in its current state, allowing minimal active management for safety, passive recreation, and other management objectives.
2. Aesthetics
3. Ecology
4. Water Quality
5. Wildlife
6. Income

The vast majority of the property has been intentionally allowed to continue to develop with limited active management as the first goal stated. The goals have been partially achieved and over time the property has changed (even the portions of the property that have not been actively managed over the last twenty five years). The relative lack of invasive plants primarily due to the mostly complete canopy closure is an important characteristic. The 1997 management plan called for setting aside the “southwest and wetlands management units” (Stands 3-5 in this management plan), and actively managing the majority of the rest of the property (called “the northeast management unit” in the previous plan and referred to as Stands 1-2 in this plan).

The intention of the treatments that were scheduled in the 1997 plan were to enhance growing conditions for residual trees using a crop tree release technique and to regenerate portions of the area using a combination of patch cuts and shelterwood treatments. This was scheduled to occur in two separate treatments spaced five years apart in both Stand 1 and Stand 2. The plan called for the regeneration of between 28-40 acres in these two stands and crop tree treatments between regeneration treatments.

A very small fraction of the regeneration treatments were completed in Stand 1. Approximately nine (9) acres were scheduled for regeneration in the late 1990s using a combination of patch clearcuts and shelterwood treatments. The stated goals at that time were to regenerate oak and desirable mixed

hardwoods in the hardwood treatments and pine in the areas dominated by white pine to enhance species diversity of regeneration on the property and to create some young forest/early successional habitat.

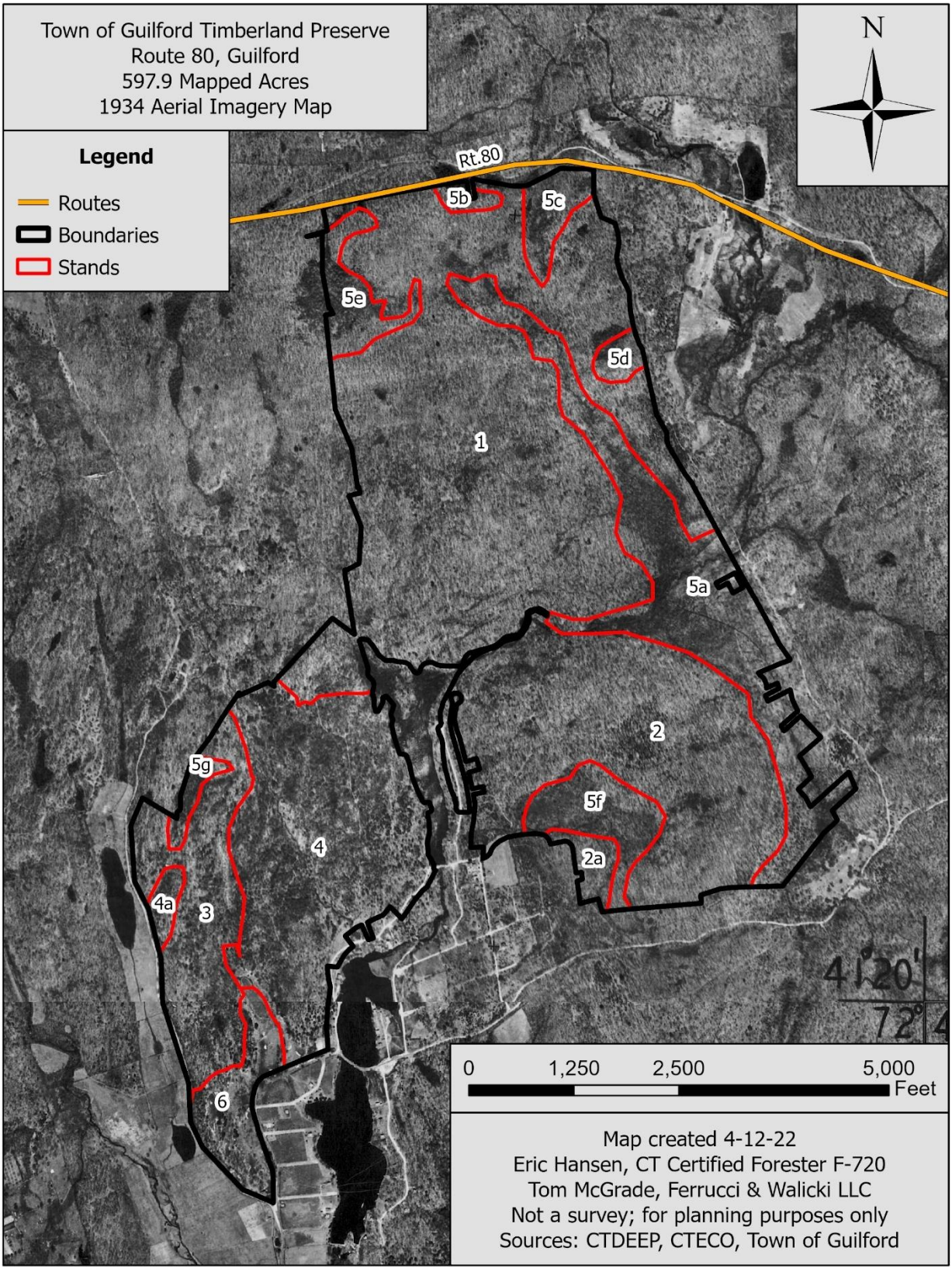
Early successional habitat was most successfully created in the small pockets that were treated, although the harvests were long enough ago that those patches have lost most of their utility as habitat for wildlife species that require early successional conditions. Efforts to regenerate intended tree species (oak, hickory, tulip poplar, sugar maple) were only somewhat successful. Inspection of this treatment showed that while most of what was regenerated was beech and black birch (both of which are highly susceptible to diseases that frequently limit their growth and life spans), roughly a quarter of the gaps created during the last treatment had enough oak, hickory, and sugar maple regeneration to provide a good chance that those trees will eventually become main canopy trees and part of the future stand.

The crop tree release treatments that were scheduled in the 1997 plan were not completed and the vast majority of Stand 1 (about 205 of the 2016 mapped acres in the stand) were allowed to continue to develop with limited to no active management.

There was another treatment in 2006, in the southeastern block of the Timberland Preserve, which is called Stand 2 in this plan. The prescribed treatments in this stand were again a combination of a crop tree release treatment and regeneration treatments. Similar to Stand 1, the crop tree release treatments were not done, but some regeneration treatments were attempted. These were a combination of small clearings and shelterwood treatments.

The outcomes in Stand 2 were slightly less successful than the treatment described above as determined by the quantity of desirable tree regeneration. While the prescriptions (patch cuts and shelterwoods) were the same as what was prescribed in the northern block of Stand 1, there was notably less regeneration of oak and hickory in the treatment areas of the southeastern block (a.k.a. Stand 2). However, some of the gaps created near the western side of Stand 2 resulted in good white pine regeneration. There is also scattered white pine regeneration throughout Stand 2, even outside of the 2006 treatments. Between the pine regenerating in the patches and shelterwoods from 2006 and the pine regenerating on its own, the softwood component of Stand 2 may increase in the next half-century. Because softwoods are generally underrepresented on the Connecticut landscape, this would be desirable.

There are many possible reasons for the lack of success in terms of regenerating target species. The two primary reasons are the relatively small sizes of the treatments (especially true in Stand 1) and an overabundant deer population that preferentially browses the species targeted for regeneration. Treatments in both stands have not resulted in an overwhelming introduction of invasive plants. The treatments have successfully increased the structural and age class heterogeneity on the property which is important given how uniform much of the rest of the untreated areas (in Stand 1-2 which make up most of the property) are in species mix, size class, and structure. This is important for resilience (whether from natural disturbances or climate change related issues) and for wildlife habitat. Enhancing structural, size, and age class diversity is a critical part of ensuring a variety of wildlife species have suitable habitat. Previous harvest maps can be found in Sections 5.2.7-9.


Town of Guilford Timberland Preserve
Route 80, Guilford
597.9 Mapped Acres
1934 Aerial Imagery Map
Legend
Routes
Boundaries
Stands
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Rt.80
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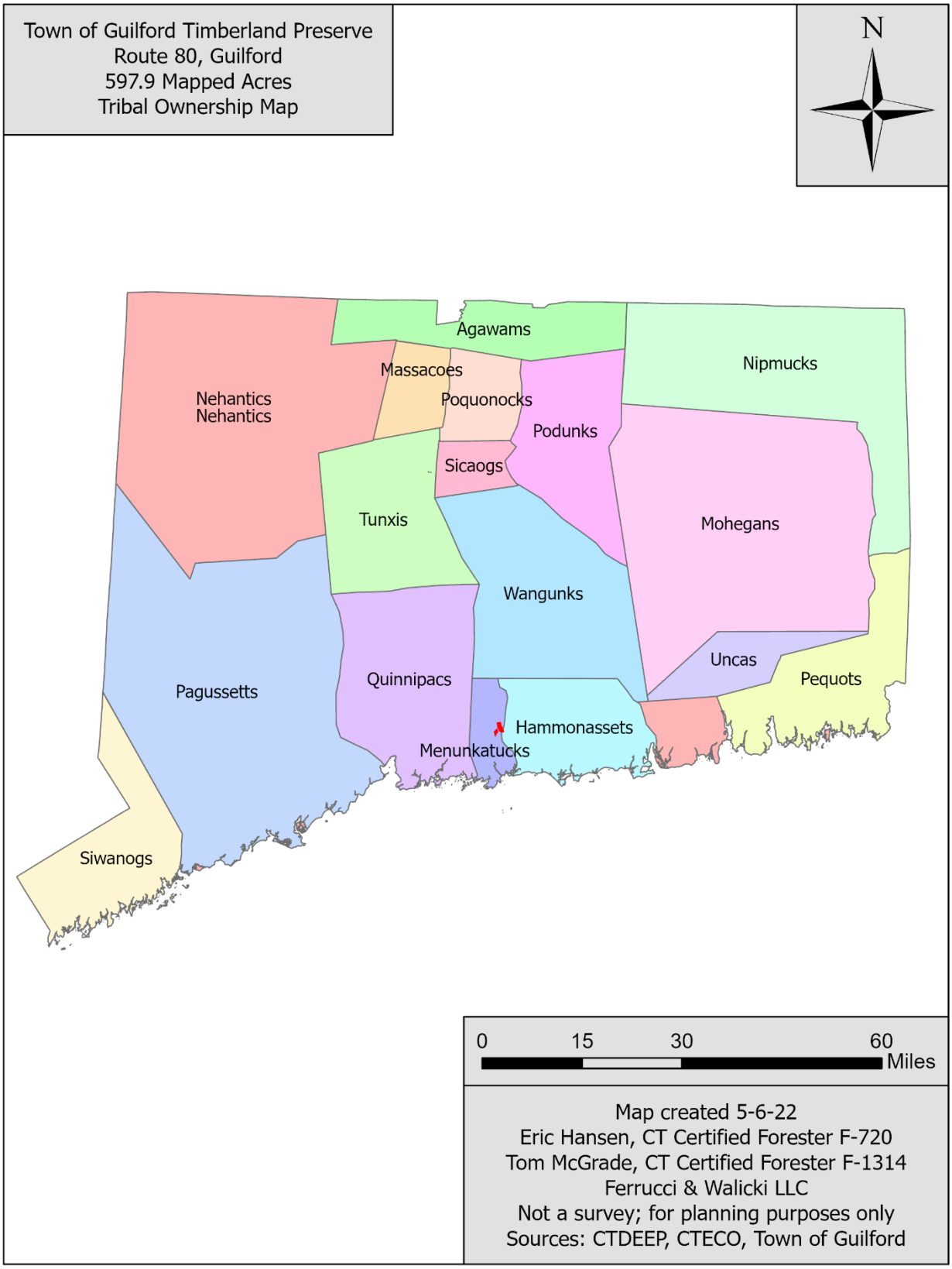
5,000
Feet
Map created 4-12-22
Eric Hansen, CT Certified Forester F-720
Tom McGrade, Ferrucci & Walicki LLC
Not a survey; for planning purposes only
Sources: CTDEEP, CTECO, Town of Guilford



The red object is the Timberland Preserve.

3.2.3 Landscape Context

The Timberland Preserve is a critical part of the region's open space portfolio. This region contains an array of open space that includes property owned by the State of Connecticut (Cockaponset State Forest), Guilford Land Conservation Trust, Guilford Sportsmen's Association, and many smaller town-conserved properties.

This amalgam of open space helps keep this area rural and reduces further fragmentation which helps protect habitat, ecological processes, and water quality. As in most of Connecticut, existing open space in this area is highly valued for its natural resource conservation and aesthetic values. Conserving open space is an important value expressed in the South Central Region Council of Governments (SCRCOG) Regional Plan of Conservation and Development (2018). The Timberland Preserve plays a very large role in the existing open space land in Guilford and the surrounding towns. Adjacency to the Cockaponset State Forest and close proximity to properties owned by the Town and smaller conservation organizations increases the ecological value of the Timberland Preserve.

Quantity, quality, location, and arrangement of forestland is important when examining natural resources at any scale, but especially at a large landscape-level view. The Timberland Preserve is part of a large block of forestland including the Cockaponset State Forest, the area surrounding Lake Gaillard owned and managed by South Central Connecticut Regional Water Authority (RWA), and numerous other smaller privately conserved land, land trusts and town-owned lands. There are corridors of development surrounding state roads in the area, but for the most part many of the forests remain connected.

According to the landcover data, there is substantial non-agricultural development to the southwest, west, and some to the southeast of the property. Much of the land to the northwest, west and northeast is less developed. The property's close proximity to the densely populated New Haven area, I-91, and I-95 corridors make it even more important as a refuge from development for both wildlife and people.

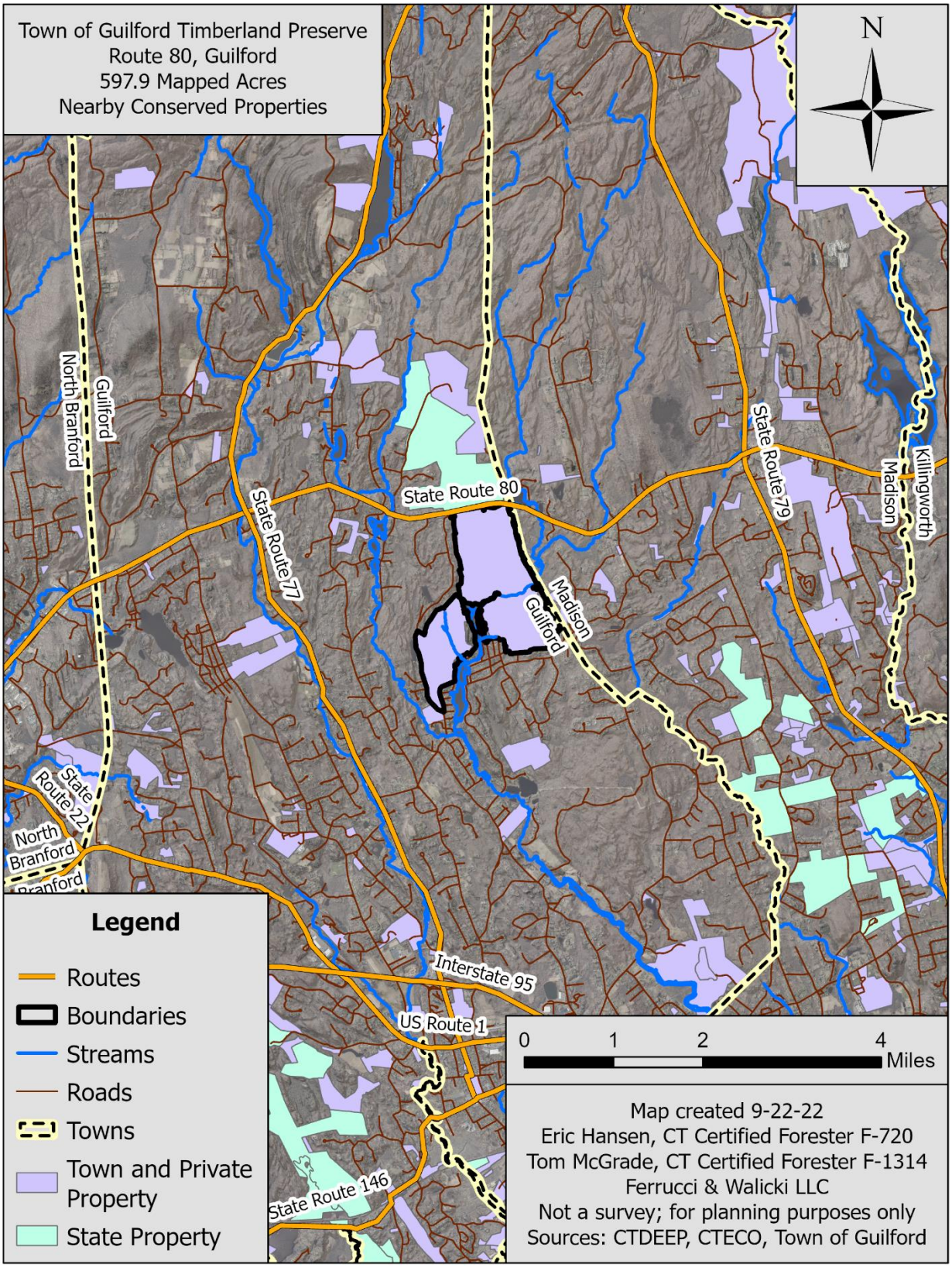
While the presence of forest cover is important, its arrangement can have significant impacts on the ways it functions as an ecosystem. Forest cover arrangements that contain a mixture of core, perforated, and edge forest types are generally desirable, as this provides forest structure diversity (which increases the ecological complexity of the area) and diverse habitat opportunities. The process where large blocks of unbroken core forest are broken up by development or conversion to other land uses is referred to as fragmentation.

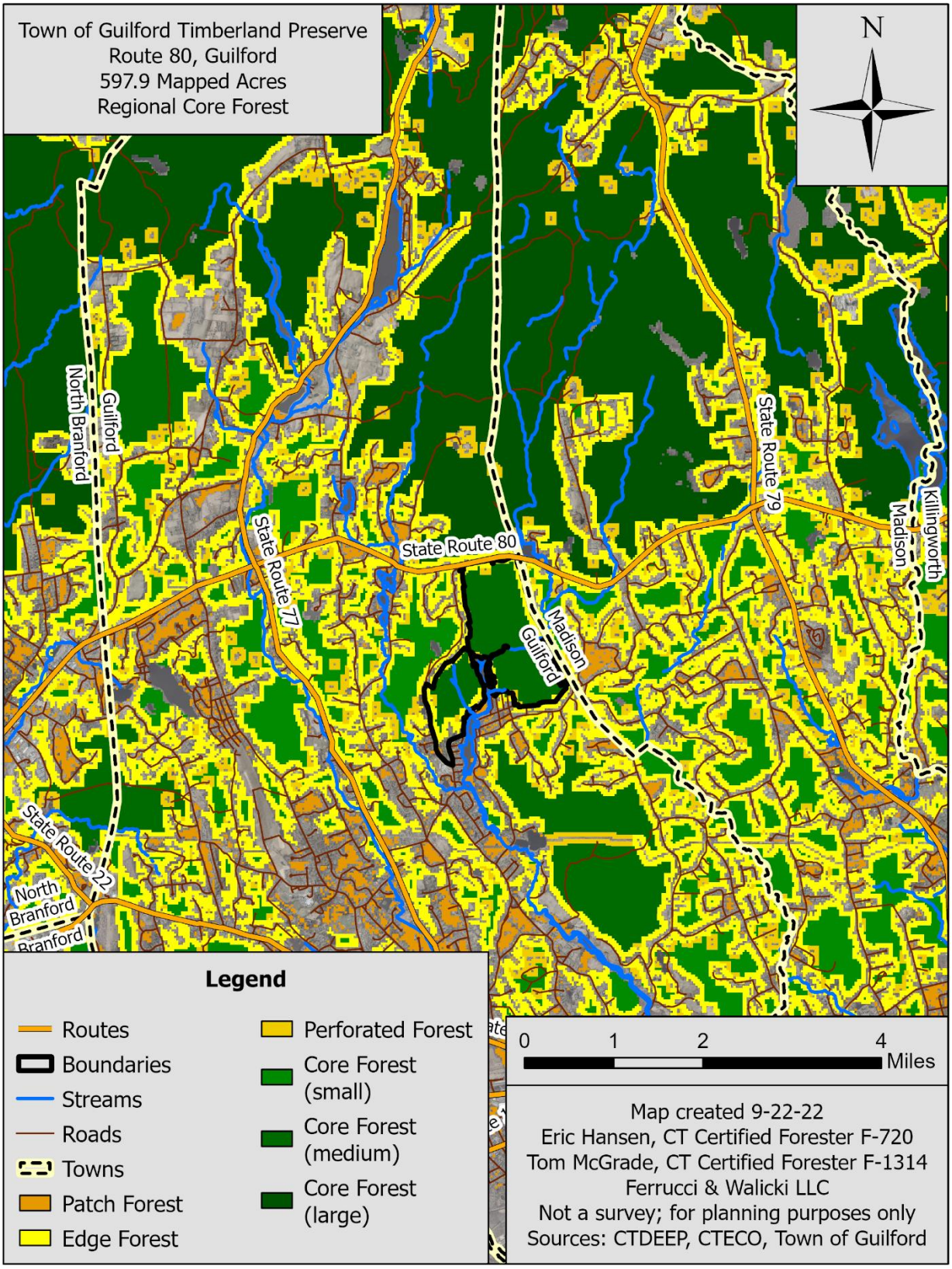
CORE FOREST: Contiguous forested areas at least 250 acres in size, and at least 300 feet in all directions from non-forested areas.

Core forest is the most quickly declining forest type in Connecticut. This loss is a concern because it is accompanied by a loss of habitats and potential loss of the wildlife species that rely on it for survival, and because core forest best provides other forest functions such as water quality protection. Forest management that involves cutting trees does not generally constitute a loss of core forest because it does not convert forestland to non-forest, but changes to other land uses (i.e. building impervious roads, houses etc.) does.

A recent study by the University of Connecticut's Center for Land Use Education and Research (CLEAR) used satellite landcover data to examine forest fragmentation and the distribution of various forest types across the State (www.clear.uconn.edu). Based on the CLEAR study, the Timberland Preserve contains and is adjacent to significant amounts of core forest, including the most important ">500 acres" core forest type. The property also contains small amounts of edge forest, important for many species such as raptors, songbirds and some mammals, mostly associated with the perimeter of the Preserve where it abuts numerous houses. The non-forest on this property is primarily golf course, which was not assessed for this plan.

Overall, developing a program to maintain or increase age, size class, and species diversity can provide many forest function and habitat benefits for this property and beyond. When this is done it is important to consider managing across boundaries to enhance impact of planned treatments. This is especially appropriate here considering the proximity of the property to Cockaponsett State Forest and a block of Regional Water Authority property to the north of the state land. Currently, planning is underway to update the plan for the state land. As an example, the utility of young forest and early successional habitat conditions for wildlife can be greatly improved when adjacent owners can cooperatively plan activities that will create such conditions over time. The ephemeral conditions created by such treatments can be extended in a relatively compact area and the wildlife that rely on them need to migrate relatively short distances to find suitable habitat.


Town of Guilford Timberland Preserve
Route 80, Guilford
597.9 Mapped Acres
Nearby Conserved Properties
N
North Branford
Guilford
State Route 77
State Route 80
State Route 79
Madison
Killingworth
Madison
Guilford
State Route 22
North Branford
Interstate 95
US Route 1
State Route 146
Legend
Routes
Boundaries
Streams
Roads
Towns
Town and Private Property
State Property
0 1 2 4
Miles
Map created 9-22-22
Eric Hansen, CT Certified Forester F-720
Tom McGrade, CT Certified Forester F-1314
Ferrucci & Walicki LLC
Not a survey; for planning purposes only
Sources: CTDEEP, CTECO, Town of Guilford


Town of Guilford Timberland Preserve
Route 80, Guilford
597.9 Mapped Acres
Regional Core Forest
N
North Branford
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State Route 77
State Route 80
State Route 79
Madison
Killingworth
Madison
Guilford
State Route 22
North Branford
Branford
Legend
Routes
Boundaries
Streams
Roads
Towns
Patch Forest
Edge Forest
Perforated Forest
Core Forest (small)
Core Forest (medium)
Core Forest (large)
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Miles
Map created 9-22-22
Eric Hansen, CT Certified Forester F-720
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Not a survey; for planning purposes only
Sources: CTDEEP, CTECO, Town of Guilford

3.3 General Property Description

The +/- 580 acres (Timberland Preserve minus the golf course) described in this management plan is in the Town of Guilford, in New Haven County, Connecticut. The land described in this plan (hereinafter referred to as "the property") is in one contiguous block and is bounded on the north by State Route 80, beyond which is Cockaponset State Forest, on the east by Twin Bridge Road, on the south by the neighborhood managed by the Guilford Lakes Improvement Association, and on the west by Maple Hill Road and Maupas Road. Twin Bridge Road, Maple Hill Road, Maupas Road, and the Guilford Lakes Improvement Association neighborhood all have numerous small private properties which abut the Timberland Preserve.

This remarkable property is a mix of upland forests, forested wetlands, and riparian areas. There are many water features on the property including Iron Stream, numerous functioning vernal pools[11] and potential vernal pools, forested wetlands, and several small streams, both intermittent and perennial. Hardwood species present include a variety of species of trees such as red maple, oaks (red, black, scarlet, chestnut, and white), hickory, birches, ash, beech, and some softwoods. Softwoods present include white pine and some midstory hemlock. The property is currently used for passive recreation, wildlife observation, and providing wildlife habitat.

3.3.1 Boundaries and Access

This property has nearly 16,000 linear feet of frontage on State Route 80, North Madison Road, Maupas Road, and Twin Bridge Road combined, although approximately 4,300 feet of that frontage are occupied by the Guilford Lakes Golf Course. There are several access points along these roads, although some lack convenient public parking. Equipment used in past management has entered the property from Laurel Road and Twin Bridge Road.

There is a series of roads and trails in the interior as well as along some of the boundaries which provide good access to and through much of the property. There is a significant road running east-west through the northern portion of Stand 1 which was used by Guilford residents cutting firewood in the 1980s in addition to several skid roads in both Stand 1 and Stand 2 which were used during management operations in the 1990s and in 2006. A network of hiking trails provides excellent walking access to much of the property, with the exception of the forest wetlands. Several footbridges are present where trails cross either Iron Stream or portions of the forest wetland. The roads and trails are mostly in good condition, although there are several wet spots on the main trails, one of which may actually be a seep. Conducting an inventory of road condition and developing a plan for desired future uses and conditions would likely be useful.

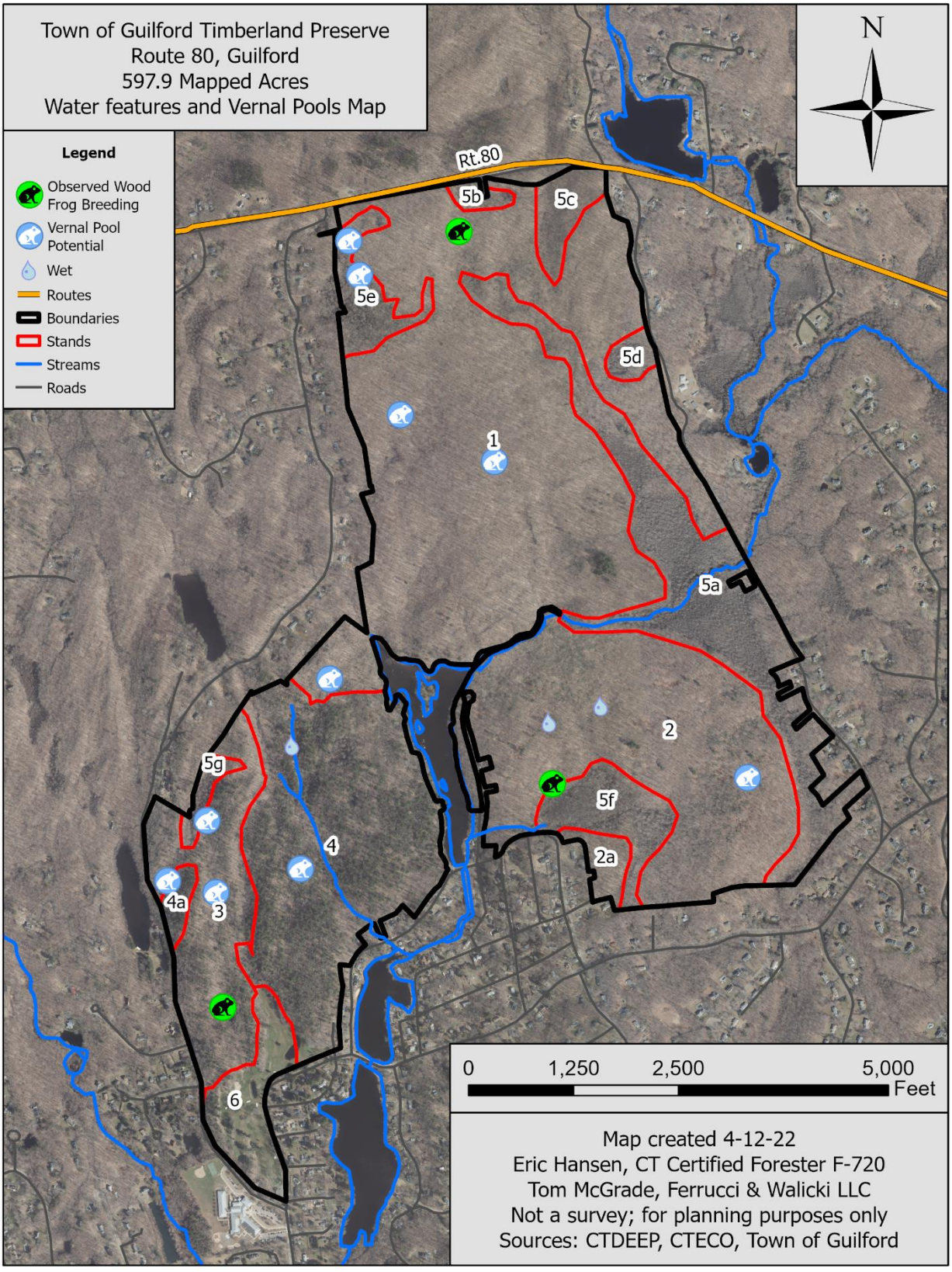
3.3.2 Water Features

The primary hydrologic feature on this property is Iron Stream, a tributary of the East River, which eventually empties into Long Island Sound. Iron Stream flows east-west through the east-central part of the property for approximately 4,100 feet. Additionally, Upper Guilford Lake, though not technically on the property is surrounded by the Timberland Preserve on its east, west, and north shorelines. There are also multiple seeps, potential vernal pools, functioning vernal pools, and smaller watercourses on the

[11] Functional in this case means that the vernal pool is successfully providing habitat for vernal pool-obligate amphibians, such as wood frog. A potential vernal pool is one which appears likely to be functioning due to its size, location, and landscape setting, but in which breeding of vernal pool-obligate amphibians was not observed during field visits.

property. There are extensive mapped wetland soils on the property, all of which are forested. Adjacent properties appear to have some similar wetlands, but Iron Stream, Upper Guilford Lake, and the numerous small wetlands between knife-edge ridges in the southwest make this property uniquely important in terms of the general area's hydrologic function.

These features appear to be in good condition, but populations of invasive plants, primarily barberry, are starting to become established in drainages, particularly in the southwest of Stand 1.


Town of Guilford Timberland Preserve
Route 80, Guilford
597.9 Mapped Acres
Water features and Vernal Pools Map
Legend
Observed Wood Frog Breeding
Vernal Pool Potential
Wet
Routes
Boundaries
Stands
Streams
Roads
N
Rt.80
5b
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1
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1,250
2,500
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Feet
Map created 4-12-22
Eric Hansen, CT Certified Forester F-720
Tom McGrade, Ferrucci & Walicki LLC
Not a survey; for planning purposes only
Sources: CTDEEP, CTECO, Town of Guilford

3.3.3 Wildlife Habitat and Biodiversity

3.3.3.1 NDDB and Critical Habitats

A check of Connecticut's Natural Diversity Database (NDDB) indicates that rare, threatened, endangered or special concern species may occur in the extreme southern end of the Guilford Lakes Golf Course, but because that part of the property is not included in the management plan no NDDB request was made to determine which species those are.

3.3.3.2 Important Features

The most notable wildlife features on this property are undoubtedly the numerous functioning vernal pools. Due to the timing of the inventory in late winter and early spring of 2022, F&W foresters were able to observe active wood frog breeding in a number of places on the property. There are also numerous large wolf trees which provide high-quality nesting and denning habitat for birds and small mammals, as well as many other cavity trees which provide potential cavities of a variety of sizes.

3.3.3.3 Structure and Composition

The Timberland Preserve is managed to promote wildlife habitat, to protect the wildlife that resides on the property, and to provide human visitors to the property a chance to connect with nature and the land. During many visits to the property a variety of wildlife and/or evidence of their presence was noted. The recommendations provided in this Plan for a habitat management program are intended to provide improved habitat for a multitude of species without creating significant, long-lasting negative impacts to non-target species of wildlife. In addition, protective provisions are included to inhibit potential impact to rare, threatened, endangered species, species of special concern, and/or rare and important habitat conditions found on the property.

The current forest conditions on the Timberland Preserve accommodate a variety of wildlife species but are limited for species that require a few conditions: young forest, dense understory of tree seedlings and saplings, and shrubby areas are some of the habitat conditions that are generally absent or in limited supply on the property. That said, the mix of forest cover types (i.e. softwood, hardwood, and mixedwood[12]), along with the water features on the property all combine to provide a great starting point for habitat diversity.

Small to medium sawtimber-sized trees dominate the forested portions of the Timberland Preserve, with a smaller amount in the poletimber-size[13] classes and an almost negligible amount of acreage in the seedling/sapling size classes. Several small patches of saplings exist as a result of management activities in the 1990s but these have "aged out" and no longer provide functional early successional habitat due to the dominance of sapling-size trees and lack of dense understory vegetation. Patches that were created as a result of the treatment in 2006 still have some value as early successional habitat, but will soon age

[12] Softwood is generally coniferous, evergreen trees such as pine and hemlock. Hardwood are generally broad-leaved, deciduous trees including maple, oak, and birch among many others. Mixedwood is a combination of softwood and hardwood such that softwood trees make up between 25-75% of the designated stand.

[13] Sawtimber-sized trees are those that are at least 12 inches in diameter (measured outside the bark) at breast height (a.k.a. dbh which is 4.5 feet above ground level). Small sawtimber is from 12-14" dbh, medium sawtimber is 14-18" dbh, and large sawtimber is >18" dbh. Poletimber-sized trees are those that are between 5 inches and 12 inches outside the bark at dbh.

out as well, reducing the amount of early successional habitat on the property to almost none. There are some dense patches of understory in riparian areas, and in some places (particularly western parts of the property), mountain laurel grows densely in the understory. Based on aerial photo interpretation, much of the forest cover adjacent to and surrounding this property contains similar size classes and mixes of species.

Many wildlife species use multiple habitat types and conditions in order to complete their life cycles. Providing diverse habitats can help ensure successful survival and reproduction of a variety of species. Lack of specific habitat features is often the limiting factor that determines whether or not a species can survive in a given area. Common habitat requirements include cover from predators, access to water, shelter from weather, breeding areas, and places where wildlife can successfully forage or hunt for food.

As a forest develops, vegetation size and species mixes can and frequently do change. Concurrently, its usefulness for satisfying the requirements of any given species also changes. Because of this, a mosaic of different habitat types is often beneficial and even necessary for most species of wildlife to be successful. For example, wild turkeys use mature forest with down woody material or shrubby areas for nesting habitat or breeding habitat. After the young have hatched they use open fields where they feed on soft-bodied insects. As the young turkeys develop they are able to use the mature forest for feeding on hard mast[14] from oak and beech trees[15].

A habitat that is regionally in short supply is early successional/young forest habitat. There is a paucity of areas with large, contiguous patches of 0-15 year old tree seedlings, saplings and shrubs as the featured[16] vegetation. Some of the management options recommended in this plan are designed to increase the amount of early successional habitat conditions, with a concurrent goal of encouraging the development of desirable regeneration, particularly oak.

Some of the important species on this property that utilize early successional habitat include songbirds and small mammals. Songbirds such as the chestnut-sided warbler, blue-winged warbler, rose-breasted grosbeak, American woodcock, and a variety of birds of prey, all known to occur in this area, require or heavily rely on old field/early successional type habitats.

Early successional forests currently make up a negligible amount of land of this property. Mature forests, which make up the majority of the forested areas on this property, can offer structural complexity (i.e., multiple canopy layers, coarse and fine woody material, snags etc.), which provides other kinds of habitat features important to many species of wildlife. However, many species of wildlife require both mature forest and young forest at different points in their lives, and some rely entirely on young forest.

There can be many strata in a forest but generally there is the main or upper canopy, the mid-canopy (a.k.a. midstory), the understory, and the forest floor. These strata develop because trees and other vegetation with different tolerances to shade grow at different rates. This, in combination with disturbance, is what leads to complex structure.

[14] Mast is fruit or nuts produced by woody shrubs or trees. Examples include acorns (hard mast) and cherries (soft mast).

[15] DeGraff, R. M. and M. Yamasaki, New England Wildlife Habitat, Natural History and Distribution, University Press of New England, Hanover, NH, 2001, 126.

[16] Featured indicates that this is the primary (i.e. top) layer of growth in the stand or area.

As a young forest grows out of the early successional stage and begins to mature, shade tolerant trees begin to fall behind the faster growing shade intolerant species, creating a mid-canopy stratum or midstory. Some shade tolerant trees (i.e. beech, sugar maple, hemlock) also have the ability to regenerate under a dense canopy, which can create another stratum near the ground. This lower stratum (i.e. understory) may also contain shade tolerant shrubs, vines and herbaceous species. On this property, mountain laurel, a relatively shade tolerant shrub, is the most common species of woody vegetation found in the understory.

These strata contribute to the requirements of different wildlife species in different ways. The wood thrush, for example, is a migratory songbird that sings from the canopy, nests in the midstory, and feeds on the ground. Managing forests with groups of species like the wood thrush in mind – species that have varied habitat requirements that may be able to act as a proxy for other species of birds and wildlife – can lead to the creation and maintenance of a mosaic of different vegetation types from open fields to mature forests. This helps to provide habitat opportunities for many different species of wildlife.

On the opposite side of the spectrum, there are not many places in Connecticut and throughout the region that contain old forests. Old forests frequently contain many of the features that managing for structural diversity and complexity creates. These include lots of coarse and some fine woody material, small canopy gaps, trees of various sizes and age classes, and large diameter live and dead trees. Old forests provide unique habitat conditions utilized by certain species of fungi that generally aren't otherwise present. Though there are no obligate old forest wildlife species in this area, many of the species that utilize diverse, well-managed forests will also use the structural attributes old forests provide.

Recent studies at the University of Vermont have helped increase our understanding of how to manage forests to increase carbon storage, maintain tree vigor, and emulate old forest conditions. These

The Importance of Oak

Oaks are important to retain as a major part of this forest now and into the future because:

- They support a wide variety of insects and wildlife, the likes of which no other native genera (i.e., genus or group of species) does.
- They have very specific associations with some species of birds that nest in our area including (but not limited to) scarlet tanager, cerulean warbler, black-throated blue warbler.
- They are well-adapted to current climatic conditions and projected climate changes.
- They grow well on this site.
- They are historically significant on the property.
- They are aesthetically pleasing and long-lived.
- Besides *Lymantria dispar* (a.k.a. spongy moth, formerly known as gypsy moth), there is currently a lack of oak-specific insects and diseases that tend to have large scale negative health implications which makes them an important piece of the puzzle for resilience and forest health and diversity moving forward
- The wood from oak is very valuable and can be used for a variety of purposes from firewood to flooring.

treatments include light thinnings, retaining many of the larger diameter trees, creating small canopy gaps to encourage regeneration, allowing much of the woody material to remain on site, and in some cases purposefully toppling trees using machines with cables to pull trees over with root ball intact to simulate windthrown trees (Brown, 2017).

Oak is perhaps the most important species for wildlife on this property. Flower production in spring, and – when it produces – acorn production in fall are just two of the features of oak that provide critical sources of food for wildlife. Many species of oaks were noted on the property. Again, though there are many oaks throughout the property in the overstory, very few oak were noted successfully growing in the understory. If the various oaks are to continue their special roles in providing benefits for wildlife moving forward, some efforts will need to be made to encourage young oak to become established. Some species of oak found on the property may be well-positioned to respond to projected changes in climate moving forward if they are able to be perpetuated. Another critical function of oaks is their association with caterpillars. Caterpillars serve as a food source for many species of birds and wildlife, and oaks support more caterpillar species than any of our other native tree species. This food source acts as the bottom of the food pyramid that supports many other species.

Courtesy of Audubon Connecticut

Best Caterpillar Trees

Oak	**557**
Willow	**456**
Cherry	**456**
Birch	**413**
Crabapple	**311**
Blueberry	**288**
Maple	**285**
Pine	**203**
Hickory	**200**

Hickory are found throughout the property. All hickory produce large nuts which can be eaten by insects and some wildlife including bear, squirrels, chipmunks, and some birds. There were a few different kinds of hickory noted on the property, the most prominent of which were bitternut and shagbark hickories. Shagbark hickory provides another feature of value for wildlife in the large flaps of bark that exfoliate in shaggy strips as the trees age. This habitat can be important for species such as bats which can use south facing shagbark hickory with direct solar radiation as daytime roosting areas. One way in which this habitat feature can be enhanced is by cutting trees on the southern, southeastern and southwestern sides of shagbark hickory to expose the main trunk of the hickory to sunlight. Ideally, this would be done for a group of hickory in relatively close proximity to provide a choice of roosting areas. Adjacency to open water features as well as open areas (including woods roads) helps improve the likelihood that the shagbark hickory could be suitable for roosting bats.

Only a few individual aspen were noted on the property. Aspen is another species that is important for wildlife in large part due to the dense cover and browse it can provide especially when in young, regenerating patches. It is a pioneer species that is very shade intolerant so over time, without large scale disturbances, this species will continue to dwindle here and across the region. Where possible, attempting to regenerate aspen can be beneficial. This is especially true when pockets of aspen can be regenerated near open areas. If aspen is to be regenerated, creating patches of five acres or larger is preferable, but irrespective of total opening size, canopy gaps should be ideally 75 ft. in radius beyond the outer edges of

the aspen to be cut to facilitate best sprouting. Ideally other competing vegetation would be treated the first year prior to aspen beginning to resprout to improve the likelihood of successful regeneration.

Hemlock is currently a relatively minor component in places on this property and is mostly found in the midstory here. Due to its extreme shade tolerance hemlock can survive in the lower canopy positions better than almost any other native tree species in this area besides beech. Frequently, hemlock can be found persisting in the midstory under an overstory of oak or other mixed hardwoods. Hemlock are attacked by both the hemlock woolly adelgid (HWA) and hemlock scale insects, both of which are invasive pests. While both of these pests were noted on the property, the overall health of the hemlock is fair, although it could be improved by lightly thinning around them to slightly increase the amount of light hitting their crowns, allowing them to photosynthesize more and grow more vigorously.

It is difficult to overstate the importance of hemlock from a wildlife perspective. There are no other tree species native to our area that can exactly fill the biological niche that hemlock occupies. Its shade tolerance, branching structure and pattern, foliage type and density, cone size and production, amount and type of falling woody material it produces, the speed and characteristics of decomposition, and where it grows make it a critical part of the ecological integrity of our region.

Many species of migratory songbirds including black-throated green warbler, Blackburnian warbler, brown creeper, hermit thrush[17], and some owls among others will preferentially nest in mixedwood forests with hemlock components. The black-throated green warbler in particular is a species that is defined by Audubon Connecticut as a "focal species[18]" (also listed as one of their priority birds). Deer and many other species use dense hemlock for cover during difficult winter conditions. Hemlock buds are frequently browsed as well. Salamanders use the coarse woody material produced in these areas for nesting and cover. Mammals including red squirrel, porcupine, and fisher also prefer forests with a hemlock component.

Densely growing stands of vigorous hemlock are better at reducing snow loads, and keep warmer relative temperatures than other softwoods, both characteristics which can be beneficial for a wide variety of wildlife during severe winter weather. Spruce can act as a closer ecological stand-in for hemlock than white pine can, but regardless of the species, retaining and promoting softwood where possible will help maintain the diversity of habitat offerings on the property. In addition to snow and storm mitigation, hemlock capture more rainwater and use water resources from the soil more efficiently than many other species. This is especially true of species like birch which transpire much more water during the growing season than hemlock.

Where feasible, retaining healthy populations of hemlock on this property can help continue to provide all these habitat conditions for the many species of wildlife that depend on it. There are no widespread forest treatments to reduce the prevalence or effect of HWA or the scale insect on hemlock, but maintaining vigor with light thinnings where appropriate can help individual trees persist if not thrive, at least for a time.

[17] All of the listed species could nest in this part of the stand or at least may use the area during migration further north in the state and New England.

[18] This is one of a dozen woodland bird species in the state that Audubon CT also refers to as the Birders Dozen. A guide for the management with these birds in mind can be found here:
https://ct.audubon.org/sites/default/files/ct_birders_dozen_pocket_guide.pdf

The Importance of Hemlock

Hemlock are important for a variety of reasons including:

- The wildlife associations they provide including specific songbird habitat for breeding and nesting
- Their ability to act as shelter during storms and adverse winter conditions
- The diversity they add to the property
- Their ability to tolerate shade adding structural complexity to closed canopy understories and midstories
- Their effective capture of rainwater reducing potential for erosion, and their efficient use of subsurface water allowing more available water for other plants and trees (Harvard Forest, 2017)

Softwoods are a critical part of the species mix on the property. Where they exist, the vast majority of the softwoods here are white pine and hemlock. Though most useful when located in groups as opposed to scattered individuals, softwood provide an important element of habitat that facilitates the use of the property for nesting, foraging and cover that would otherwise not be present. Many species of birds, some mammals, insects and plants preferentially occupy space within areas dominated by softwood or at least where softwood plays a role. Maintaining softwood in all three forest strata (i.e., understory, midstory, and overstory) can help ensure its long-term sustainability here.

3.3.3.4 Types of Mast

Mast production is an important consideration for habitat on this property. Mast comes in two main forms: hard and soft. Hard mast includes nuts and other physically hard seeds produced by species such as oak, hickory, beech, and hazelnut among others. Soft mast is present in the form of berries and other soft fruits including black cherry, sassafras, dogwood, and black gum in tree form, but also blueberry, huckleberry, and many viburnums in shrub form.

Currently, valuable hard-mast producing trees (especially oak) play a major role in many stands at The Timberland Preserve. The primary oaks here are red, white, and black, but there are also scarlet and chestnut oaks in places. In addition to oaks, there are also hickories and American beech that are all hard mast producers. Wildlife species that depend on mast generated by this cover type include ruffed grouse, wild turkey, redheaded and red-bellied woodpeckers, blue jay, squirrels, chipmunks, mice, gray fox, red fox, black bear, striped skunk and white-tailed deer. “Wood duck, American black duck and mallard can also benefit from hard mast where...[hard-mast producing trees] occur adjacent to shallow water bodies, streams and other wetlands."[19]

Soft mast producing species including blackgum (a.k.a. tupelo which is what this species is referred to in charts and tables later in this document), sassafras, grapevine, blackberry, raspberry, winterberry, dogwood, spicebush, and some invasive plants are present in various places throughout the property. It is beneficial for many species of wildlife to have a combination of hard and soft mast in their diet as each

[19] DeGraff, R. M., M. Yamasaki, W. B. Leak, and J. W. Lanier. "New England Wildlife: Management of Forested Habitats". USDA Forest Service General Technical Report NE-144. USDA Forest Service, Northeastern Forest Experiment Station, Newtown Square, PA, 1992.

mast source provides different dietary elements. Hard mast often has more protein and fats, whereas soft mast tends to be higher in sugars.

3.3.4 Snags, Cavities, and Down Woody Material

As a forest develops and trees become stressed by competition, drought, disease, insects, or severe weather, some trees begin to decline and die. In our changing climate, more extreme storms are likely to occur more frequently. As processes of decline happens regardless of cause, columns of rot can develop in affected trees. Following the development of rot, insects often find their way into the tree, which in turn attracts predators including woodpeckers. The woodpeckers create larger openings in the trees, which can lead to the development of cavities. Cavities are useful as shelter and feeding habitat for many small mammals and birds.

As trees die, some remain standing and continue to rot, becoming what are known as standing dead snags. Standing dead trees provide habitat for insects that birds and small mammals will eat. As these trees, or pieces of them fall, down woody material is created. Larger pieces (greater than 4" inches in diameter) are considered to be coarse woody material or CWM. Smaller pieces of down woody material are referred to as fine woody material or FWM. Coarse and fine woody material are both important as habitat features and for the purposes of habitat, nutrient cycling, hydrologic cycles, and other reasons on the site. Storm damage and the death of oak from infestations of spongy moth[20] and hemlock from scale and hemlock woolly adelgid have resulted in increases of snags and down woody material recently.

CWM can provide habitat for salamanders and other wildlife that use it for cover. Also, as CWM decomposes, it holds significant amounts of water and can act as a good germination site for seedlings. During the process of decomposition, carbon in coarse woody material is slowly released back into the atmosphere and reabsorbed into the soil. Fine woody material when aggregated (intentionally – in the form of slash piles – or otherwise) can act as nesting and foraging areas as well as cover for many species. Given the amount of functional vernal pools on the property retaining and recruiting coarse woody material in various stages of decomposition is important for the large amount of amphibians which may be using the area.

Wildlife biologists, ecologists, mycologists, foresters, and fuels specialists are some of the people interested in down woody material because it helps describe the quality and status of wildlife habitats, structural diversity within a forest, fuel loading and fire behavior, carbon sequestration, and the storage and cycling of nutrients and water.[21]

As a forest matures, large trees die and fall to the ground increasing CWM. While forest management generally results in a net increase in down woody material, the increase can be primarily in fine woody material that has less long-term value than large diameter material, and is much more ephemeral because it decomposes relatively rapidly. To ensure that forest management activities contribute coarse woody material as well as fine woody material, leaving large snags and cavity trees (where safe to do so), and intentionally leaving large pieces of wood on the forest floor instead of removing them, should be part of

[20] The common name of *Lymantria dispar*, formerly called gypsy moth, has officially been changed by the Entomological Society of America to avoid using an ethnic slur as a common name. Their press release can be found here: https://www.entsoc.org/news/press-releases/spongy-moth-approved-new-common-name-lymantria-dispar

[21] Mount, J. R. "Water, Wildlife, Recreation, Timber…Coarse Woody Debris", USDA Forest Service GTR, PSW-GTR 181, 2002.

management strategies here. In addition, the purposeful retention of some large CWM can help recruit additional features which will be more long-lasting and have greater ecological impact.

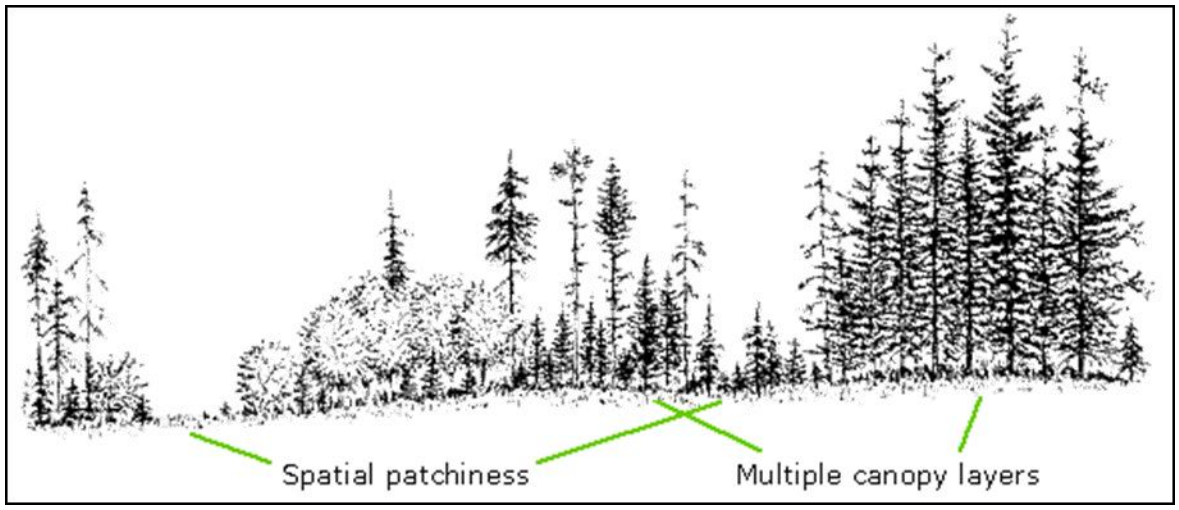
General management guidelines for coarse woody material (CWM)[22]

1. Larger pieces of CWM are more valuable than smaller pieces.
2. CWM scattered across a site is more valuable than if it is concentrated (with some piles).
3. It is important to maintain a full range of CWM decay classes (from hard to crumbling).
4. Coniferous CWM is generally more long lasting than wood from deciduous trees.
5. For long-term management, consider the distribution and quantity of future CWM sources, including retention of snags and cavity trees where safety is not an immediate concern.

[22] Mount, J. R. "Water, Wildlife, Recreation, Timber…Coarse Woody Debris", USDA Forest Service GTR, PSW-GTR 181, 2002.

3.3.5 Forest Health

In general, forest health throughout this property is fair to good. The major issues are a lack of structural diversity, infestations of invasive plant species, a lack of tree species diversity and tree regeneration in the understory, excessive herbivory, decline of some key overstory species, and some native and non-native invasive insect pests.



The figure above shows the multiple canopy layers in one spot representing vertical structure and the spatial patchiness of horizontal structure over a wider area, both described in greater detail below. Diagram courtesy of the British Columbian Ministry of Forests.

Forest structural diversity is described both vertically and horizontally. Vertical diversity is the presence of vegetation of various heights (also called strata) in a relatively small observable area. Horizontal diversity is the variation of vegetation types and heights on a larger landscape scale. In many places on this property, desirable tree regeneration is completely or almost completely absent from the 0-5 foot size class. Although this facilitates some kinds of recreation, this lack of understory vegetation greatly reduces habitat value to many species of wildlife that use this level of vegetation for cover, feeding, and nesting. Deer, ruffed grouse, American woodcock, rabbits, turkeys, and songbirds, among others, are some of the wildlife that rely on a combination of habitat types including dense understory vegetation for one or more life requirements.

Species diversity is another important component of diversity in a forest. In particular, maintaining the significant softwood component of this property is critical to maintaining the diversity of this property and the surrounding area. Ensuring that there is diverse hardwood regeneration is also necessary to ensure that the hardwood stands on this property are as diverse in 25, 50, or 100 years as they are today. Especially with a changing climate, having a variety of tree species in a variety of size classes is crucial to ensuring the resilience of the forest and maximizes the chances that whatever species will grow well in the future climate are currently regenerating.

3.3.5.1 Invasive Species

Large populations of non-native invasive plants are established in some parts of the property, most notably in riparian areas and in the southwest portion of Stand 1, although they are also found at essentially every access point to the property. Japanese barberry, winged euonymus, tree-of-heaven (*Ailanthus sp.*), wineberry, garlic mustard, Japanese knotweed, Japanese stiltgrass, and multiflora rose were all noted on this property.

Not all non-native species are considered invasive. In fact, some non-native plants such as apple trees and some clovers have become naturalized in our region and are considered beneficial for a variety of reasons, including their values for pollinators, wildlife, and aesthetics. As opposed to native and beneficial naturalized species like those described above, invasive plant species have qualities that make them detrimental to the overall ecological health of an area. These qualities can give invasive plants a competitive advantage over native species and can lead to the development of monocultures of invasives, reducing species diversity. Such features include:

- Vigorous sprouting when above ground portions of the plant are cut;
- Prolific seed production;
- Rapid growth rates;
- Ability to colonize disturbed areas;
- Long periods of seed bank viability;
- Extended growing seasons due to early leaf out and ability to photosynthesize later in the season;
- A lack of wildlife species that browse on buds.

The reduction in species diversity noted above is important because a diverse ecosystem is more resilient to climate change and other environmental stressors and provides habitat options for wildlife and insect populations including pollinators. Wildlife and insect species have adapted to be able to utilize the pollen, seeds etc. produced by native species in an area. In general, fewer insect species utilize the nectar of invasive plants. Because significant populations of invasive plant species can have a negative effect on ecosystem health, it is best to treat known infestations while they are small and manageable. For more information on how to identify and control invasive plant species in Connecticut visit: https://cipwg.uconn.edu/control-information/#.

Invasive Plants Noted at Timberland Preserve

Japanese Barberry
Winged Euonymus
Tree-of-Heaven (*Ailanthus sp.*)
Wineberry
Garlic Mustard
Japanese Knotweed
Multiflora Rose
Japanese Stiltgrass

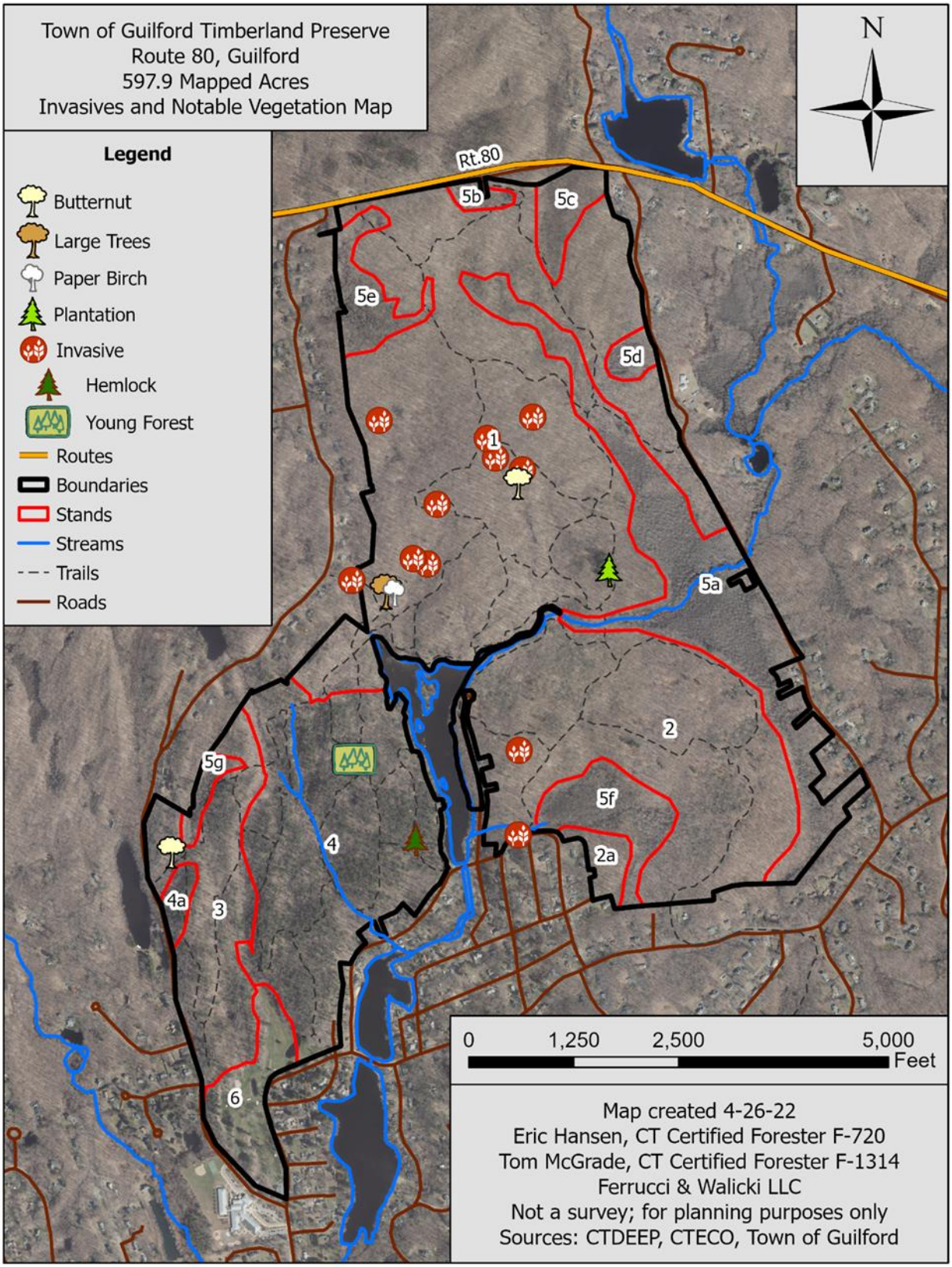
Invasive species control generally includes one or more of the following:

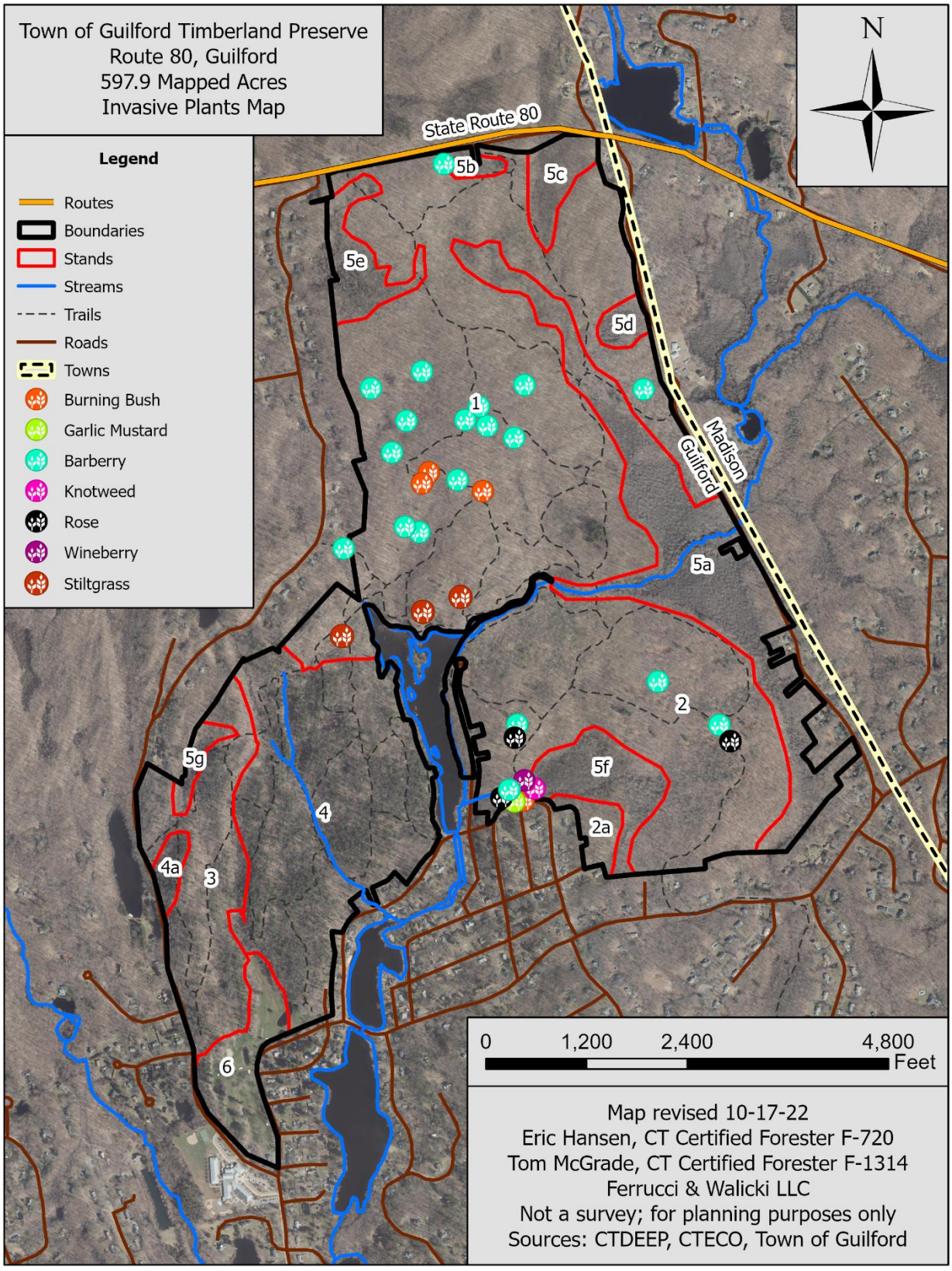
Chemical control – using herbicides/pesticides

Mechanical control – physical removal of the invading species

Biological control – introduction of natural enemies or predators

Ecological control – manipulation of environmental factors to favor native species


Town of Guilford Timberland Preserve
Route 80, Guilford
597.9 Mapped Acres
Invasives and Notable Vegetation Map
Legend
Butternut
Large Trees
Paper Birch
Plantation
Invasive
Hemlock
Young Forest
Routes
Boundaries
Stands
Streams
Trails
Roads
N
Rt.80
5b
5c
5e
5d
1
5a
2
5g
5f
4
2a
4a
3
6
0
1,250
2,500
5,000
Feet
Map created 4-26-22
Eric Hansen, CT Certified Forester F-720
Tom McGrade, CT Certified Forester F-1314
Ferrucci & Walicki LLC
Not a survey; for planning purposes only
Sources: CTDEEP, CTECO, Town of Guilford


Town of Guilford Timberland Preserve
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Streams
Trails
Roads
Towns
Burning Bush
Garlic Mustard
Barberry
Knotweed
Rose
Wineberry
Stiltgrass
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State Route 80
Madison
Guilford
5a
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2a
3
4
4a
6
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1,200
2,400
4,800
Feet
Map revised 10-17-22
Eric Hansen, CT Certified Forester F-720
Tom McGrade, CT Certified Forester F-1314
Ferrucci & Walicki LLC
Not a survey; for planning purposes only
Sources: CTDEEP, CTECO, Town of Guilford

3.3.5.2 Insect

Evidence of several invasive insects was noted on this property. Spongy moth[23], emerald ash borer, hemlock woolly adelgid, hemlock scale, and white pine weevil were all noted on this property.

Many oaks on the property appear to be declining, and a significant number have died in the last few years. Many of the black oaks which appear to be declining have reached, or will soon reach, biological maturity at which point they gradually stop growing and begin to senesce. Additionally, some oaks of all species on this property appear to have been damaged by spongy moth outbreaks from 2016-2018. Many of the oaks that have died were likely unable to recover after three successive years of defoliation combined with drought in 2015-2016. The spongy moth is an early- to mid-season defoliator of a variety of species of trees, but it focuses primarily on oak and aspen. No new egg masses were noted during the inventory, which suggests that this coming year will, hopefully, not have a large spongy moth outbreak.

One method of reducing the negative impacts of spongy moth on forests is to keep individual trees healthy and vigorous through periodic thinning and to manage for species diversity, including trees that the insect finds less palatable. For more information on spongy moth and its control see this website: https://portal.ct.gov/DEEP/Forestry/Forest-Protection/The-Spongy-Moth-Information-for-Tree-and-Woodland-Owners.

Ash on the property appear to have suffered almost 100% mortality due to emerald ash borer (EAB). EAB is an invasive insect from Asia discovered in Canton, Michigan in 2002. Since then, it has spread wherever there are sufficient populations of ash trees, including Connecticut as of 2012. Currently, there are no forest management techniques known to ensure the survival of ash trees once infected, so ash are often cut to salvage economic value.

Signs of EAB infestation include the telltale serpentine galleries beneath the bark in the sapwood, and the small D-shaped exit holes formed when the larvae exit the tree. Symptoms of infestation include crown dieback, epicormic branching, blonding[24], and/or tree mortality. There are several ways to dispose of an ash infested with EAB once the tree is felled including chipping it into mulch, turning it into lumber, hiring a professional tree service to take it away, or burning it. Ash makes excellent firewood even when freshly cut. Since the larvae reside inside the bark, infected trees should never be transported long distances to avoid spreading the borer faster than it would naturally disperse.

On this property, borer-killed ash that do not have wildlife cavities and are not large enough to foreseeably become high-quality wildlife trees can either be removed and used as firewood locally, felled and left on the forest floor as a source of coarse woody material (CWM), or left standing where safety is not an issue. If any ash trees that are not infested with emerald ash borer are encountered, they should be retained; in places like this property where ash mortality is almost complete, any ash that are not infested or killed have the potential to be resistant to emerald ash borer and should be retained as a potential seed source. Although the overall prognosis for ash in this region is very poor, retaining trees that may be resistant is worthwhile to give this ecologically and culturally important species a chance.

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[23] The common name of *Lymantria dispar*, formerly called gypsy moth, has officially been changed by the Entomological Society of America to avoid using an ethnic slur as a common name. Their press release can be found here: https://www.entsoc.org/news/press-releases/spongy-moth-approved-new-common-name-lymantria-dispar

[24] "Blonding" is the term used for the removal of outer bark by woodpeckers to access the beetles beneath the bark of the tree. The inner bark that is exposed by the woodpeckers' removal of the outer bark is significantly lighter in color than the outer bark, giving the tree a blonde appearance from a distance.

Hemlock woolly adelgid is an invasive insect from Japan that feeds on the stored nutrients in the twigs of hemlock, thus weakening the tree and causing a sometimes rapid decline. Hemlock woolly adelgid was first found in Connecticut and 1985 and had become ubiquitous by 1997. Although many hemlock have died since then, many have also hung on in varying levels of health. While there is no single treatment or management activity that is both effective and feasible for protecting hemlock in the forest from HWA, light thinnings to increase the vigor of surviving hemlock can make individual trees more able to survive HWA infestation.

Elongate hemlock scale (*Fiorinia externa*) was also noted on hemlock throughout the property. This insect is non-native and invasive and latches itself onto the underside of hemlock needles, injecting its mouthparts into the primary nutrient pathway of the needle and sucking out the nutrients. If enough scale is present on an individual tree, the foliage of that tree will begin to appear greyish-green and can eventually die. It does not appear at this time that the scale infestation is severe enough to cause hemlock mortality, but that may not always be the case and should be monitored regularly.

The white pine weevil is a native insect that kills the terminal leader[25] of some species of softwood trees. Common hosts for this insect include white pine, Norway spruce, and blue spruce. White pine is the only one of these species that is native to this area. The white pine weevil female lays her eggs in the terminal leader of suitable white pine trees. When the larvae hatch they burrow into the terminal leader. Their feeding can deform and kill the terminal leader which then causes the horizontal branches to compete for dominance. This results in poor form, and while it is not fatal to the tree, the new branching pattern usually significantly decreases any future potential timber value. White pine weevil damage was noted on some of the white pine on this property.

3.3.5.3 Disease

Several forest diseases were noted on this property, including white pine blister rust, beech bark disease, beach leaf disease, and *Nectria* canker.

White pine blister rust is a fungal pathogen that was introduced to the eastern US in 1909, and has caused extensive loss of white pines throughout the country. The western white pines have been almost entirely eliminated throughout much of their range. Thankfully, the impact on eastern white pine has not been as disastrous, although it can still be quite severe. White pine blister rust requires two hosts to survive and spread; one, logically, is white pine. The other is *Ribes spp.*, a genus of small woody shrubs also known as gooseberry or currant. For blister rust to impact white pines, *Ribes spp.* must be present in the vicinity, and the conditions for fungi to proliferate (shade, moisture, lack of airflow) must exist. Common symptoms of infected trees are orange discoloration of the needles, crown dieback, and blisters or lesions on the trunk. Only one instance of white pine blister rust was observed at the Timberland Preserve.

Beech bark disease is a complex introduced into the tree when an insect called the beech scale feeds on sap just under the bark by attaching itself to the outside of the tree and drilling into the tree through the bark. A fungus called *Nectria* then finds its way into the vascular system of the tree. The physical manifestation of this on beech trees is black pock marks on the normally smooth, light grey bark of the beech. The result of infestation is a loss of vigor, introduction of rot, and frequently structural failure and mortality can occur. Since many beech regenerate from root suckers, large areas of beech can be

[25] The terminal leader is the top vertical extension of a tree.

genetically identical and share susceptibility, or lack thereof, with their parent tree. Many of the beech on this property appear to be susceptible to beech bark disease and are currently infested.

In addition to beech bark disease, beech leaf disease (BLD), which is new to Connecticut (first discovered in 2019 in Fairfield County), has begun to impact large swaths of beech trees in some parts of the state. This disease is not yet well understood in terms of the dynamics of Connecticut's forests and beech's response here, but it has been established in different parts of the U.S. and Canada for almost a decade. The disease is caused by a nematode (small roundworm-like insect) and its presence results in leaf discoloration, leaf curl, and early leaf drop, all of which can impact tree health. The Connecticut Agricultural Experiment Station is currently working on experimental solutions to help treat infested beech trees. A preliminary visit to this property in summer of 2021 revealed a very advanced infestation in the northernmost portion of Stand 1 near the trailhead across from the Cockaponset State Forest parking lot. An inspection of Stands 3, 4, and the southwest corner Stand 1 in August 2022 confirmed that beech leaf disease is present in these stands as well, and is fairly advanced in some places. For more information see: https://portal.ct.gov/-/media/DEEP/forestry/BLD/Beech-Leaf-Disease---Updates-2021.pdf

Nectria canker (*Neonectria galligena*) was noted on many of the black birch trees on the property, which is typical for Connecticut forests. Nectria canker is a fungal infection that forms in wounds on the tree. Once the fungus becomes established, it spreads annually, creating expanding target-shaped patterns within the wound that eventually choke off nutrient flow, effectively girdling portions of the tree. Over time this can and frequently does kill the host tree, though trees can survive many years before mortality occurs. Depending on its location on the tree, Nectria can ruin the financial value of the trees it infects and is therefore considered a pest in terms of forest management. Treatment primarily consists of attempting to limit prolific establishment of black birch in the first place, but if black birch is present then the removal of Nectria-infected trees is appropriate.

3.3.5.4 Regeneration and Resource Allocation

During the 2022 forest inventory, regeneration was observed in two ways. The first was a nested 1/1000th acre plot at each inventory point that tallied saplings[26] and seedlings[27]. The second was a visual observation made at each inventory point that recorded whether a species was present or not regardless of whether the sapling or seedling fell within the 1/1000th acre nested plot.

Overall, regeneration of desirable species (as defined on page XXX) is lacking, and the tree regeneration that does exist is overwhelmingly beech and black birch[28]. The exception to that statement is Stand 4 where there is abundant white pine regeneration. Most of the regeneration in the rest of the stands is found where past treatments have intentionally created gaps or in areas where the canopy is less dense and therefore enough sunlight reaches the forest floor to encourage new growth. This is not necessarily indicative of an unhealthy forest but rather something to keep in mind when managing these stands in the future. More detail on stand management recommendations can be found in 'Stand Descriptions' beginning on page XXX.

[26] A tree between 0.5" - 4.5" DBH

[27] A tree less than 0.5" DBH

[28] Because both beech and black birch are highly susceptible to diseases that prevent their ever becoming large enough to provide significant value to wildlife or to store large amounts of carbon, it is prudent to focus efforts on regenerating trees like oak that are more likely to provide significant ecological value.

Despite the existence of some regeneration on the property, there are no large patches of young forest (i.e., areas between 0-15 years old) as has already been mentioned. The largest gaps created by past management were little more than 2 acres, and are quickly aging out of being useful to early successional wildlife species. In addition, though oak regeneration is present in places, on the property level, it is not present in sufficient numbers to replace existing oaks as they die. With the recent loss of many oaks to spongy moth, current decline of black oak reaching biological maturity, and the urgent need to create early successional habitat, taking steps to ensure that those treatments also regenerate oak is vital to ensuring that the Timberland Preserve remains a diverse and functioning forest.

General lack of tree vigor was also noted in some places on the property. No trees were cored during the inventory, but visual observations indicate that many trees are growing relatively slowly[29]. Tree growth rates are frequently proportional to tree vigor and associated health for many of the species of interest, primarily oak. Tree growth rates are impact by several factors including:

- Site conditions (overall site and microsite);
- Genetics;
- Slope position and aspect (i.e. direction the slope faces)
- Competition (primarily for sunlight); and
- Species.

Shade tolerant trees such as hemlock and some hardwoods (including beech) can be perfectly healthy but growing very slowly. For other species which require more sunlight, individual tree vigor and growth can be increased by active management techniques, such as thinning or crop tree release, that allow each individual more sunlight and room to grow.

In addition to using active forest management to attempt to increase vigor for the sake of healthier trees, a more vigorously growing forest can be more resilient when attacked by insects and/or infested with diseases. Forest management that increases structural diversity and complexity can also help a forest to be better prepared to respond to storm events and the threats posed by climate change.

Although it is important to attempt to ensure tree health and vigor through active management, not all trees that appear to be poorer quality should be removed. Having trees (standing and on the ground) that show signs of rot etc. provides an element of ecological diversity that is important for a variety of species of insects, fungi, bacteria and wildlife.

Extensive deer browse was also noted on this property. Many parts of the state, and the region, suffer from an overabundance of deer. In forests, deer impact the abundance and diversity of understory vegetation, including tree regeneration, by preferentially browsing some species and ignoring others. Some preferred browse species are oaks, maples, yellow birch, hemlock, and pines, while they tend to ignore most invasive plants, beech, and black birch. Accordingly, an excess of deer in a given area will make it extremely difficult to successfully regenerate a wide diversity of desirable tree species. No hunting is currently allowed on the property, but developing a controlled hunting program would likely improve the diversity and volume of understory vegetation and tree regeneration.

[29] This observation is based on crown sizes in many parts of the property as well as bark appearance.

3.3.5.5 Storm Damage

Several major storm events over the last decade or so including Tropical Storms Isaias, Irene, Sandy, some tornadoes, and the October 2011 snowstorm have all had significant impacts in different parts of the state. Not many tree tops appear to have been lost on this property, but where this has occurred it is likely attributable to one of these events. However, multiple trees have been blown over on this property, particularly in wet soils or those with a hardpan reducing the depth to water table. Windthrow is a natural part of forest dynamics and is not necessarily a forest health issue. It can cause personal safety risks, loss of economic value, and difficulty of access, but the addition of coarse woody material to the forest floor, the canopy gap created by the trees' absence, and the habitat created by upturned rootballs actually benefit forest health.

3.3.5.6 Fire

Wildfire risk on this property is moderate on the whole, with some areas at greater risk than others. The wetland portions of the property (Stand 5) and Stands 3 and 4 are at relatively low risk of wildfire due to being generally somewhat wet and sheltered. Stands 1 and 2 are at greater risk, but not extreme. Both of these stands are relatively exposed, somewhat dry (more so in Stand 2), and have ladder fuels[30]. The primary risk in Stand 2 is due to relative continuity of ladder fuels in the central portion of the stand. Although the probability of ignition is relatively low, it would be possible for a fire to crown (i.e., reach the upper canopy of the forest) and spread if ignition did occur. The ledge and outcrop area in the south-central portion of Stand 1 is at risk primarily due to the terrain. Although there are not excessive or continuous ladder fuels in much of this area, the terrain itself makes it possible for fire to spread; fire moves up and could potentially move from the crown of a tree below an outcropping to the forest floor above, or vice versa. Risk of ignition here is also relatively low, but fire could spread if ignition did occur and due to the terrain fighting the fire could be complicated.

3.3.6 Current Uses

Today, the property is mostly used by people for passive recreation. The Timberland Preserve is also intended to provide wildlife habitat, which it currently does for some species, but its overall habitat value could be greatly improved by treatments that create areas of early successional habitat and increase the structural complexity of the forest, both vertically and horizontally.

4 MANAGEMENT

4.1 Property Summary

This property presents a number of opportunities to improve forest health and resilience, diversify and improve wildlife habitat, and provide recreational opportunities. The property contains a number of ecologically important water features, including vernal pools and perennial watercourses, which add greatly to its ecological value and should be treated with caution during management activities to ensure that they continue to add to the site's natural values. Wildlife habitat on this property is generally fair, but both old and young forest conditions are underrepresented; while one cannot simply create old forest, management techniques that accelerate the development of old-forest features that benefit wildlife should be practiced. Management to create young forest conditions can significantly increase the

[30] A ladder fuel is any flammable object, usually a tree or tall shrub, in a forest that can facilitate the movement of flames from the forest floor into the upper tree canopy. In most cases, ladder fuels are midstory trees in the sapling and poletimber size classes whose crowns approach the main canopy. If a tree of this size burns completely from bottom to top, the flames may ignite the crown of a main canopy tree, initiating a crown fire.

structural and species diversity of this property. The primary forest health issues on this property include a lack of diversity of tree regeneration, loss of vigor and mortality from prior spongy moth defoliation, emerald ash borer, hemlock woolly adelgid, hemlock scale, beech bark disease, beech leaf disease, and Nectria canker. Treatments to enhance individual tree vigor and reduce the proportion of disease-prone and maladapted[31] trees should be performed and will likely improve overall forest condition. During any management activities, measures will be taken to protect important cultural and historic features and maintain soil integrity and water quality.

4.2 Inventory Methods

An inventory of the forest resources on the property was completed in spring of 2022. A series of inventory points were laid out throughout the forested portions of this property. At each point a 20 Basal Area Factor (BAF) angle gauge was used to determine basal areas[32] and a Biltmore stick and/or diameter tape were used to determine diameters and merchantable heights of trees. Additionally, a qualitative visual inspection of individual tree and stand health, as well as understory prevalence and species composition was conducted at each point.

4.3 Silviculture

This property has relatively high stocking levels throughout. The general lack of active management has resulted in a mostly closed canopy forest with shade tolerant species regenerating. Moving forward, in accessible portions of the property where active management is appropriate, a mixture of even-age and uneven-age management will be practiced. One very important tree species on the property is oak. The long-term presence of oak in our forests is critical for many reasons (some of which are discussed in the Wildlife Habitat and Diversity section of this plan), but overall oak is declining both on the property and regionally. Where feasible, successfully regenerating oak over time in parts of this property can help to ensure the long-term sustainability and productivity of the forest. As Tom Worthley (Associate Extension Professor in Forestry from the University of Connecticut) would say, “If we want people 100 years from now to be able to experience 100-year-old oak trees, we have to start today with a seedling.” Details regarding silvicultural recommendations can be found in the *Stand Descriptions and Recommendations* section of the plan beginning on page XXX.

Silviculture[33] on this property will be driven by the goals stated at the beginning of this plan. If implementation occurs, some of the treatments recommended in this plan will result in the cutting and removal of some trees that have commercial value. Being able to sustainably produce a variety of forest products as part of the management of the forest (as has been done here in the past) provides an additional benefit to local, regional and global economies. In addition, growing trees to larger size simultaneously allows the trees to grow for longer periods of time increasing the amount of carbon they uptake and store, while also producing higher quality wood which is generally converted into longer lasting wood products. Durable, long-lasting wood products continue to store carbon in their fibers while

[31] A maladapted tree is one that is either highly susceptible to mortality-inducing diseases, is not well-suited to the physical and chemical characteristics of the site, or is unlikely to be well-suited to future climatic conditions. For example, beech is maladapted to essentially any site right now because of the suite of diseases that effect it, while white pine might be maladapted to calcium-rich soils, such as in the west of Stand 1 because it would grow better in different soils while other trees, such as sugar maple, would better use the calcium-rich soils.

[32] Basal area is a relative measure of density of trees in a given area. Usually described on an average per acre basis it is the cross-sectional surface area (in square feet) of wood that would be found in all trees at breast height which is 4.5 feet above the ground on any given acre.

[33] Silviculture is defined as the art and science of growing trees.

residual trees in the forest adjacent to trees that are felled and removed can increase their rates of carbon uptake and storage due to increased resource availability (i.e., primarily sunlight).

Using concepts from recently published guidelines for "Exemplary Forestry[34]" can help ensure the management activities undertaken can maintain and enhance resilience and productivity.

a. Continuously improving forest stands in terms of both quality and quantity.
b. Providing conditions which are well-suited to the umbrella wildlife species known to be representative of the habitat needs of the great majority of native species
c. Maintaining connectivity between habitats.
d. Achieving a diverse size class distribution of 5-15% of stands in seedlings, 30-40% in saplings and poles, 40-50% in sawtimber and including up to 10% of the landscape in large diameter multi-storied stands.
e. Growing tree species well-suited to each site (e.g., matched to soil and physiographic conditions as well as expected changes in climatic conditions).
f. Stocking that fully occupies the sites; this is an average of "B" line stocking for stands not currently being regenerated.
g. Growing and harvesting quality timber at an average of 0.5 cords/acre/year.
h. Addressing climate change

It is not the intent of this management plan to create a scenario in which all of the acreage on the property receives some treatment. The entire property should be cared for and monitored, but not everywhere is appropriate for active management. Specifically, portions of Stand 4 could be set aside as either limited treatment areas to monitor for invasive plants or intentionally set aside as reserves. This will be addressed further in the stand description and recommendation for this and other stands.

Due to the prevalence of valuable ecological features and the historical value of the property, large scale management operations – that impact sizable portions of the property in a relatively short time period – to influence current and future stand composition and growth conditions may not be feasible or desirable. Recommended actions in this plan are intended to achieve stated goals with care and balance for as many features and factors as possible. All of the recommendations in this plan are intended to help guide the managers to achieve stated goals. Dates and recommendations should be flexible based on changing conditions and goals. Ensure equipment is site specific and, if feasible, using animal power (horses or oxen) is a good way to achieve management goals with minimal unnecessary disturbance, as well as reducing the carbon footprint of the operation. When possible, create educational opportunities when management actions are undertaken at the property.

4.3.1 Summary of Silvicultural Objectives

- Increase structural and compositional diversity through the use of gap creation from ½ acre to 1 ½ acre or more. The intent is to create areas of dense growth of both tree regeneration and native vegetation. This will also begin the transition to an uneven-aged forest structure, which will provide greater structural diversity, wildlife habitat, and resilience to climate change. Plantings with temporary protection may be required to help ensure desired species mixes can be maintained.
- Improve forest health through targeted thinning of diseased and declining trees. The intent of this treatment is to increase the vigor of retained trees, improving growth and resilience to pests,

[34] Exemplary Forestry is a concept developed and promoted by the New England Forestry Foundation. It is intended to help increase the awareness of important and potentially measurable forest management outcomes with a wide breadth of goals driven in large part by regionally appropriate presence of wildlife species and site specific potential for production of wood.

pathogens, and environmental stressors. It is also possible that tree regeneration may occur in areas where heavier thinning has sufficiently modified light conditions on the forest floor. Although the intention of this kind of treatment is primarily to allocate resources to desirable trees, thinning to reduce stocking of trees infested with transmissible pests or diseases is also appropriate.

- Control invasive plants where feasible and appropriate. Invasives control should be performed prior to any activities that involve tree cutting, and the entire property should be monitored frequently.

4.3.2 Management Design and Mitigation

- Retain at least 50% canopy closure within 150 feet of wetlands, streams, and vernal pools[35].
- Exclude steep slopes and thin or excessively moist soils from active management..
- Minimize skid distances and avoid water feature crossings except as necessary.
- Leave tops and residual woody material on site for both nutrient cycling and wildlife habitat. Use some tops and residual wood to create brush piles in some areas.
- Leave all snags, where not a safety concern, for wildlife habitat. If the number of snags is inadequate, consider creation of snags through girdling of large diameter trees at least 2 tree lengths away from a walking trail or access road.
- Avoid disturbance to stonewalls and other historic features as much as possible.
- Require any harvest equipment to be pressure washed and thoroughly dried before being brought onto the property to reduce the risk of additional invasive seeds being transported into the forest.
- Any seed mix used to stabilize soils or skid trails must be certified invasive-free and should be composed of native (or at least non-invasive) plants. Where mulching is necessary use invasive-free straw as opposed to hay mulch to cover seed until successful germination can occur.
- Follow all Connecticut Best Management Practices not covered above to maintain water quality and soil stability. Published BMPs should be viewed as a minimum requirement and actual measures taken to protect water and soil resources will likely exceed legal requirements.

4.4 Timberland Preserve Stands

For the purposes of this management plan, the property has been divided into five management units, or stands, excluding the golf course. Forested stands are sections of the property sufficiently uniform in vegetation, species composition, age class, size class, density, etc. to be treated as a unit for management purposes. Other features that are considered when grouping stands are location, accessibility, and size of area. However, forested stands are certainly not completely uniform. There will always be variability within a stand due to the fact that we are attempting to quantify and qualify natural systems, where conditions exist along spectrums and defy perfect categorization. Stands were kept mostly uniform with stands from previous management plans to ensure continuity of data. The Stands map from the last management plan (1997) can be found in Section 5.2.6. A list of understory plants observed in each stand can be found in Section 5.3.

4.4.1 Natural Community Types

In Connecticut, classifying forestland by its natural community type for forest stewardship plans is very uncommon due to the lack of an accurate, representative, and state-specific guide to natural communities. Nevertheless, the most representative natural community type, or types, for each stand

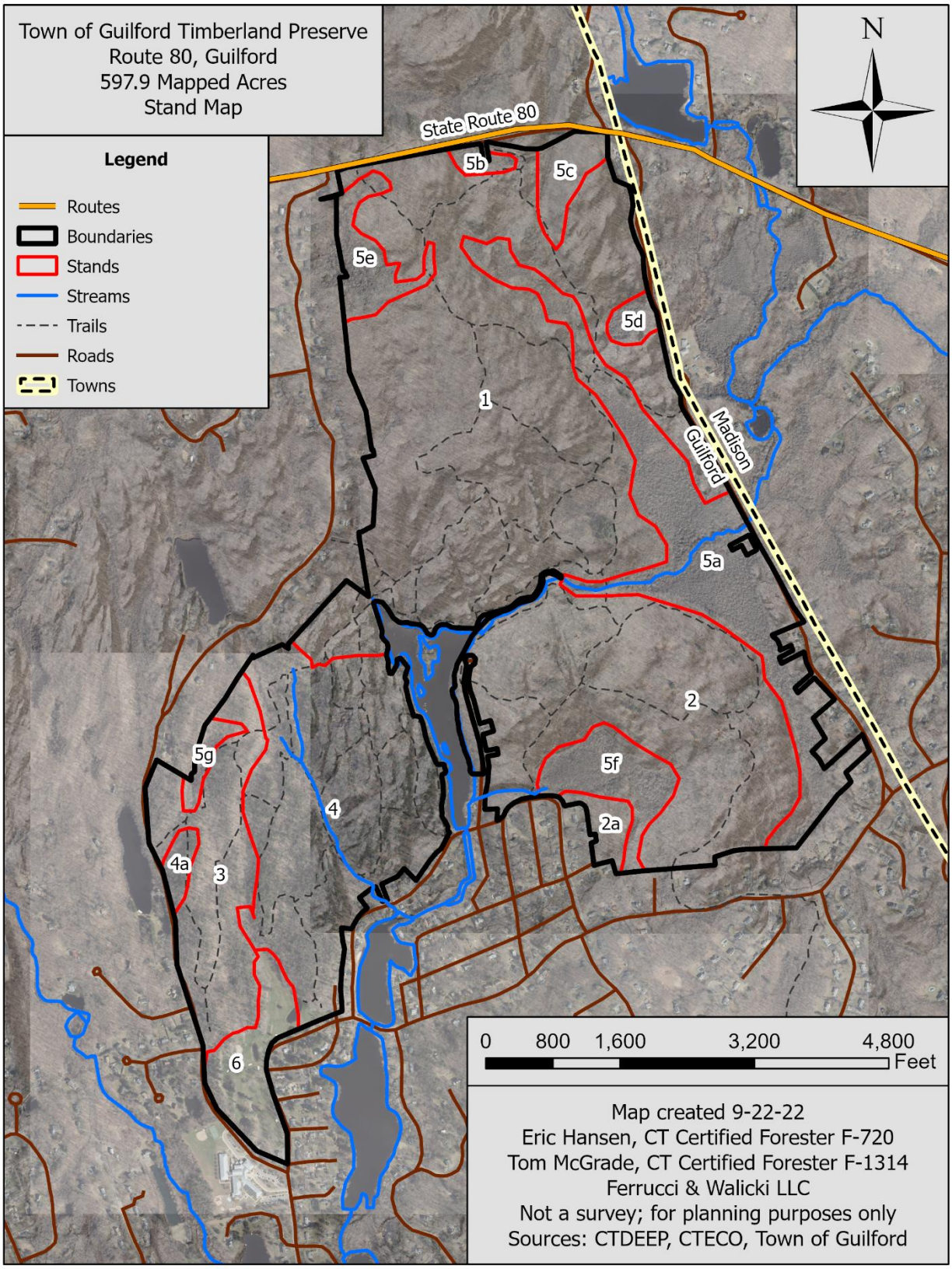
[35] Connecticut's published Best Management Practices manual suggests a 50 foot buffer with 50& crown closure around vernal pools but 150 feet is recommended here out of an abundance of caution.

was determined according to “The Vegetation of Connecticut, A Preliminary Classification” by Kenneth J. Metzler and Juliana P. Barrett (2006).

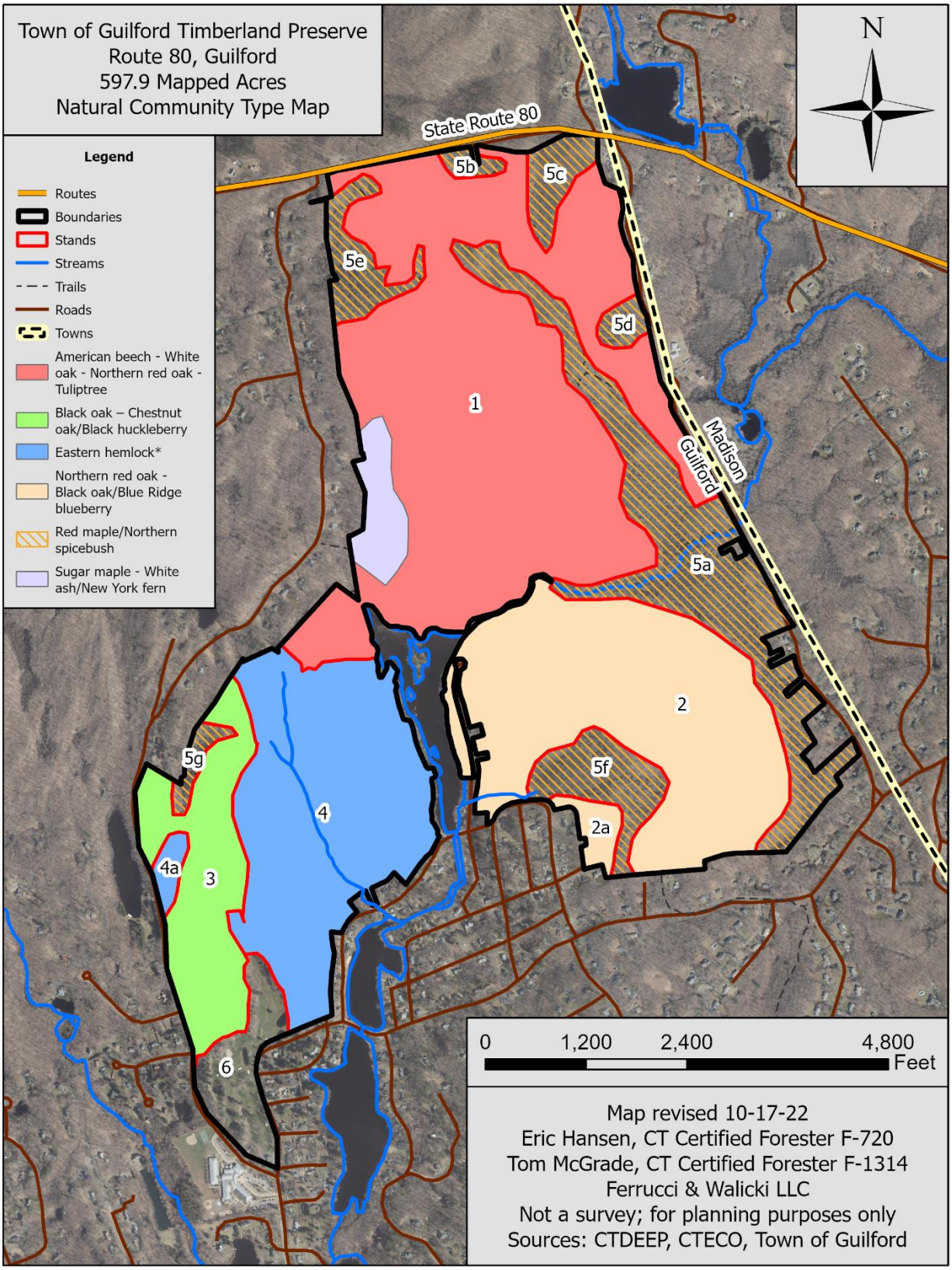
TIMBERLAND PRESERVE STAND INFORMATION

Stand	Stand Type	Acreage
1	Mixed hardwood sawtimber and poletimber	216.51
2	Dry hardwood sawtimber and poletimber	115.43
3	Mixed hardwood sawtimber and poletimber	42.63
4	White pine sawtimber with scattered hardwood	96.18
5	Wetland	109.57
6	Golf course	17.60
	TOTAL ACREAGE	**597.92**

4.5 Stand Map


Town of Guilford Timberland Preserve
Route 80, Guilford
597.9 Mapped Acres
Stand Map
Legend
Routes
Boundaries
Stands
Streams
Trails
Roads
Towns
N
State Route 80
Madison
Guilford
5b
5c
5e
5d
1
5a
2
5f
2a
5g
4
4a
3
6
0
800
1,600
3,200
4,800
Feet
Map created 9-22-22
Eric Hansen, CT Certified Forester F-720
Tom McGrade, CT Certified Forester F-1314
Ferrucci & Walicki LLC
Not a survey; for planning purposes only
Sources: CTDEEP, CTECO, Town of Guilford

4.6 Natural Community Type Map



4.7 Regeneration Table

Seedlings

Stand	American Chestnut	American Elm	Beech	Black Birch	Black Cherry	Black Oak	Chestnut Oak	Eastern Hemlock	Eastern Red Cedar	Grey Birch	Hickory	Ironwood	Musclewood	Northern Red Oak	Paper Birch	Pin Cherry	Red Maple	Sassafras	Scarlet Oak	Serviceberry	Sugar Maple	Swamp White Oak	Tupelo	White Ash	White Birch	White Oak	White Pine	Yellow Birch	Yellow Poplar	Total
1			353	382			x				x	235	x				147				x						x			1117
2			91																								x			91
3			x				x												x								1333			1333
4			x	x				83									x										1083			1166
5			x																								250			250

Saplings

Stand	American Chestnut	American Elm	Beech	Black Birch	Black Cherry	Black Oak	Chestnut Oak	Eastern Hemlock	Eastern Red Cedar	Grey Birch	Hickory	Ironwood	Musclewood	Northern Red Oak	Paper Birch	Pin Cherry	Red Maple	Sassafras	Scarlet Oak	Serviceberry	Sugar Maple	Swamp White Oak	Tupelo	White Ash	White Birch	White Oak	White Pine	Yellow Birch	Yellow Poplar	Total
1			553	141	x		x				6	15	24				9				29					x	3	3		783
2			736	9								27	x				27				x									799
3			250	17			x										117		33								17			434
4			267	117				8									67	x	8					8		8	117			600
5			75								25	x					x											x		100

4.8 Stand Descriptions and Recommendations

4.8.1 Stand 1

Acres – 216.51

Cover Type – Mixed hardwood

Natural Community – Primarily *American beech – White oak – Northern red oak – Tuliptree*, with a small pocket of *Sugar maple – White ash/New York fern* in the southwest corner of the stand

Size and Structure – Primarily medium sawtimber with poletimber and scattered large sawtimber

Stage of Development[36] – Stem exclusion

Major Soils[37] – Charlton-Chatfield fine sandy loams and Hollis-Chatfield-Rock outcrop complex

Site Index[38] – 47-65 (northern red oak). A site index value of 65 indicates that red oak can grow well in this part of the stand, but 47 is relatively poor.

Water features – There are several potential vernal pools in this stand, one confirmed functioning vernal pool, as well as a seep and several potential intermittent streams. Most of the soils within this stand appear to be well-drained.

Topography – The topography of this stand is defined by a relatively flat plateau above a ledgy slope with aspects that vary from northeast to southwest.

Access – Access to this stand is fair in the flatter northern and western portions, but access to the rest of the stand is somewhat more difficult due to the presence of ledges and the steep and rocky nature of the terrain. In the past, this stand has been accessed for management purposes from the northeast entrance to the Preserve and the access road used by Guilford residents with firewood cutting permits in the 1970s is still used as a main trail across the northern portion of the stand.

Stand description – This is the largest stand on the property and is in one contiguous block which makes up most of the northern portion of the property. This stand is bounded to the north by State Highway 80/Old Toll Road, to the east by private properties on Twin Bridge Road, to the south by Stands 2, 4, and 5, and to the west by Maple Hill Road.

Tree species in the overstory include red, white, and black oaks, beech, black birch, red maple, and scattered tulip-poplar and hickory. The midstory is primarily composed of black birch and. Small and

[36] There are four recognized stages of development that will be referred to in this plan. They are stand initiation, stem exclusion, understory reinitiation, and old growth. For more information see: https://www.na.fs.fed.us/spfo/pubs/misc/ecoforest/dyn.htm.

[37] These soil types are based on NRCS mapping available online through the web soil survey accessed on 2/16/22.

[38] Site index is a measure of the relative suitability of a soil for a specific tree species, and is given at a certain age (50 years in this region, by convention). For example, in soil with a site index of 65 for northern red oak, healthy northern red oak with suitable growing space would be approximately 65 feet tall at 50 years of age. Increasing site index indicates greater suitability for a species and therefore greater productivity.

medium sawtimber are the dominant size classes, although there are significant numbers of large sawtimber and poletimber trees as well. Notable herbaceous species observed in this stand include ramps, meadow rue, and three-leaved rattlesnakeroot.

This stand is essentially even-aged, although there are some wolf trees which are clearly much older (and larger) than most of the other trees in the stand. There are approximately 115 trees per acre, as well as 1,900 seedlings and saplings. Of those 115 trees, approximately 37 are in the sawtimber size class, with the remaining 78 in the poletimber class. Total basal area in the stand is 79 sf/ac, 52 of which is sawtimber. According to the 1971 Gingrich stocking guide for upland central hardwoods this stand is optimally stocked for maximizing tree growth.

Tree regeneration in this stand is somewhat dense, but is primarily made up of beech, black birch, and red maple. Attempting to shift this regeneration towards greater diversity which includes oak, hickory, yellow birch, tulip poplar, and sugar maple (all of which are currently represented in the main canopy in this stand) in at least part of the stand would significantly increase the likelihood that this stand will continue to be as diverse as it is now into the future. The best way to do this would be through the use of regeneration treatments including small patch cuts and low-density shelterwood treatments to favor desirable species that are less shade-tolerant than beech, black birch, and red maple.

Management History – There have been two major management activities in this stand in last 60 years, one in the 70s and 80s when firewood permits were issued to Guilford residents and one in the 90s when several small regeneration treatments were done, ostensibly to regenerate oak and other shade intolerant species. During the firewood cutting era, several different areas were designated for treatment, trees to be cut were marked by professional foresters, and permits for specific areas were sold to Guilford residents. The largest of the current trails in the northern portion of this stand was the road used by Guilford residents to access their permit areas and to remove cut firewood. The trees marked to be cut were primarily small and poor quality trees; the intent of the marking was a light thinning to improve growing conditions for residual trees, not to regenerate trees.

In the 1990s several small groups of trees were cut with the intent of regenerating oak in the resulting gaps. Each of these groups was small and altogether they totaled only a few acres. In the absence of advance oak regeneration (i.e., seedlings or saplings that had germinated in the understory prior to the treatment removing the overstory), these treatments primarily regenerated black birch. As discussed earlier, these areas did and do still provide important structural features useful for wildlife and have meaningful contributions to structural complexity and resilience, although their utility for wildlife species that require early succession habitat/young forest conditions has expired. Regardless of the relative success of regenerating intended tree species, almost all of the vegetation that regenerated is native species with a few exceptions in the western block of this stand within which scattered barberry is present along edges.

Health – Overall forest health in this stand is fair, but not excellent. Many large oak trees in this stand succumbed to repeated defoliation by spongy moth in 2016-2018, and many of the overstory oak appear to be starting to decline due to competition for resources. Additionally, black oak have much shorter lifespans (100-150 years) than either red or white oak, so black oak that appear to be declining are likely suffering from competition and naturally senescing simultaneously. Visual observation of symptoms of decline are primarily multiple dead major branches in the top of the crown and dieback starting at branch tips in the upper portions of the crown.

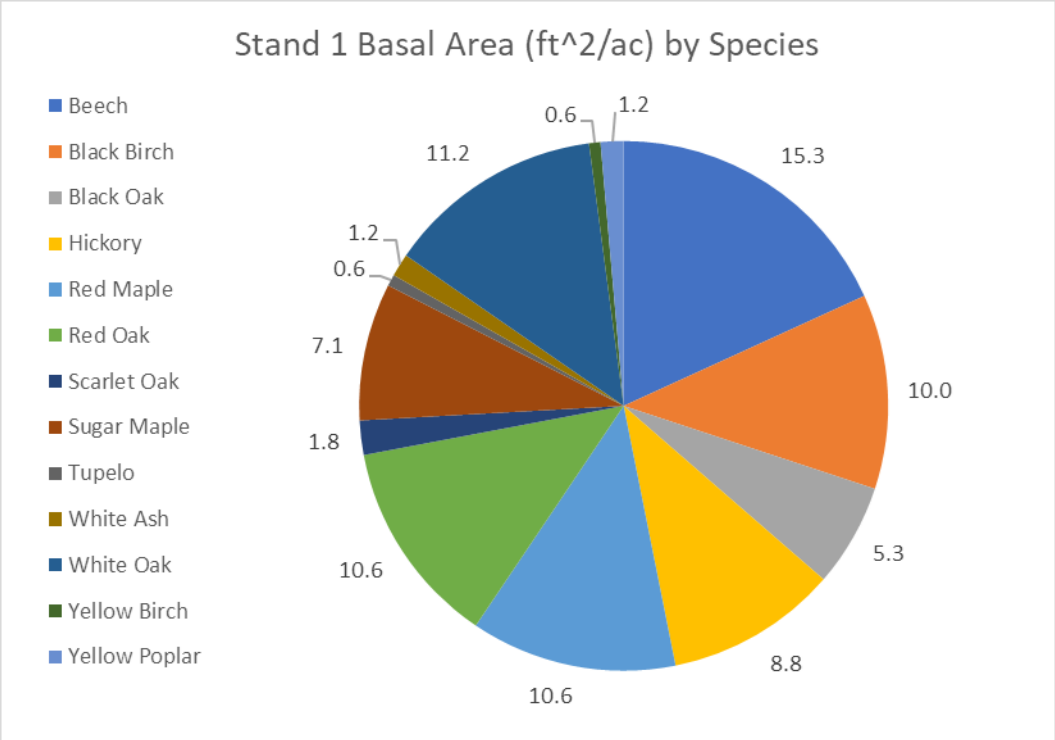
Beech in this stand are doing poorly on the whole. Beech in this region have been dying from beech bark disease for many years, but beech leaf disease (BLD) is a relatively new occurrence that is already having a significant impact on this property. First discovered in Connecticut in 2019, beech leaf disease is caused by a nematode that burrows into the conductive tissue within a beech leaf, cutting off nutrient flow to and from the leaf, effectively starving both the leaf and the tree. Many beech on this property are already infested with BLD and have lost many of their leaves.

If beech decline or die (especially midstory and understory beech) due to BLD, that may ultimately have some potential benefits in terms of long-term species diversity. The deep shade cast by a midstory of beech is one of the primary factors inhibiting regeneration of more desirable species, such as the various oaks. As BLD progresses and impacts more beech, additional sunlight will be able to reach the forest floor which, in turn, will make it possible for a greater diversity of species to regenerate in the next few years. On the other hand, BLD is speeding up the loss of beech from the landscape; in addition to the value that beech has as a native species, mature beech trees are also an important source of hard mast for a variety of wildlife.

Invasive plants, primarily barberry, are also present at low densities throughout this stand. If not treated while the infestation is still manageable it will likely become much more difficult to do so once the invasives have become more densely established.

NDDB, critical habitats, special features – Connecticut's Natural Diversity Database and Critical Habitats mapping do not show any features within this stand. However, there is a seep in the south-central portion of the stand and the numerous wolf trees, some of which have already died, have the potential to provide excellent habitat for cavity-nesting birds and small mammals.

	BA/acre	BA/acre AGS	Trees/acre	Trees/acre AGS	Volume/acre	Volume/acre AGS
Seedlings			1118			
Saplings			782			
Sawtimber trees	51.8	41.2	36.6	29.1	3.8 MBF	3.4 MBF
Poletimber trees	27.1	22.4	78.2	63.6	2.4 CD	2.1 CD
Snags	5.3		13.1			
Total**	78.8	63.5	114.8	92.7		
MSD*	11.2					
*Quadratic Mean Stand Diameter						
** Total trees includes sawtimber and poletimber-sized trees only						
MBF= Thousand board feet						
BA= Basal area and is given in square ft./acre						



Desired Future Condition

- Uneven-aged forest
- Diverse species mix
- Diverse age and size classes
- Some component of desirable regeneration and/or young forest
- Oak regeneration
- Diverse wildlife habitat
- High degree of resilience to disturbance
- Maintained accessibility
- Reduced invasive plants
- Produce high-quality forest products
- Maintained or enhanced ability to uptake and store carbon
- Retention/enhancement of historic features

Management Recommendations

2023-2024 – Treat invasive plants. Targeted chemical control is likely to be the most effective method at this relatively early stage of the infestation. If this is completed successfully, spot treatment may be the only treatment necessary in the future.

2026 – 15-20 acres (8-10 percent of the stand) of regeneration treatments. Creation of patches should be anchored on existing pockets of overstory mortality, trees showing signs of imminent decline (including – but not limited to – beech dying from beech bark disease or beech leaf disease), or existing desirable regeneration. New treatment areas could also be located adjacent to or near areas treated in the 90s to have a gradient of forest sizes and age classes in close proximity to each other. Avoid any areas with populations of invasive plants to limit spread of invasives. Each patch should ideally be at least 1 acre and up to 3 acres. There is not necessarily an upper limit to the size of individual patches, but keeping patches

to around 3 acres will both limit aesthetic impact and allow the regeneration of desirable species in more locations within this large stand.

The rest of the stand could be allowed to continue to develop. This can simultaneously help limit aesthetic impacts and provide a large sample size of a "control" which can help property stewards and the public see the results of more passive management options.

If a suitable organization with sufficient resources can be engaged, attempt to conduct some qualitative and quantitative analyses inside and outside the treatment areas before, immediately after, and in subsequent years to determine how the areas are changing. This could be a local school, university or college, a state agency, or even a contractor if funding is available. Regardless of whether or not this is achieved, it is important to conduct public outreach before and keep people informed of what is happening and why during the treatment. Signage, posting information on the Town's website, and walks can help keep the public informed.

2028-2029 – Inspect treated areas to verify that treatments created the desired outcomes in terms of regeneration and species diversity. If not, supplemental treatments including fencing, prescribed burns, planting, scarification, and control of competing vegetation should be considered.

4.8.2 Stand 2

Acres – 115.42

Cover Type – Mixed hardwood

Natural Community – *Northern red oak – Black oak/Blue Ridge blueberry*

Size and Structure – Primarily small and medium sawtimber with scattered large sawtimber and poles

Stage of Development – Late stem exclusion

Major Soils – Charlton-Chatfield fine sandy loams, Canton gravelly loams

Site Index – 52-65 (northern red oak). These values indicate that red oak can grow well in parts of the stand with site index values of 65, but will only have moderate growth in parts of the stand with site index values of 52.

Water features – This stand is bounded to the north by Iron Stream and to the west by Upper Guilford Lake, to the east by Stand 5 (which is a wetland), and there is a block of Stand 5 between the main body of Stand 2 and Stand 2a. Additionally, there are several wet areas and a potential vernal pool within the stand. The majority of the soils in this stand appear to be well-drained.

Topography – The topography of this stand is dominated by a somewhat intermittent ridge that runs roughly east-west in the western part of the stand but turns south as it heads east, eventually running roughly north-south in the southeast portion of the stand. The main block of the stand itself is crescent-shaped with the ridge running down the center. Both sides of the ridge contain moderate slopes with south, north, east, and west aspects in various parts of the stand. Stand 2a, the smaller block of the stand, has a gentle northeast aspect.

Access – Access to this stand for management purposes is fairly good and old skid roads from the last treatment can still be seen throughout the stand. It appears that the end of Laurel Road, which separates the stand from Upper Guilford Lake, was used as a landing during the last harvest.

Stand description – This is the second largest stand on the property and is in two blocks, one of which makes up the vast majority of the stand (110.15 ac) while the other smaller block is only 5.27 acres. This stand makes up the majority of the Preserve south of Iron Stream and east of Upper Guilford Lake.

Tree species in the overstory include red, black, white, and scarlet oaks, red maple, beech, and black birch, with scattered white pine. Midstory trees are primarily beech, black birch, hickory, and red maple. Small to medium sawtimber-sized trees (12-18 in. DBH) are the dominant size class, although there are scattered poletimber and large sawtimber trees. Notable understory species observed in this stand include huckleberry and three-leaved rattlesnakeroot.

This stand is essentially even-aged with pockets where the stand is two-aged due to the influx of regeneration resulting from the treatments done in the mid-2000s. There are approximately 81 trees per acre, 40 of which are sawtimber-sized, and 41 of which are poletimber-sized, as well as approximately 891 seedlings and saplings per acre. Total basal area in this stand is approximately 64 sf/ac, 44 of which is sawtimber. According to the 1971 Gingrich stocking guide for upland central hardwoods this stand is understocked, meaning that the site's ability to grow trees is not being fully utilized by the number of trees that are currently there. As the stand continues to grow, tree crowns will again begin to fill in the vacated space and the stand will trend toward fuller stocking.

Tree regeneration in this stand is present, but is primarily beech. Attempting to shift this regeneration towards oak, hickory, and white pine in at least part of the stand would significantly increase the likelihood that this stand will continue to be as diverse as it is now into the future. This could likely be achieved by expanding some of the gaps created during the last harvest and perhaps creating some more gaps wherever desirable regeneration is found.

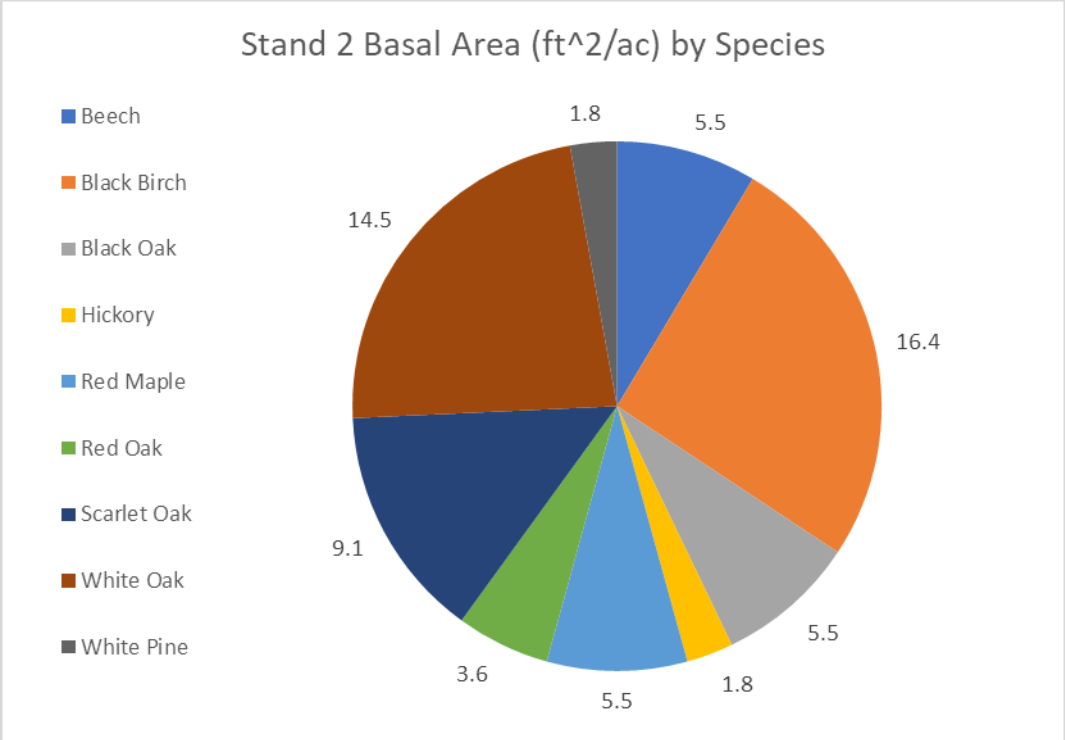
Management History – This stand was last managed actively in 2006 when a series of small regeneration treatments were conducted with the intent of regenerating oak and other shade intolerant species using shelterwoods and small patches. Based on a visual inspection in 2022, these treatments did not succeed in regenerating much oak and seem to have primarily regenerated beech and black birch. This is likely because none of the gaps were large enough, and none of the shelterwoods large enough or low enough density to supply the amount of light required for oak to outcompete black birch. Similar to Stand 1, the positive outcomes of this treatment include the introduction of a new size and age class of trees which provides important habitat diversity for wildlife that use regenerating forests. In addition, the vast majority of vegetation that grew in the gaps created during the last treatment is native. Some of the regenerating areas in this stand still have utility for wildlife species that require or prefer young forest conditions, but within the next five years or so it is likely that that utility will wain and eventually be eliminated as the forest matures.

Health – Overall forest health in this stand is fair. Most overstory trees appear to be in good condition, but some are showing early symptoms of decline, likely due to the spongy moth outbreaks of 2016-2018 as well as the increasing frequency of drought over the past decade. There are some overstory trees in places that succumbed to spongy moth damage and are now standing dead trees. Beech bark disease is by far the most common forest health issue in this stand and is currently impacting a significant proportion of beech. Nectria cankers are present on some birch (both yellow and black) but are not ubiquitous.

Invasive plants are present in this stand but are mostly concentrated around the edges and at access points. The forest interior does not, for the most part, have dense populations of invasive plants. However, if the infestations around the edge of the stand are not treated it is likely that they will invade the forest interior in the near future. Invasive plants found around the edges of this stand include barberry, winged euonymus, knotweed, wineberry, garlic mustard, and multiflora rose.

NDDB, critical habitats, special features – Connecticut's NDDB and Critical Habitats mapping indicates that there are no special features within this stand. However, there is at least one potential vernal pool and several wet areas that contribute to the overall biodiversity of this stand.

	BA/acre	BA/acre AGS	Trees/acre	Trees/acre AGS	Volume/acre	Volume/acre AGS
Seedlings			91			
Saplings			800			
Sawtimber trees	43.6	27.3	40.3	25.1	2.5 MBF	1.9 MBF
Poletimber trees	20.0	10.9	40.8	21.5	2.3 CD	1.4 CD
Snags	5.5		4.0			
Total	63.6	38.2	81.1	46.6		
MSD*	12.0					
*Quadratic Mean Stand Diameter						
** Total trees includes sawtimber and poletimber-sized trees only						
MBF= Thousand board feet						
BA= Basal area and is given in square ft./acre						



Desired Future Condition

- Uneven-aged forest
- Mostly closed canopy
- Diverse species mix
- Diverse age and size classes
- Some component of desirable regeneration and/or young forest
- Oak regeneration
- Diverse wildlife habitat
- High degree of resilience to disturbance
- Maintained accessibility
- Reduction of invasive plants
- Produce high-quality forest products
- Maintained ability to uptake and store carbon
- Retention/enhancement of historic features

Management Recommendations

2023-2024 – Treat invasive plants. Targeted chemical control is likely to be the most effective method at this relatively early stage of the infestation. If this is completed successfully, spot treatment may be the only treatment necessary in the future.

2024-2025 – Locate areas where regeneration treatments had occurred in 2006, and within those areas find any oaks, hickory, yellow birch, sugar maple, tulip poplar, or white pine. Cut competing stems to help ensure these trees have sufficient growing space to continue to become a viable part of the future forest. In areas of pure beech or black birch, clear 1/20 or 1/10 acre areas and replant with desirable species. Use tall tree shelters or fence these areas with temporary fencing if needed to eliminate deer browsing. Doing this in areas where there is already sufficient amounts of sunlight reaching the forest floor can ensure the plantings will have enough sunlight to develop. If this is to be done, consider attempting to source tree stock from nurseries south of here in an attempt to grow trees that are more suited to a warmer climate. The intent of this treatment is to help ensure the diversity currently in the mature overstory of this stand is perpetuated in the forest that is regenerating now. This has long term implications for forest health, resilience, wildlife habitat diversity, and carbon sequestration and storage[39].

2028 – Expand preexisting gaps and remove some overstory trees that were retained in previous shelterwoods. Attempt to regenerate 5-10% of the stand (6-10 acres) creating additional patches of 1-3 acres each anchored on desirable regeneration, if possible, or pockets of overstory mortality if not enough desirable regeneration can be found.

2029-2030 – Inspect treated areas to verify that treatments created the desired outcomes in terms of regeneration and species diversity including oak, hickory, and white pine. If not, supplemental treatments including fencing, prescribed burns, planting, scarification, and control of competing vegetation should be considered.

[39] Though beech and black birch (the primary species found in the understory throughout this property) are native species, their future is uncertain due to the diseases that are currently impacting them. Their collective wildlife values are relatively low compared to that of the less shade tolerant species identified here as ideal targets for regeneration. Due to their rapid growth and long life spans oak are particularly useful for up taking and storing carbon in addition to their value to wildlife.

4.8.3 Stand 3

Acres – 42.63

Cover Type – Hardwood-dominated mixedwood

Natural Community – *Black oak – Chestnut oak/Black huckleberry*

Size and Structure – Primarily small to medium sawtimber with scattered large sawtimber and poles

Stage of Development – Late stem exclusion

Major Soils – Charlton-Chatfield fine sandy loams

Site Index – 65 (northern red oak) This information indicates that red oak grows well on this site.

Water features – This stand has numerous potential vernal pools and one pool in which wood frog breeding was actively observed as were wood ducks. Due to the extreme ridge and valley topography of this stand, there are many hollows in which water accumulates during the spring and which may serve as vernal pools.

Topography – The topography of this stand is dominated by a significant hill and several smaller ridges, all of which run north-south except for one drainage which heads southwest towards a parking area on Maupas Road. This stand has primarily east and west aspects, some of which are fairly steep.

Access – Access to this stand for management purposes is relatively poor due to the steep and somewhat ledgy terrain, but trails that run along and between ridges provide good access on foot.

Stand description – This is the smallest stand on the property and is in one contiguous block. This stand occupies the space between Stand 4 and Maupas Road.

Tree species in the overstory include red, white, chestnut, and scarlet oaks, red maple, beech, black birch, and white pine. Midstory trees are primarily beech, black birch, hickory, and red maple. Small to medium sawtimber-sized trees (12-18 in. DBH) are the dominant size class, although there are scattered poletimber and large sawtimber trees and some of the white pine are very large diameter.

This stand is essentially even-aged, although it has some of the appearance of an uneven-aged stand due to the presence of some large white pine. Because white pine grow so much faster than the various hardwood species present in this stand, white pine of the same age as the hardwoods they're growing with can frequently be much larger. There are approximately 155 trees per acre, 46 of which are sawtimber-sized, and 108 of which are poletimber-sized, as well as approximately 1,767 seedlings and saplings per acre. Total basal area in this stand is approximately 103 sf/ac, 63 of which is sawtimber. According to the 1971 Gingrich stocking guide for upland central hardwoods this stand is fully stocked, meaning that the potential of the site to grow trees is being fully utilized by the number of trees present.

There is a significant amount of tree regeneration in this stand, most of which is white pine, although there is also some beech, black birch, red maple, and scarlet oak regeneration. Releasing some of this regeneration by creating two or three small gaps would help ensure that this stand retains a vigorous softwood component into the future.

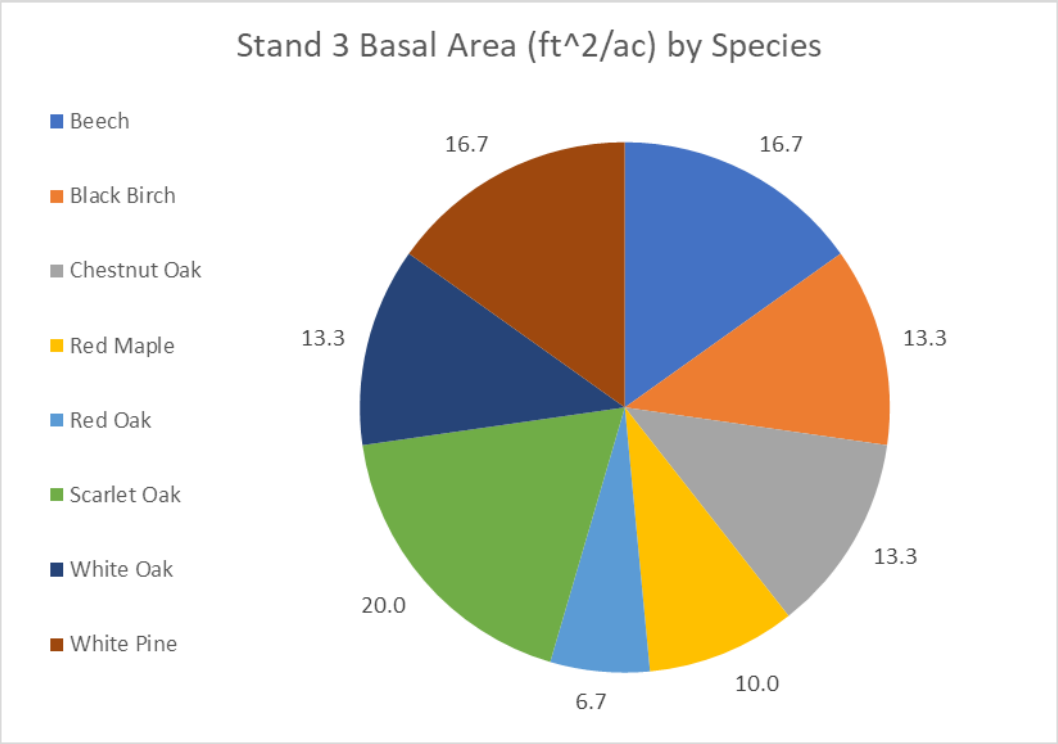
Management History – This stand appears to have seen no significant management activity in the recent past.

Health – Overall forest health in this stand is good. Most trees appear to be in good condition, and there are very few invasive plants. The most common forest health issues in this stand are beech bark disease, with which many beech are infected, general decline, and white pine weevil. Although many of the overstory oak are in good condition, a significant number are also suffering from general decline. The droughts and subsequent spongy moth outbreaks of 2016-2018are likely to blame for this, as well as secondary pests and pathogens such as two-lined chestnut borer and shoestring fungus which attack already-weakened trees.

At this point, there are very few invasive plants in this stand. This stand should be monitored yearly and any invasive plants found should be spot treated to maintain this relatively invasive-free condition.

NDDB, critical habitats, special features – Connecticut's NDDB and Critical Habitats mapping indicates that there are no special features within this stand. However, there is at least one confirmed functioning vernal pool and many more potential vernal pools. Additionally, the large softwoods in this stand provide unique and necessary habitat to a variety of wildlife, such as Blackburnian warbler, which require large softwoods for one or more important life functions. The topography of this stand and Stand 4 is also unique and provides wetland, ledge, and mixedwood forest habitat all within a relatively small area.

	BA/acre	BA/acre AGS	Trees/acre	Trees/acre AGS	Volume/acre	Volume/acre AGS
Seedlings			1333			
Saplings			434			
Sawtimber trees	63.3	36.7	46.2	23.5	3.8 MBF	3.1 MBF
Poletimber trees	40.0	20.0	108.4	48.9	2.4 CD	1.1 CD
Snags	6.7		13.7			
Total**	103.3	56.7	154.6	72.3		
MSD*	11.1					
*Quadratic Mean Stand Diameter						
** Total trees includes sawtimber and poletimber-sized trees only						
MBF= Thousand board feet						
BA= Basal area and is given in square ft./acre						



Desired Future Condition

- Uneven-aged forest
- Mostly closed canopy
- Diverse species mix
- Diverse age and size classes
- Some component of desirable regeneration and/or young forest
- Oak and pine regeneration
- Diverse wildlife habitat
- High degree of resilience to disturbance
- Maintained accessibility
- Reduction of invasive plants
- Maintained ability to uptake and store carbon
- Retention/enhancement of historic features

Management Recommendations

2023-2024 – Spot treat invasive plants. Because there are so few invasives at the moment, treating the few that are there currently is an easy way to keep this stand invasive-free for the foreseeable future.

2025 – Create 2-3 small (1-2 ac) gaps to release pockets of desirable regeneration. This should be done in areas with high percentages of pine regeneration as well as high percentages of either poor quality or declining trees. The gap creation described here will increase the stand's structural diversity and help ensure that a vigorous softwood component exists within this stand in the future. This treatment should be performed by hand (with chainsaws) and all wood left on site to increase structural complexity, increase nutrient cycling, provide wildlife habitat, and moderate unpredictable water regimes.

2027-2028 – Inspect treated areas to verify that treatments created the desired outcomes in terms of regeneration release from competition. This can be determined by an increase in vertical growth annually which can be observed visually. If the treatment does not appear to have been successful, expand gaps where shade is still having too much of an impact on regeneration and where it makes sense to do so based on the condition and composition of the overstory trees (i.e., limit or prohibit cutting of additional vigorous pine, oak, or hickory to expand the gap). Control competing vegetation if necessary.

4.8.4 Stand 4

Acres – 96.18

Cover Type – Softwood-dominated mixedwood

Natural Community – *Eastern hemlock*[40]

Size and Structure – Medium to large sawtimber with scattered poletimber and small sawtimber

Stage of Development – Stem exclusion with pockets of understory reinitiation

Major Soils – Charlton-Chatfield fine sandy loams, Hollis-Chatfield-Rock outcrop complex, and small pockets of Sutton fine sandy loam and Walpole sandy loam

Site Index – 55-65 (eastern white pine) This range is fair for white pine which indicates that the soils are suitable for growing this species. Tree size and height confirm this as there are some tall pine in this stand.

Water features – This stand is bounded to the east by Upper Guilford Lake and contains several potential vernal pools in the hollows between ridges. This stand also contains a small stream that flows south and eventually drains into Iron Stream just below Upper Guilford Lake.

Topography – The topography of this stand is defined by multiple parallel knife-edge ridges that run approximately north-south with small valleys in between. The ridges themselves are composed of dramatic rock outcrops and the valleys in between have a very moist, somewhat riparian character, some of which hold standing water.

Access – Access to this stand for management purposes is impractical due to the topography, but the stand is accessed by a number of hiking trails that traverse the ridges and valleys between.

Stand description – This is the second smallest stand on the property and is in two blocks, one of which comprises the majority of the acreage, the other of which is a relatively small block adjacent to Maupas Road, separated from the rest of the stand by Stand 3.

Tree species in the overstory include white pine, white, scarlet, and red oaks, and smaller percentages of beech, black birch, black oak, hemlock, red maple, and aspen. Midstory trees are primarily beech, black birch, and hemlock. Medium to large sawtimber-sized trees are the dominant size class, with some being

[40] *Although this stand contains little eastern hemlock its major components are listed as associates in the Eastern hemlock natural community and there is no listed natural community type that lists white pine as the dominant tree species.*

very large, but there are also small sawtimber and poletimber-sized trees. Notable understory species in this stand include fairy mist, water pennywort, and marsh blue violets.

This stand is essentially even-aged, although there are pockets of understory reinitiation where overstory trees have died in small groups and allowed other vegetation, including tree regeneration, to take advantage of the increased light reaching the forest floor. There are approximately 91 trees per acre, 37 of which are sawtimber-sized, and 54 of which are poletimber-sized, as well as approximately 1767 seedlings and saplings per acre. Total basal area in this stand is approximately 80 sf/ac, 60 of which is sawtimber. Although there is no readily available stocking guide for white pine-central hardwoods stands, interpolation from Gingrich (1971) and Leak (1999) indicate that this stand is slightly understocked. However, this slight understocking is not negatively impacting the stand's ability to provide wildlife habitat, sequester and store carbon, or provide recreational opportunities so there is no pressing reason to attempt to increase stocking.

There is a significant amount of tree regeneration in this stand, most of which is white pine, although there is also some beech, black birch, hemlock, scarlet and white oak, and white ash regeneration. In places, this regeneration is being released naturally as canopy trees die and allow more sunlight to reach the forest floor.

Management History – It appears that no significant harvesting activity has taken place in this stand in the recent past. Both the lack of stumps and the lack of skid roads/trails indicate that no significant harvesting with any sort of equipment has occurred recently.

Health – Overall forest health in this stand is fair. The structure of this stand is somewhat more diverse than other stands on the property and the mix of softwood and hardwood provides habitat (in the form of both food and cover) to a variety of wildlife. The health of individual trees in this stand is good overall, although beech bark disease, spongy moth-related decline or mortality, emerald ash borer-related mortality of ash, hemlock scale and adelgid, and potentially white pine blister rust or white pine decline are all present. Beech bark disease in this stand is widespread and some trees appear to have died from it, but many are persisting in spite of infestation. While beech leaf disease was not visually observed in this stand, it is likely that it is present here due to its presence in other parts of the property. While spongy moth-killed trees were observed in this stand, they are not nearly as prevalent as in Stand 1 due to the lower proportion of oak in the overstory in this stand.

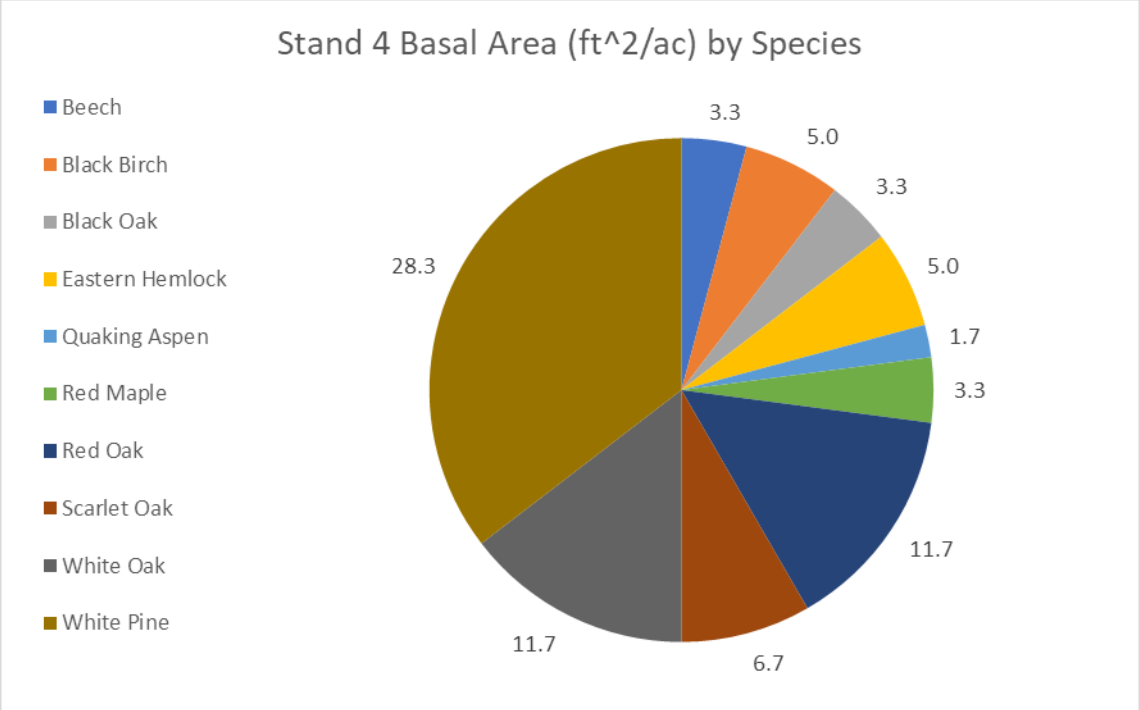
Both hemlock woolly adelgid and hemlock scale were observed in this stand. Many hemlock appear to be declining from one or both of these pests, but hemlock mortality due to either adelgid or scale is not yet widespread. Finally, one white pine was observed during the inventory that appeared to have either the beginnings of white pine blister rust or another needle disease. Few cultural treatments for white pine blister rust, if that is indeed the cause of the observed dieback, exist apart from removing *Ribes spp.* from the area, but taking that step at this stage would be excessive without first confirming that white pine blister rust is the causative agent of the observed decline.

There are very few invasive plants in this stand. This stand should be monitored regularly and spot treated as necessary to maintain this invasive-free state.

NDDB, critical habitats, special features – Connecticut's NDDB and Critical Habitats mapping indicates that there are no special features within this stand. However, there are several potential vernal pools in this stand and the large softwoods in this stand provide unique and necessary habitat to a variety of wildlife, such as Blackburnian warbler and other birds including barred owls. Pine warbler (one of Audubon

Connecticut's Priority Species) was observed in this stand. The topography of this stand and Stand 3, is unique and provides wetland, ledge, and mixedwood forest habitat all within a relatively small area.

	BA/acre	BA/acre AGS	Trees/acre	Trees/acre AGS	Volume/acre	Volume/acre AGS
Seedlings			1167			
Saplings			600			
Sawtimber trees	60.0	33.3	36.5	17.3	5.4	3.9
Poletimber trees	20.0	15.0	54.5	42.9	1.0	0.7
Snags	3.3		5.6			
Total**	80.0	48.3	90.9	60.2		
MSD*	12.7					
*Quadratic Mean Stand Diameter						
** Total trees includes sawtimber and poletimber-sized trees only						
MBF= Thousand board feet						
BA= Basal area and is given in square ft./acre						



Desired Future Condition

- Uneven-aged forest
- Mostly closed canopy
- Diverse species mix
- Diverse age and size classes
- Some component of desirable regeneration and/or young forest
- Oak and pine regeneration
- Diverse wildlife habitat

- High degree of resilience to disturbance
- Maintained accessibility
- Continued absence of invasive plants
- Maintained ability to uptake and store carbon
- Retention/enhancement of historic features

Management Recommendations
2023-2024 – Spot treat invasive plants. Because there are so few invasives at the moment, treating the few that are there currently is an easy way to keep this stand invasive-free for the foreseeable future.

Ongoing – Monitor and spot treat invasives to keep this stand invasive-free. Monitor the general health of white pine in this stand and apply appropriate cultural treatments if a treatable disease becomes prevalent, or looks as if it might begin to spread. Other than keeping this stand free of invasives, it is recommended that this stand be set aside as a permanent unmanaged reserve where natural processes are the dominant forces at work.

4.8.5 Stand 5

Acres – 109.57

Cover Type – Red maple swamp

Natural Community – *Red maple/Northern spicebush*

Size and Structure – Poletimber and small sawtimber

Stage of Development – Stem exclusion

Major Soils – Ridgebury, Leicester, and Whitman fine sandy loams, Timakwa and Natchaug muck soils, Catden and Freetown muck soils

Site Index – 55-62 (red maple) This is fair to good for red maple indicating that the soils are suitable for growing red maple.

Water features – This entire stand is a swamp, much of it standing water, or flowing during significant precipitation events.

Topography – The topography of this stand is primarily flat and its constituent blocks are mainly in valley bottoms.

Access – All blocks of this stand would be extremely difficult (and likely inappropriate) to access with any equipment due to the swampiness of the ground and standing water in many places. Access on foot is facilitated in places by footbridges.

Stand description – This stand comprises slightly more than 20% of the acreage of the Timberlands Preserve although it is in many small blocks, the largest of which is 64.31 acres.

The vast majority of the trees in this stand are red maple although there are smaller components of black birch, yellow birch, and red, white, and scarlet oaks. Midstory trees are primarily red maple. In many places, a dense mountain laurel understory provides a significant amount of structure in addition to the

red maple overstory and midstory. Poletimber-sized trees are the dominant size class in this stand though some larger sawtimber-sized trees are also present. Notable understory plants in this stand include meadow rue, rue anemone, and sweet woodruff.

This stand appears to be essentially even-aged, although assessing age structure is difficult in red maple swamps. Because growth is so slow in these ecosystems, trees some trees may be older than they appear, and two trees of very different ages may appear very similar. In red maple swamps like this, new cohorts (age classes) are generally established when a pocket of existing overstory trees blows down (or falls over due to wet soils and shallow roots) and several seedlings or saplings take advantage of the newly-available light. It is possible that this has occurred in places in this stand that were not inventoried due to accessibility and that this stand is starting to develop a more uneven-aged character. There are approximately 201 trees per acre, 60 of which are sawtimber and 141 of which are poletimber, in addition to approximately 350 seedlings and saplings. Total basal area in this stand is approximately 110 sf/ac, 65 of which is sawtimber.

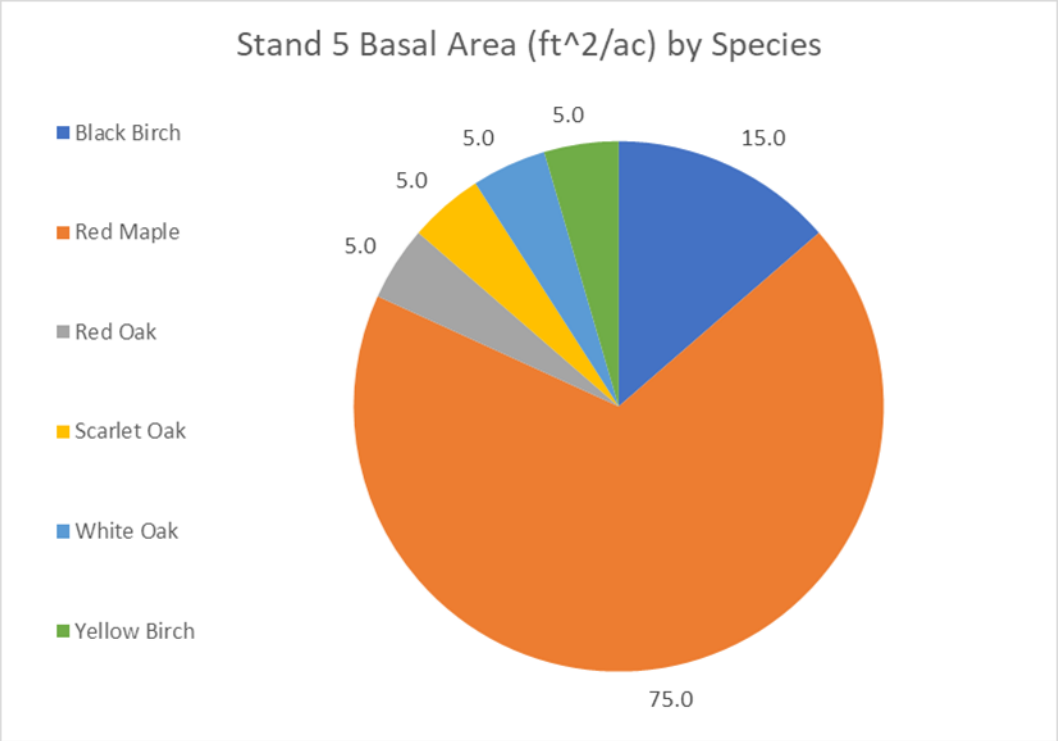
Tree regeneration in this stand is present, but not dense. Most of the observed tree regeneration was white pine, but some hickory and beech were also noted. Red maple and black birch are also present, but not dense.

Management History – There appears to have been little to no management activity in this stand.

Health – Forest health in this stand is acceptable, given the ecosystem type. While the trees are generally in poor form and prone to rot due to the wetness of the stand, no widespread diseases were noted. Irrespective of the trees' poor form, they provide excellent function for the wetland system in which they're growing. In fact, the rot that is common in this stand increases the habitat value for cavity-nesting wildlife that require structurally-complex trees with rot pockets that they can excavate to use as nests and/or foraging for insects.

NDDB, critical habitats, special features – Connecticut's NDDB and Critical Habitats mapping indicates that there are no special features within this stand. However, all blocks of this stand are forested wetland which provides valuable habitat for a variety of wildlife and important landscape-level diversity, hydrologic function, and unique aesthetics. Additionally, wood frogs were observed breeding in some parts of this stand, so while no part of this stand meets the hydrological definition of a vernal pool, some parts are functioning as such for some vernal pool obligate species.

	BA/acre	BA/acre AGS	Trees/acre	Trees/acre AGS	Volume/acre	Volume/acre AGS
Seedlings			250			
Saplings			150			
Sawtimber trees	65.0	30.0	59.9	31.8	2.2 MBF	1.4 MBF
Poletimber trees	45.0	35.0	141.3	117.8	2.5 CD	1.7 CD
Snags	0.0		0.0			
Total**	110.0	65.0	201.2	149.6		
MSD*	10.0					
*Quadratic Mean Stand Diameter						
** Total trees includes sawtimber and poletimber-sized trees only						
MBF= Thousand board feet						
BA= Basal area and is given in square ft./acre						



Desired Future Condition

- Mostly closed canopy
- Continued red maple swamp wildlife habitat
- High degree of resilience to disturbance
- Reduction of invasive plants
- Maintained ability to uptake and store carbon
- Retention/enhancement of historic features

Management Recommendations
2023-2024 – Spot treat invasive plants around the edges of the stand. Treating invasive plants in the interior of the stand is not logistically feasible but removing invasive plants from the edges of the stand will help limit their spread.

Ongoing – Monitor and spot treat invasive plants around the edges of the stand.

4.9 Summary of Stand-Specific Recommendations

4.10 Summary Table of Recommendations

Timberlands Preserve – Guilford, CT
Stand Schedule Summary
2023-2033

Year	Stand/ Area	Treatment

5 SUPPLEMENTAL INFORMATION

5.1 Sources Consulted and/or Cited

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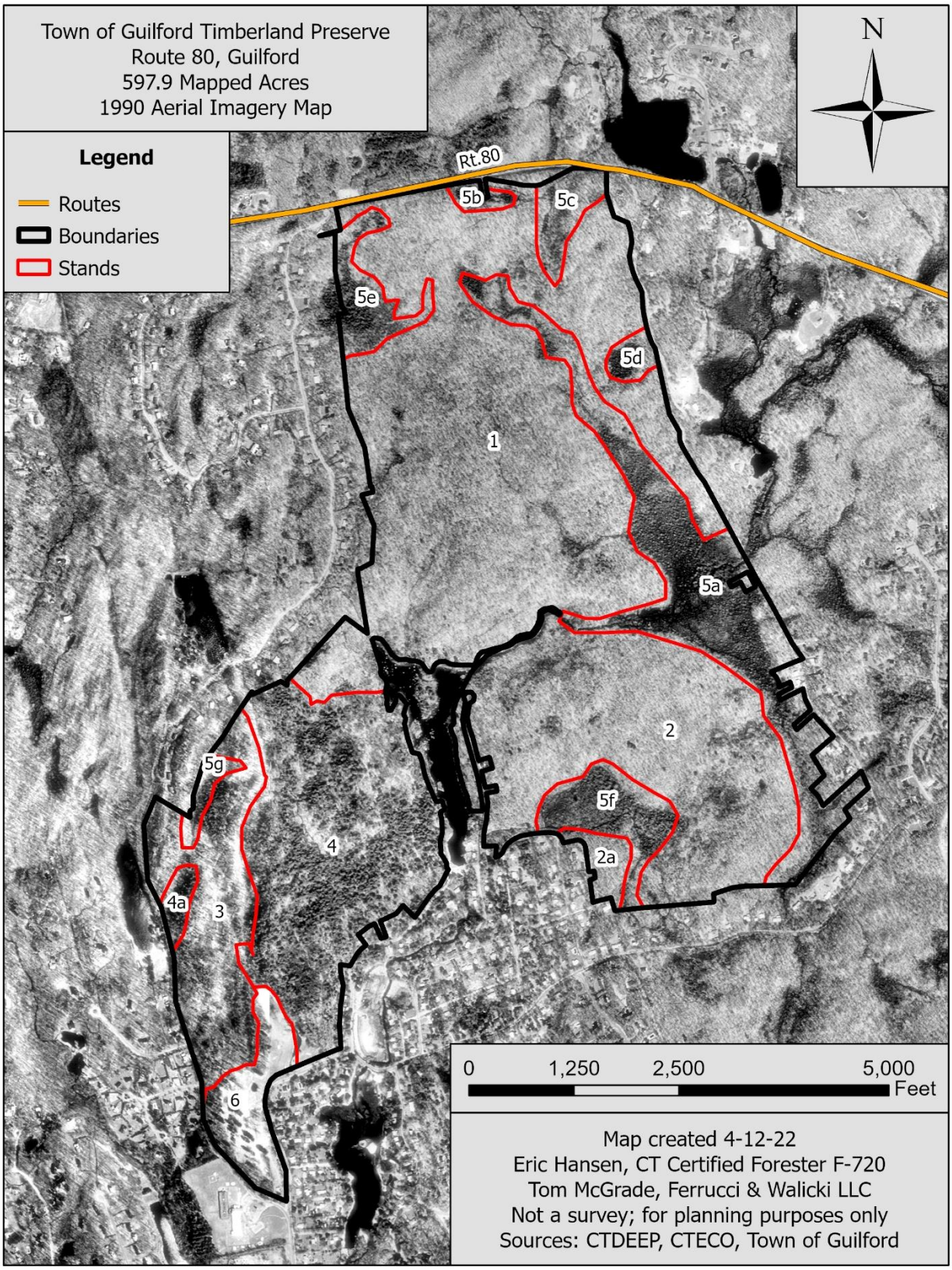
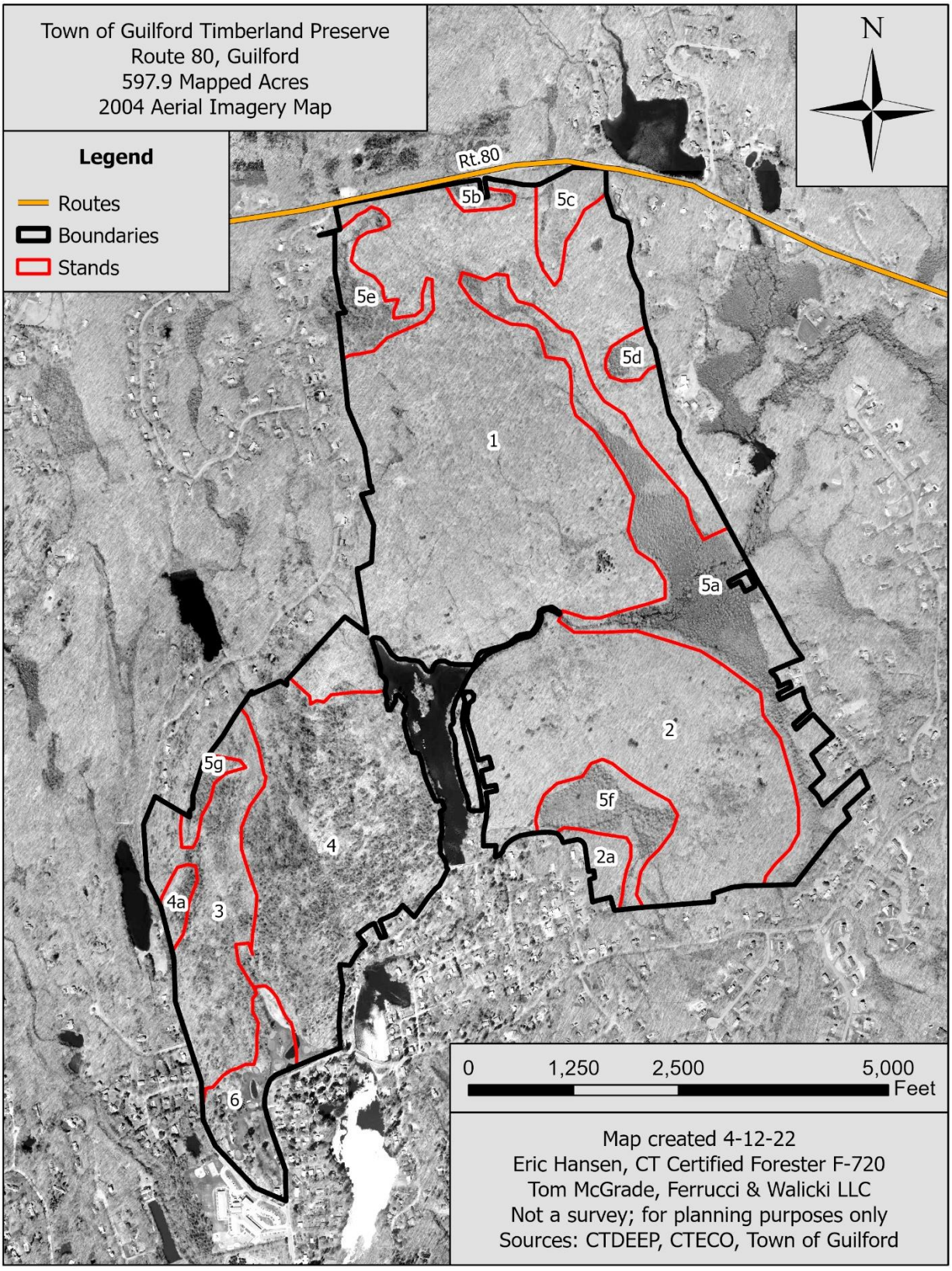
5.2 Maps

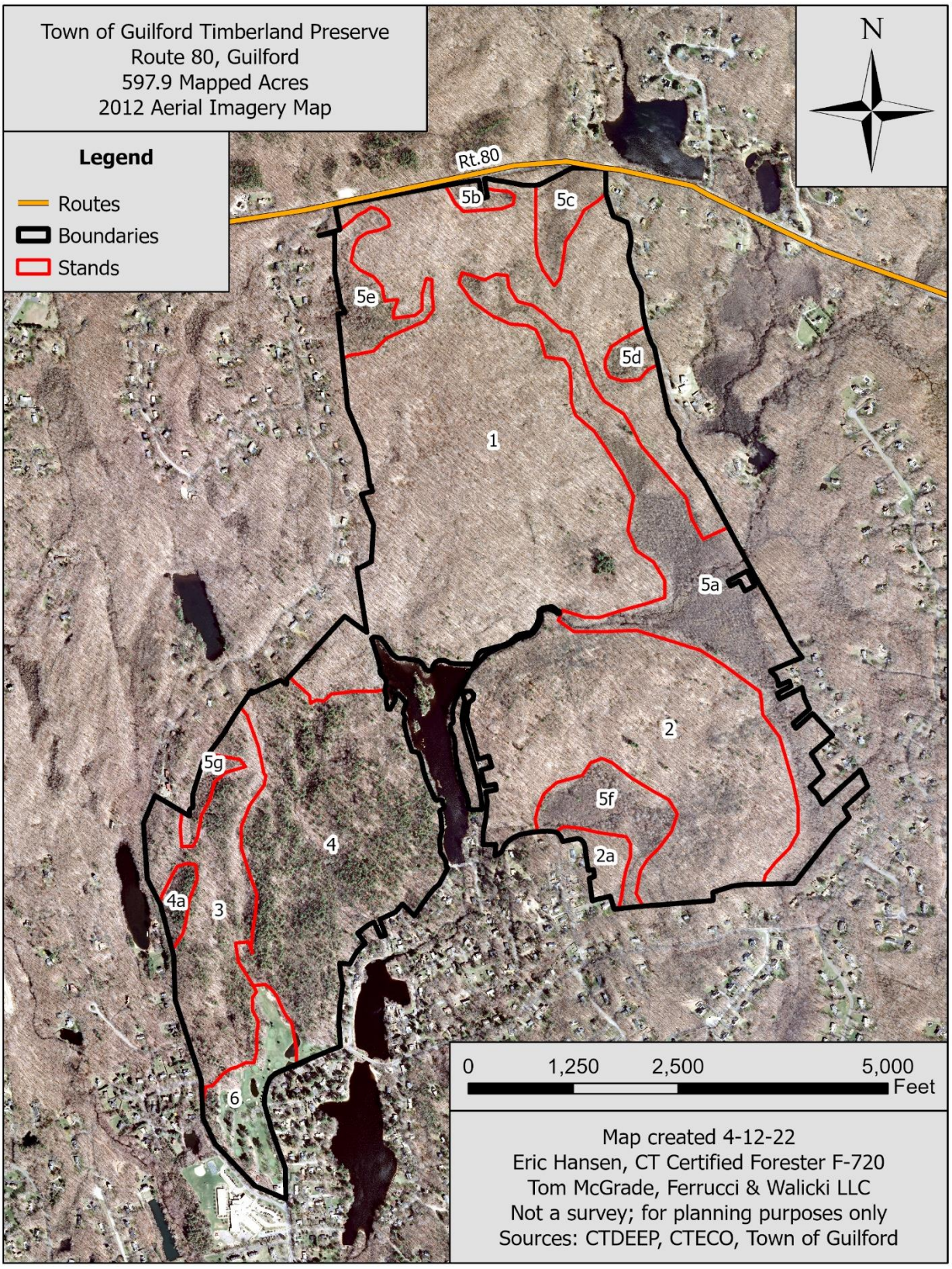
5.2.1 1990 Aerial Imagery Map



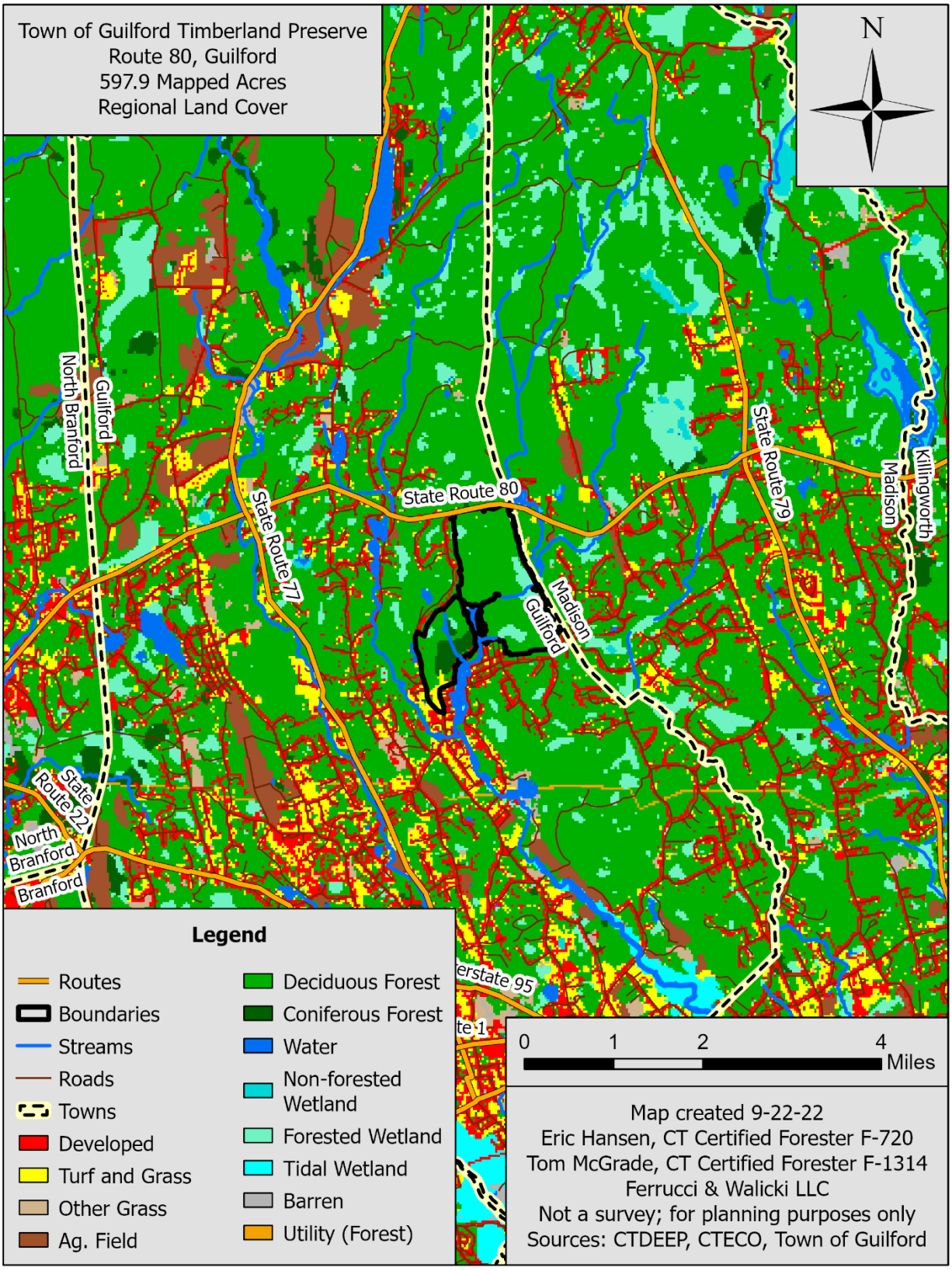
5.2.2 2004 Aerial Imagery Map



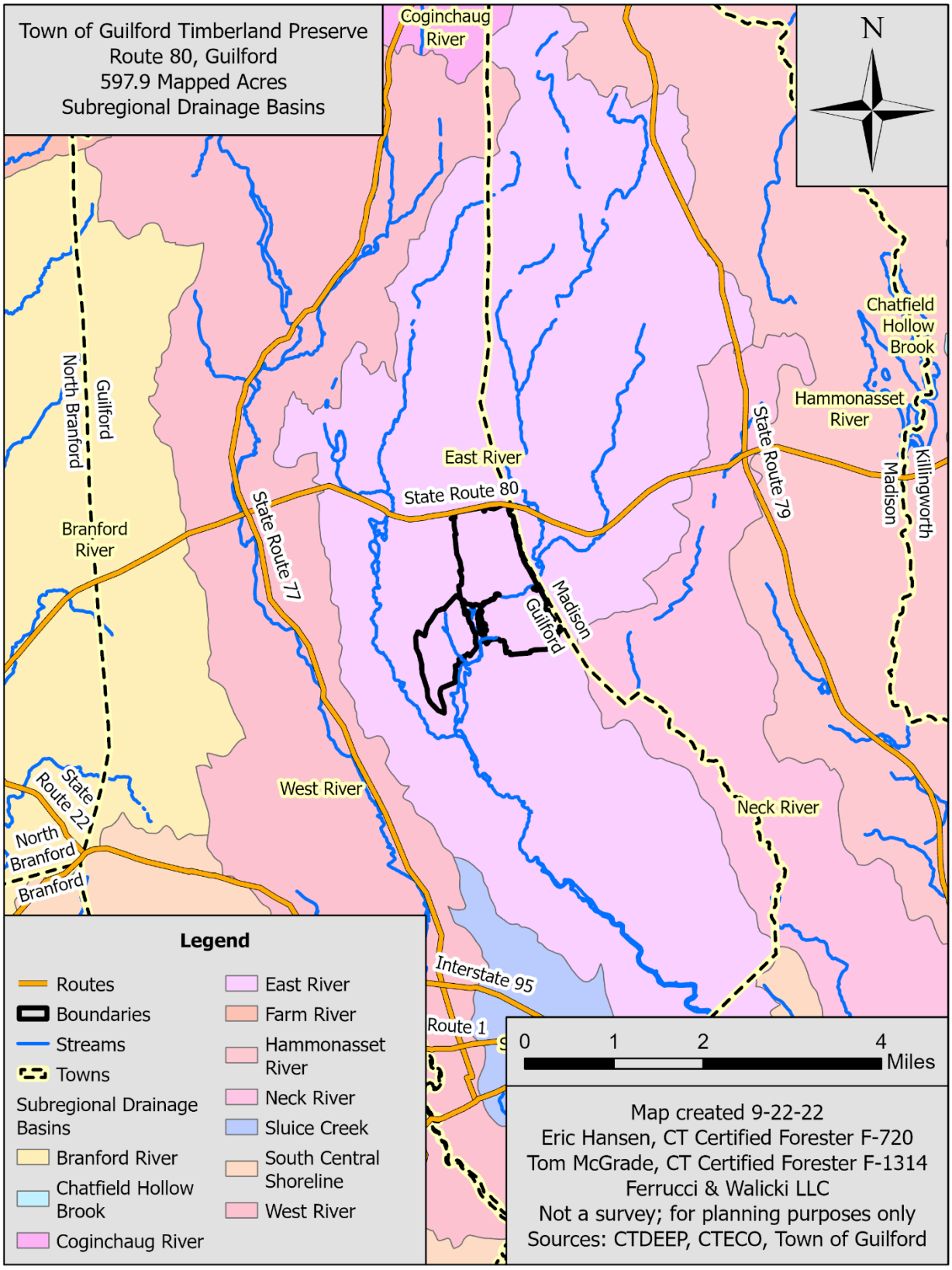
5.2.3 2012 Aerial Imagery Map



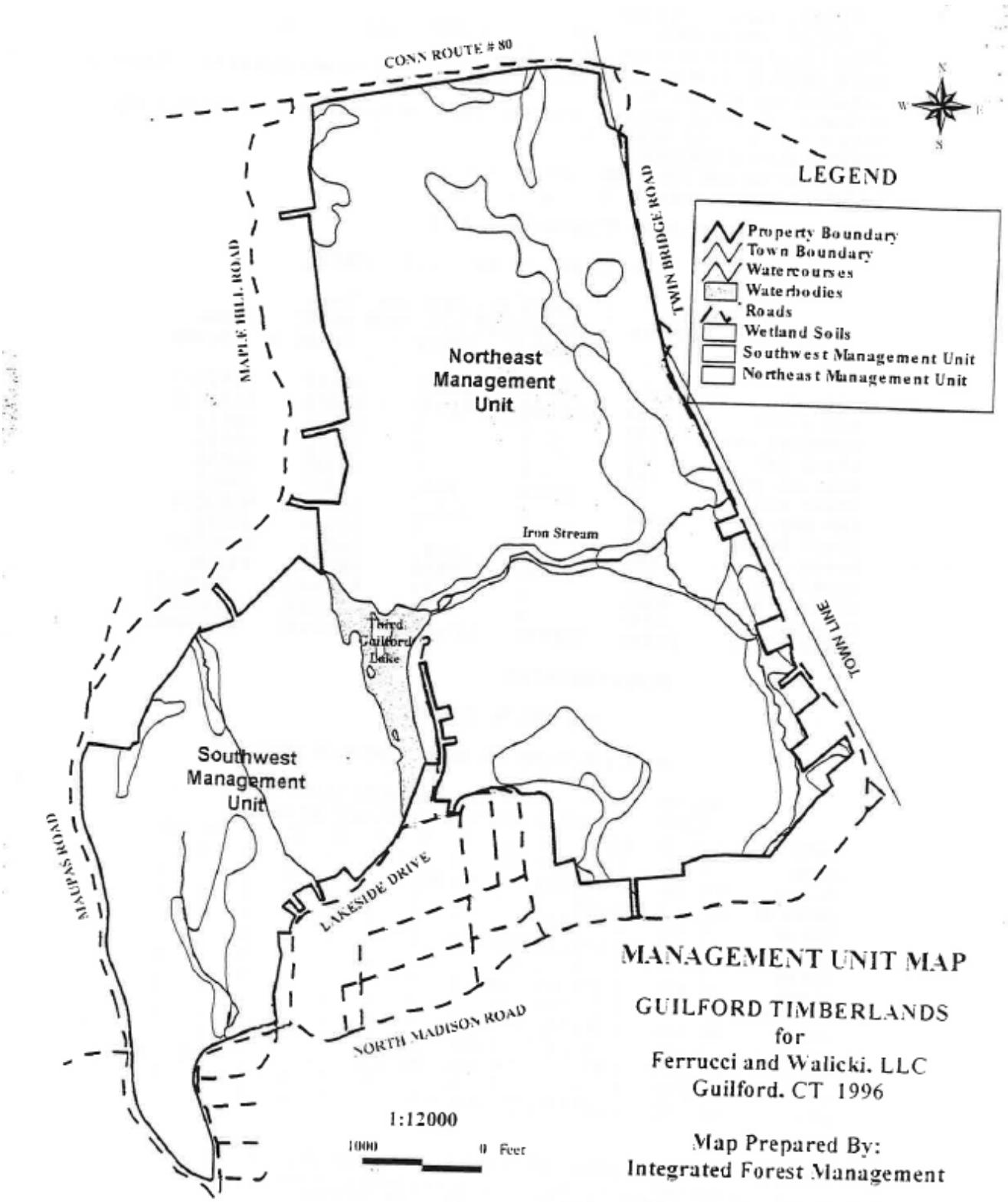
5.2.4 Regional Land Cover Map



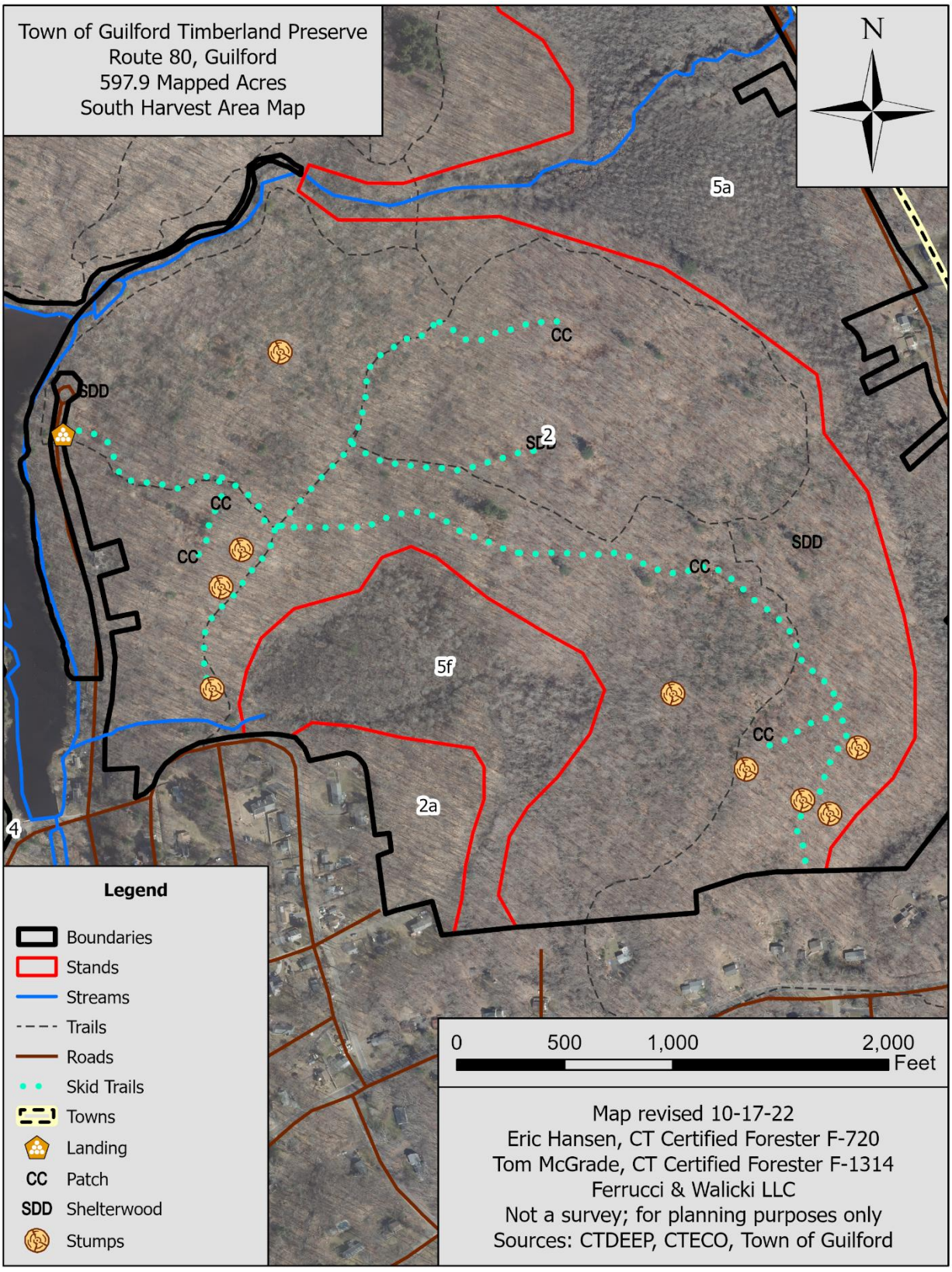
5.2.5 Subregional Drainage Basins Map



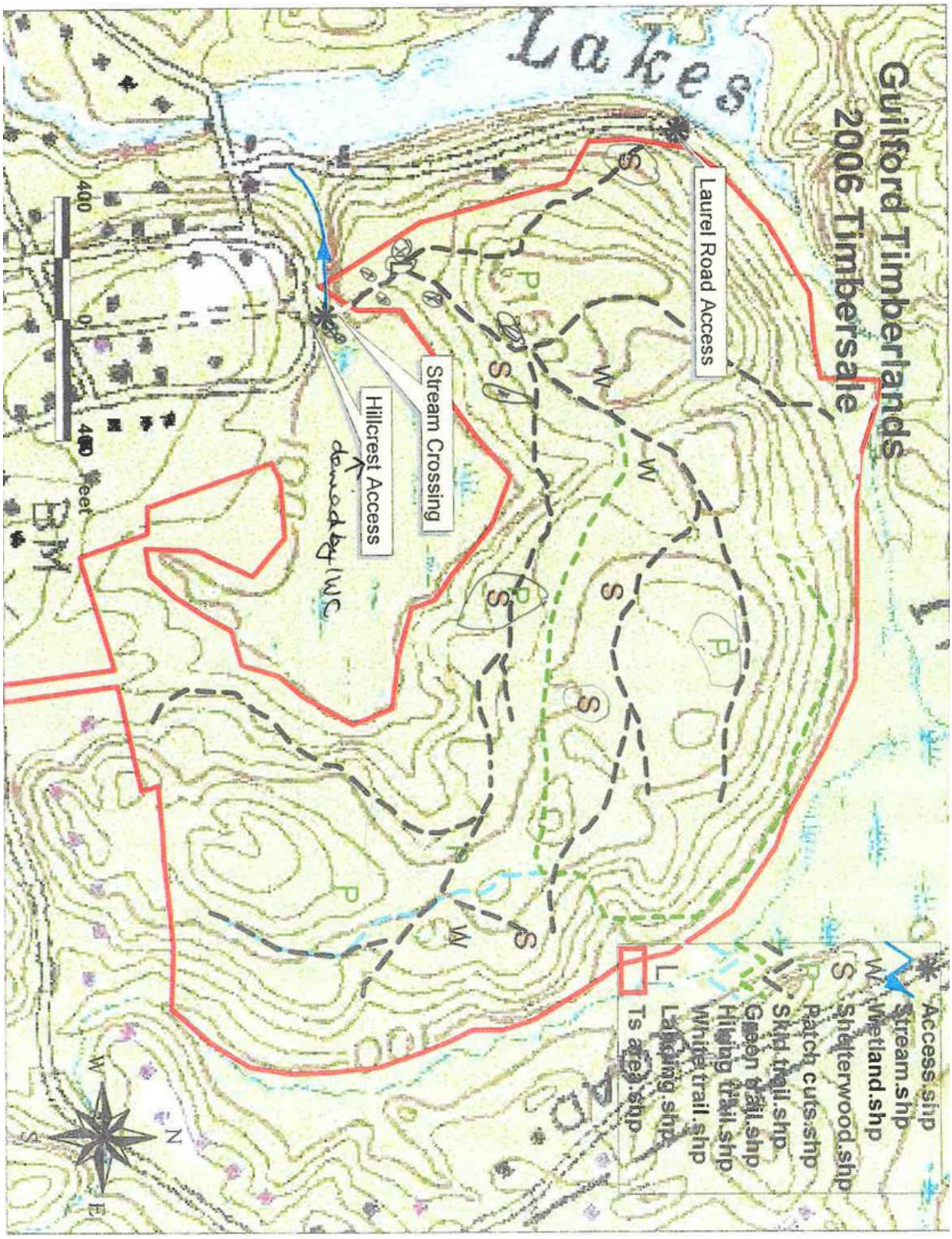
5.2.6 1997 Stands Map



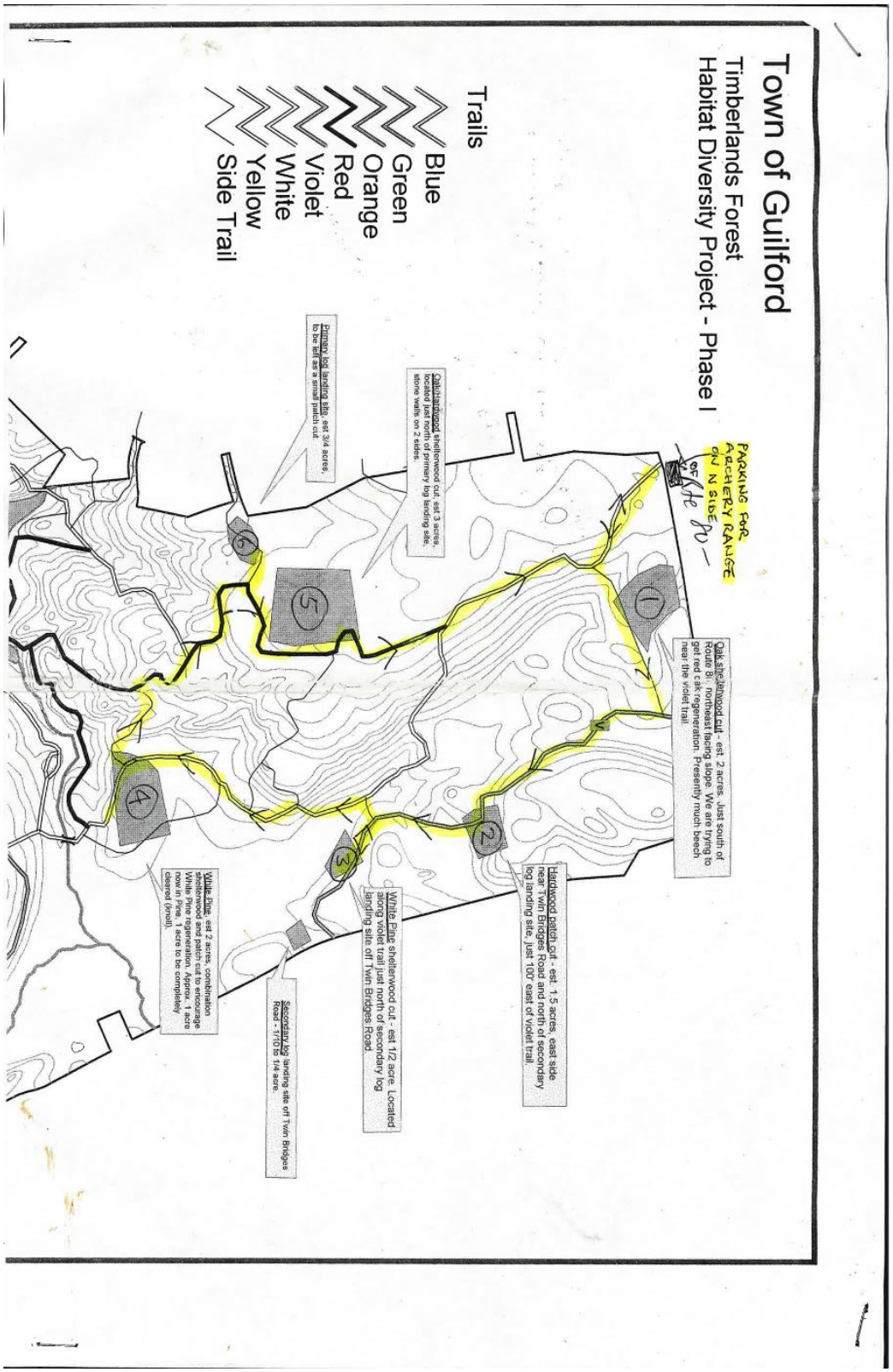
5.2.7 South Harvest Area Map



5.2.8 South Harvest Area Layout Map



5.2.9 North Harvest Area Layout Map



Courtesy of Orrin Jones.

5.3 List of Understory Plants on The Timberland Preserve

Stand 1	Stand 2	Stand 3
Asters	Asters	Asters
Beech Drops	Blue Volets	Blue Violets
Bittercress	Canada Mayflower	Canada Mayflower
Blue Violets	False Solomon's Seal	Dwarf Ginseng
Canada Mayflower	Ferns	False Hellebore
Dwarf Ginseng	Grasses	False Solomon's Seal
False Hellebore	Greenbrier	Ferns
False Solomon's Seal	Huckleberry	Jack-in-the-pulpit
Ferns	Lowbush Blueberry	Mapleleaf Viburnum
Goldenrod	Mapleleaf Viburnum	Rue Anemone
Grasses	Partridgeberry	Sedge
Greenbrier	*Rubus spp.*	Skunk Cabbage
Jack-in-the-pulpit	Sedge	Solomon's Seal
Lowbush Blueberry	Shinleaf	Three-leaved Rattlesnake-root
Mapleleaf Viburnum	Skunk Cabbage	White Violets
Marsh Blue Violet	Solomon's Seal	Wild Oats
Marsh Marigold	Starflower	Wood Anemone
Meadow Rue	Striped Pipsissewa	
Partridgeberry	Three-leaved Rattlesnake-root	
Ramps	White Violets	
Rattlesnake Plantain	Wild Oats	
Rock Tripe	Wild Strawberry	
Rubus spp.	Wintercreeper	
Rue Anemone	Wood Anemone	
Sedge		
Shinleaf		
Skunk Cabbage		
Striped Pipsissewa		
Sweet Pepperbush		
Three-leaved Rattlesnake-root		
Trilliums		
White Wood Aster		
Wild Geranium		
Wild Oats		
Wild Strawberry		
Wood Anemone		

Stand 4	Stand 5
Asters	Asters
Beech Drops	Blue Violets
Blue Violets	Canada Mayflower
Canada Mayflower	Clubmoss
Clubmoss	Dwarf Ginseng
Dwarf Ginseng	Fairy Mist
Fairy Mist	False Hellebore
False Solomon's Seal	Ferns
Ferns	Goldenrod
Goldenrod	Grasses
Grasses	Jewelweed
Greenbrier	Mapleleaf Viburnum
Huckleberry	Marsh Blue Violet
Jack-in-the-pulpit	Marsh Marigold
Jewelweed	Meadow Rue
Lowbush Blueberry	Partridgeberry
Mapleleaf Viburnum	Rattlesnake Plantain
Marsh Blue Violet	Rue Anemone
Partridgeberry	Sedge
Rattlesnake Plantain	Shinleaf
Rubus spp.	Skunk Cabbage
Sedge	Starflower
Skunk Cabbage	Striped Pipsissewa
Solomon's Seal	Sweet Pepperbush
Trout Lily	Sweet Woodruff
Water Pennywort	Trout Lily
White Violets	White Violets
Wild Oats	White Wood Aster
	Wild Oats
	Wild Strawberry
	Wood Anemone

5.4 Glossary

acceptable growing stock (AGS)
Trees that are vigorous and now or in the future are capable of producing a sawlog that is at least 8 feet long

aspect
The general direction in which land slopes

basal area
A commonly used measure of forest density or stocking. It is measured as the cross sectional area of a tree in square feet at 4.5 feet above ground.

B-level
The stocking level considered optimal for sawtimber growth.

board foot
A measurement unit for lumber volume. One board foot is a piece of wood 1 foot long by 1 foot wide by 1 inch thick (Abbreviated b.f.)

breast height
Measurement at which diameter is generally measured for inventory and timber tally purposes. Breast height is measured at 4.5 feet above the ground. Where there is any slope, breast height is always measured from the highest part of the slope where the ground intersects the tree.

clearcut
An even-age silvicultural technique in which all the trees in an area are severed and – typically – removed. Silvicultural clearcuts generally remove all trees above 2 inches dbh. Commercial clearcuts or "high-grades" remove all the trees of value leaving poorer quality trees of a variety of diameters.

clearcut with reserves
A modified clearcut in which the majority of the trees in an area are cut, but some minimal trees are left standing. Typically reserve trees will allow to mature and will not be cut. This differs from a shelterwood or seed tree harvest in that residual trees following the initial regeneration cut are intended for removal.

clear log
A length of tree stem or cut log that has no horizontal (i.e. side) branches.

coppice
A sprout from roots or stumps. Or a practice of cutting a tree or group of trees to cause them to resprout from the stump or roots.

cord
A measurement unit for firewood. One cord of stacked wood measures 4 feet by 4 feet by 8 feet. 1 cord contains 85 cubic feet of solid wood. (Abbreviated cd)

crown
The top of the tree, including the live branches and the leaves.

cruise
An inventory of standing trees during which information about species, size and other characteristics is gathered.

cull
A tree of such poor quality that it is not suitable for sawtimber. Culls are sometimes sold for firewood.

dbh
Diameter of a tree outside the bark measured at breast height

den tree
A tree with a hollow or cavity large enough to potentially be used by wildlife (a.k.a. cavity tree)

even-age management
Managing trees in such a way that it creates a single or two age classes in a stand.

free-to-grow
A condition in which seedlings, saplings, or other smaller, younger vegetation has sufficient sunlight to allow them to continue to develop. This is achieved when there is little to no competing vegetation overtopping the smaller vegetation.

girdle
To attempt to kill a tree by cutting through the outer bark and cambium around its entire circumference.

hardwood
A deciduous, broadleaf tree. Angiosperm.

high-grade
A logging practice in which only the best trees are removed leaving poorer quality and/or damaged trees.

International Rule
A type of log (measuring) rule. The International Rule is the legal standard for measuring sawtimber in Connecticut.

live crown ratio
The ratio of live crown length to total tree height.

mast
Seeds and nuts produced by trees and shrubs. Mast is often discussed in terms of hard and soft and is crucial to providing food for wildlife.

mbf
One thousand board feet (of sawtimber) or "a thousand".

midstory
Level of strata of the forest layer from between 6-30 feet in height. Dense foliage in this stratum is important for nesting and cover for many forest breeding birds and other wildlife.

mixedwood

A forested area that contains both hardwood and softwood tree species in the main canopy. Typically a mixedwood stand contains between 25-75% softwood.

overstory
The portion of trees in a stand which form the upper canopy.

overstory removal
An even age silvicultural treatment type in which most or all of the overstory trees are removed in order to release established regeneration.

poletimber
Trees from 5 to 11 inches diameter at breast height (4.5 feet above ground). Also pole or pole tree.

regeneration
New trees, generally seedlings, saplings and sprouts. Regenerating a forest involves replacing existing trees with new ones.

release
To free a desirable tree from competition by cutting or otherwise killing one or more adjacent competing trees or shrubs.

sapling
A tree from 1 to 5 inches diameter.

sawlog
A log that is straight, large and sound enough to be sawn into boards. Sawlogs are usually at least 8 feet long and ten inches or larger in diameter.

sawtimber tree
A tree large enough to contain at least one sawlog. (Saw)timber trees are usually twelve inches or larger in diameter outside the bark at breast height.

seedling
A tree from newly germinated up to 1 inch diameter.

Selection System
A silvicultural system involving the removal of individual trees or groups of trees at regular intervals. This system tends to promote the development of uneven aged forests.

Shelterwood System
A silvicultural system whereby new trees are regenerated under the partial shelter of other trees. This system is one of the options available to regenerate a stand or part of a stand to create an even aged or two-aged forest. (The latter occurs when the overstory trees are not removed following the successful regeneration of trees in the understory).

silvicultural system
A planned program of silvicultural treatments during the entire life of a stand. The main focus is on the methods used to obtain desirable regeneration.

silviculture
The science and the art of growing and tending trees for a variety of purposes.

slash
The debris left after logging, pruning or thinning. Slash can include tree tops and unused or unusable portions of the main stems of trees.

softwood
A coniferous, frequently "evergreen" tree. A gymnosperm. Common examples include pine, hemlock, spruce, fir, cedar, and larch (though the latter is not evergreen).

stand type
A group or community of trees sufficiently uniform with respect to size, species composition, spatial arrangement, age or condition to be distinguished from other groups of trees.

stocking
An indication of the amount or density of trees in a stand.

strata
The different heights of vegetation in the forest. Typically divided into understory, midstory, overstory or superstory. The latter exists when a few trees are at least twice as tall as most trees in the stand.

stumpage
Standing trees, usually associated with volume information and intended for sale.

thinning
A cutting done in immature stands in order to maintain tree health and vigor, stimulate the growth of the trees that remain and increase the total yield of useful material from the stand.

tolerance
The relative ability of a tree species to survive and/or grow in shade.

timber stand improvement (TSI)
Improving a stand of trees, usually by pruning, cull-tree removal or pre-commercial thinning.

unacceptable growing stock (UGS)
Trees which are either incapable of producing at least an 8 foot long sawlog now or in the future due to defect, rot, branches, etc. or are in poor health, have significant decline/dieback, or are likely to succumb to insect or disease mortality in the near future.

understory
Vegetation in the lower levels or strata of the forest. Frequently is composed of tree seedlings and saplings, shrubs, herbaceous species and/or invasive plants. Dense low-growing vegetation and foliage is important for many species of wildlife which use this stratum of the forest for cover, nesting, and forage opportunities. Can be considered between ground level to 5 feet in height.

uneven-age management
Managing trees in such a way that it creates three or more age classes in a stand. The selection system is most often used to develop uneven-age stands.

wolf tree
A large, open-grown tree that was present in an area before it reverted to forest

5.5 Appendix A: Brush Pile Construction

NRCS Natural Resources Conservation Service

Connecticut Wildlife Brush Piles- 645

Conservation Practice Job Sheet ***Lifespan - 1 Year***

Definition

A mound or pile of appropriate woody material, fashioned by piling brush and loose branches on top of a base comprised of larger logs, or other natural materials, to provide cover for wildlife where cover is limited.

Purpose

This practice is used to create cover for many songbirds, small mammals, reptiles, and amphibians when natural cover is limited; such as after clear-cutting. It provides areas for nesting, resting, escape from predators, and protection from harsh weather conditions.

Criteria, Considerations, and Specifications

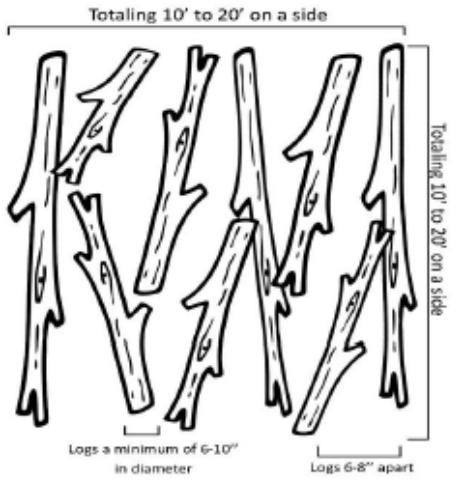
Brush piles may be built to various dimensions based on the size of available material; however, the size should range between 10 to 20 feet on a side and 4 to 8 feet high.

Materials

Brush piles can be constructed using a variety of materials. Commonly, materials left from timber harvesting, woodland edge development, forest stand improvement, forest opening development and firewood cutting are utilized. Natural features, such as rocks, boulders, and stumps may also be incorporated.

Construction

1. Base Layer:
    a. Logs at a minimum of 6-10 inches in diameter are laid at various angles, leaving small openings (6 to 8 inches wide) between base logs for easy wildlife access. Avoid creating parallel runways through the base layer.
    b. Logs of various lengths (that add up to 10 to 20 feet on a side) can be staggered throughout the foundation, with breaks, creating a maze-like environment.
    c. Outer logs should be closer to 20 feet in length to provide stability for the brush pile.



2. A second layer of smaller diameter logs should be laid on top and roughly perpendicular to the first base layer, in the same fashion, and repeated with increasingly smaller logs, 1-3 times.

3. The foundation should be covered with 2-4 feet of brush, using small limbs, saplings, loose brush, and pine boughs. Larger branches should cover the foundation, and smaller branches placed on top.

4. Brush should loosely drape over the edges, with openings (6 to 8 inches in diameter) left on the sides in several places for easy wildlife access and escape.

NOTE: *When constructing brush piles using mechanized forestry equipment, it is not possible to construct piles exactly as described. It is suitable if larger logs are crisscrossed on the base and covered with increasingly smaller logs and finally brush, so long as adequate spaces are left for wildlife to enter and exit the pile.*

Placement

Several considerations should be made when placing brush piles:

- Multiple brush piles are better than one large pile, providing more opportunities for cover and escape from predators.
- Good locations include adjacent to forest openings, pastures or hay fields; within shrub thickets or fencerows; in field corners; near stonewalls and wetlands.
    - On properties with little natural cover, such as after a clear-cut, begin brush piles within 25 feet of woodland edges, and build in towards the center of the habitat patch, resulting in 1- 4 brush piles per acre, evenly distributed across the project site.
- Place near wildlife food sources, such as mast and fruit trees.
- Avoid placing brush piles on existing high quality food or cover sources.
- Avoid placing brush piles near homes, lawns, or gardens, to prevent situations where wildlife could become a nuisance.
- Keep away from buildings due to flammability.

Variations for Brush Pile Base

- Tree stumps still in place can be incorporated into your brush pile base. Several logs (6 to 10 inches in diameter and 5 to 6 feet long) are placed on top of and around the stump.

- Small rock piles - these should be staggered about 12 inches apart with each pile about 10 inches high and 12 inches across to support next layer of limbs. Existing boulders and rocks on the landscape can be piled together to provide additional den sites; start with the largest rocks on the bottom of the stack to create hiding places between the rocks, and stack brush on top for additional cover.

Other Types of Cover *(not for reimbursement)*

- Living brush pile - take a cluster of small diameter trees, each tree is cut half way through the trunk about 12-18 inches above the ground; treetops are folded inwards towards other trees in groups so they rest on the ground or on top of the other half-cut trees.
- Stonewalls - may be incorporated into the brush piles base; brush should be placed against the wall with similar dimensions and distribution to brush piles created in an open space.
- When harvesting trees, leave the crowns of the largest trees (e.g. an oak treetop) for wildlife cover.
- Windrowed brush piles - typically these linear brush piles can best be created following a forestry or tree removal operation. As with other brush pile creation, larger materials should be placed on the bottom at various angles with subsequently smaller material on top. Avoid packing the logs tightly, as this will eliminate any openings for wildlife to enter and exit the linear pile. Windrows should range from 10 to 20 feet on a side and 6 to 8 feet high. Windrows should have breaks built into them every 50 to 100 feet to provide travel lanes for wildlife.

Additional Notes

- Brush piles are not permanent; new brush needs to be added over time or new piles may need to be constructed. Rot and decay is a natural process and may attract more insects, providing additional food sources.
- Do not use materials that contain toxic substances (i.e. pressure treated lumber/posts, creosote railroad ties, lead painted surfaces, tires, etc.). These substances can cause wildlife mortality either through contact, consumption, or inhalation.

5.6 Appendix B: Climate Change, Oak, and Carbon

According to decades of science, there is a consensus that climate change is real and is caused by human activity. In southern New England, these climatic changes are likely to have the following effects:

- Warmer average temperatures
- Fewer days below freezing
- Increased storm intensity and frequency
- Increased summer droughts

Warmer average annual temperatures will fundamentally change the habitat suitability for species that depend on cooler temperatures such as eastern hemlock, eastern white pine, white birch, aspen, sugar maple, and others. These species will not disappear overnight, but other species that are better-suited to warmer temperatures such as cherry, oak, tulip poplar, and sassafras will gain a competitive advantage over time.

Fewer days below freezing will result in less accumulated snowpack over winter, which in turn means reduced snowmelt in the spring. This also means fewer days in which open water bodies are frozen at the

surface. Less snow melt in the spring will result in drier ground conditions throughout the forest. Spring in Connecticut is already considered the driest time of year on the forest floor due to direct sun exposure without a canopy to intercept the sun's radiation. As a result, spring is the most common time of year for forest fires in Connecticut. If the forest floor becomes even drier in the spring then the likelihood of forest fires occurring will increase.

Warmer winters also have the practical effect of reducing the number of days in which forest harvest operations can occur, especially in areas with wetter soils. Typically, winter harvests are performed when the ground is frozen, ensuring it is hard enough to support mechanized equipment. This is done both to maintain the integrity of the soil and also to reduce the amount of time spent on machine maintenance. The past several decades have seen a reduction in the number of operable days in the winter, which means harvests are increasingly delayed or pushed off to the late spring, summer, and fall when/if the ground is dry. This has an unintended impact of operating more frequently during the growing season for vegetation and the mating, breeding, nesting, and roosting seasons for most wildlife.

Increases in storm intensity in recent years have had a noticeable impact on our forests. Heavy precipitation events overwhelm infrastructure that wasn't designed to handle repeated downpours and/or severe wind events. On this property, ensuring proper placement of roads, water diversion, drainage crossing types and installation can help mitigate potential impacts to water quality and soil integrity.

Increased temperature and more frequent droughts during the summer months may also increase the risk of forest fire. Other consequences potentially include reduced tree vigor and associated growth, mass die-off of trees (especially when combined with other stressors such as spongy moth defoliation), and a lack of resistance to forest pest and disease outbreaks. The latter was experienced in central and eastern Connecticut starting in 2016-2018[41] where spongy moth (Lymantria dispar) outbreaks defoliated large swaths of hardwood forests. Normally, trees are resilient enough to survive several defoliations before dying, but due to historic drought conditions many trees that would normally have survived did not possess the resources to sprout new leaves.

Oak

The result of the defoliation coupled with drought has been mass mortality, particularly of oak[42] across much of central and eastern Connecticut. In many cases it is the largest-crowned previously most vigorous oak trees that have been killed, which generally runs contrary to what would have been expected. Typically, vigorous trees with large crowns will have more resources to withstand stressors, but in this case the larger trees appear to have responded as though the large crowns and higher volumes of wood were a liability. The financial repercussions have been severe, as the stumpage price of oak has fallen considerably since the outbreak began[43]. This is expected to continue into the near future, at least in the near-term.

[41] There was significant mortality of spongy moth caterpillars in much of the region in spring and early summer of 2019, though a buildup of populations could occur again with drier spring conditions.

[42] Even more particularly of white oak, though all native oak species have shown significant mortality

[43] Flooding of the market due to spongy moth/drought killed oak trees is one of the factors for the decline in prices but there are several others as well.

In addition to the economic impacts, there are other no less important (and perhaps more) long-term impacts as well. These include (but are not limited to) the conversion of dominant species in these forests from oak to other species, and the gradual loss of stored carbon (see more about carbon below) as the dead trees decompose. Where forests in our region have not been intentionally managed to attempt to regenerate oak, other species have begun to become established in the understory and midstory of these stands. This frequently includes species such as beech and black birch. Beech is shade tolerant and black birch is well-adapted to a variety of growing conditions and is not generally browsed by deer. This species shift is significant ecologically because oaks are a keystone species for many of our forest types for all the reasons mentioned in this plan. See Appendix C for additional information about wildlife habitat.

Carbon

The concept of atmospheric carbon is a very complex and important topic. The recent dramatic increase in carbon stocks (since the Industrial Revolution) in the atmosphere is largely responsible for the climatic changes the earth is experiencing. Healthy, vigorous trees and well-functioning forest ecosystems act as sponges for absorbing (i.e., sequestering) and storing large amounts of carbon[44]. Reducing amounts of atmospheric carbon by significant amounts is expected to have a positive effect on mitigating impacts of climate change.

Land ownerships in our part of the world are generally small enough that no one ownership's actions will have a large impact from the perspective of carbon. However, cumulatively, region-wide conservation efforts and improvements in forest management can. The recommendations made in this plan are consistent with managing forests as a natural climate solution, but also function for other compatible outcomes. These include:

- Maintaining water quality and soil integrity which limits the release of carbon stored in the soils
- Retaining many of the healthy, large diameter, large-crowned trees (especially oaks and hemlocks) during management activities. This retains the carbon currently stored in those trees and provides aesthetic and wildlife habitat benefits.
- Producing wood products that will be used locally (firewood), regionally, and on the global wood market. The use of wood (a renewable resource) replaces more carbon intensive products such as steel and plastics, though more local uses would have a greater carbon benefit.
- Keeping the property undeveloped which allows forest processes (including carbon sequestration and storage in trees and soils) to continue
- Reducing invasive plant species which can help maintain or enhance biodiversity, and can help ensure the ecosystem continues to function well
- Enhancing growth rates of residual trees following the removal of competing trees. This can increase the amount of sequestration that occurs and can increase the amount of stored carbon in the residual trees. If durable and/or local wood products are created from the trees that are felled to release the residual trees, there are additional carbon and economic benefits.

For more information regarding climate change predictions and its effects on forest ecology in the New England region, refer to "New England and northern New York forest ecosystem vulnerability assessment

[44] An excellent resource that describes the relationship between trees, forests, storage, sequestration, and release of carbon can be found here: https://masswoods.org/sites/masswoods.org/files/Forest-Carbon-web_1.pdf.

and synthesis: a report from the New England Climate Change Response Framework project"[45], a US Forest Service publication by Maria K. Janowiak et al. in 2018. In addition, the Yankee Division of the New England Society of American Foresters recently developed a position statement which outlines the complex history we have with our forests as well as the benefits of well-managed forests as it relates to climate change, carbon, and the other societal needs we have. It can be found here: https://nesaf.org/wp-content/uploads/2020/09/2020_Yankee_SAF_Position_Mgt_and_Climate_Change.pdf.

For more information on predicted changes in the ranges of birds due to climate change see the Birds and Climate Visualizer at https://www.audubon.org/climate/survivalbydegrees, or download the full report at: https://www.audubon.org/sites/default/files/climatereport-2019-english-lowres.pdf.

5.7 Appendix C: Forest History and Management in Southern New England

5.7.1 Pre-Settlement

Southern New England's pre-European forests consisted of a shifting mosaic of forest stands and habitats that were generally even-aged and comprised of multiple species. [46] Hardwood trees such as chestnut, oak, hickory, maple, and birch largely dominated these forests. During this time, most of the region's forests were primarily shaped by periodic severe hurricanes that tended to topple large swaths of mature forests, leaving seedlings and saplings to regrow. Since 1600, southern and central New England have been subjected to three such destructive hurricanes, the most recent in 1938.

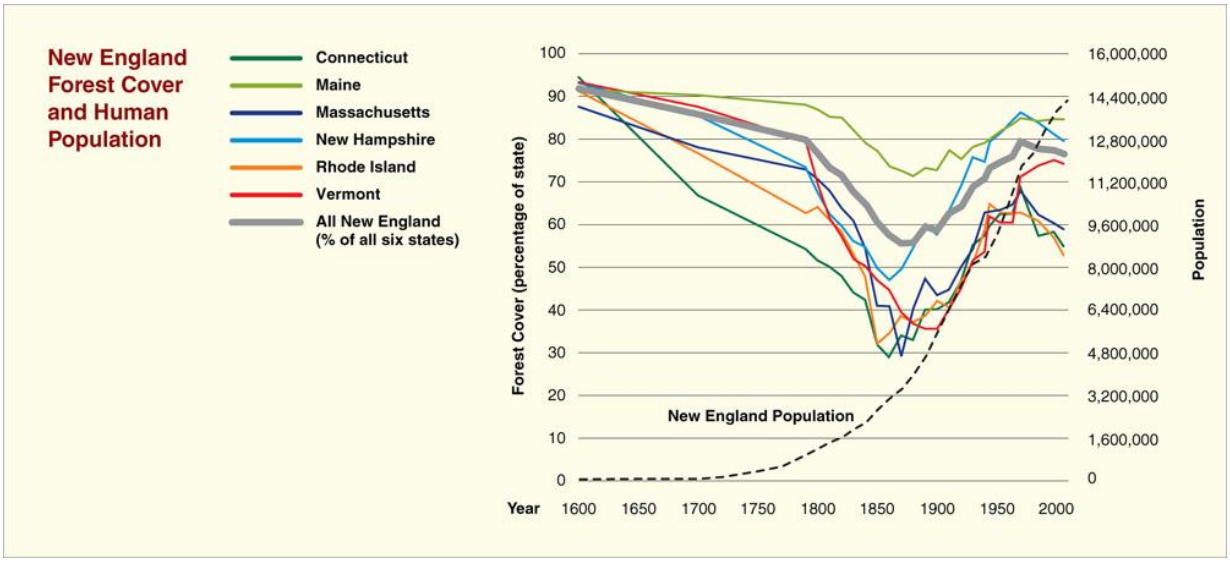
Along with hurricanes and periodic fires, the pre-settlement forest was also shaped by a complex pattern of geology, landforms, and soils. The resulting forest, when viewed at the landscape scale, likely consisted of a shifting mosaic of forest stands and habitats. Portions of the landscape protected from fires and windstorms, such as deep ravines, developed multiple-age stands of shade-tolerant beech, sugar maple, and hemlock. Fire-dependent pitch pine/oak barrens communities developed where soils were dry and sandy. Beaver meadows added small openings. Some areas also likely had some level of openness due to Native American activities such as agricultural clearings, fuel wood gathering, and periodic fires next to small settlements.

Primeval Forest of Central New England-1700[47]

[45] Janowiak, Maria K., et al. 2018. New England and northern New York forest ecosystem vulnerability assessment and synthesis: a report from the New England Climate Change Response Framework project. Gen. Tech. Rep. NRS-173. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 234 p. https://doi.org/10.2737/NRS-GTR-173.

[46] DeGraff, R. M., Yamasaki, M., New England Wildlife Habitat, Natural History and Distribution, University Press of New England, Hanover, NH, 2001, 482 pp.

[47] Harvard Forest Dioramas, http://harvardforest.fas.harvard.edu/dioramas, accessed on December 31, 2012.



Dark green line indicates historical forest cover in Connecticut. Dotted line shows New England population.[48]

Native Americans used the forest for hunting and gathering, and as a source of fuel and building materials (for wigwams or stick-built structures). Early European colonists had similar uses but were far more interested in converting the forests for tillage or forage lands.

The effect of fires set by Native Americans on forest structure and composition is subject to some debate. At one extreme is the contention that the pre-settlement forests throughout the state were in a savannah or semi-savannah condition. At the other extreme is the contention that fires set by Native Americans had no effect on upland forests.

5.7.2 Post-Columbian

Since European settlement, the New England landscape has undergone dramatic changes. Land was cleared for agriculture and pastureland, slowly until the 1750s and then at an increased pace. Between 1800 and 1860, more than 75 percent of the arable land in southern and central New England was in pasture and farm crops, with an estimated peak of 81% in 1860. One hundred years later, New England was again mostly forested as the result of a long period of farm abandonment that began soon after the opening of rich farmlands in Ohio and the Midwest.[49]

Over time, the post-Columbian forests (those present post-European colonization) were reduced to areas unsuitable for tillable agriculture or animal grazing, and to small areas used to supply fuel wood. Most forested areas were often repeatedly harvested for fuel wood and charcoal production. Starting in the late 1800's much of the region's marginal farmland was abandoned, with additional abandonment during the industrial development of the area and with the advent of World War I.

[48] Foster, D.R. et al., *Wildlands and Woodlands: A Vision for the New England Landscape*, 5.

[49] Harvard Forest Dioramas, http://harvardforest.fas.harvard.edu/dioramas.

Above: *Height of Forest Clearing and Agriculture*, a representative New England landscape at the height of agricultural clearing.[50] At the height of clearing, about 60% of Connecticut was open.

Around 1910 the cutting of the trees that had seeded into the abandoned agricultural and pasture land constituted the last major land clearing in the region. Once cut, these sites tended to regenerate to hardwoods. Today about 65 percent of southern New England remains forested.[51]

More recently, many of southern New England's forests have been high-graded (repeated diameter-limit cutting of most valuable species). High-grading results in forests with low stocking, less desirable species composition, trees of lower vigor and economic value, and a higher percentage of damaged or poor quality trees. This contrasts dramatically to the forest management approach recommended for the property discussed in this Management Plan.

The process of agricultural decline and subsequent forest regrowth has essentially eliminated or significantly limited many species of wildlife, especially grassland birds and other grassland/meadow and shrub oriented species, from most areas of the New England landscape. This successional trend underscores both the dynamic nature of the landscape and the long-term effects of past and present human activities.

[50] Harvard Forest Dioramas, http://harvardforest.fas.harvard.edu/dioramas.

[51] Harvard Forest Dioramas, http://harvardforest.fas.harvard.edu/dioramas.

5.7.3 Current Conditions & Management

Currently, most of the region's forests are even-aged due to past land use history. However, forest management operations designed to mimic natural disturbance patterns can help diversify stand structure, age classes and plant communities. Such activities, often create openings in the canopy that enhance vigor of residual trees, encourage regeneration, create down woody material useful for many ecological processes, and depending on opening sizes created, may provide early successional habitat. Moving forward, the combination of the managed forested portions of the property, the maintenance program of the open fields, the largely unmanaged wetlands and other parts of the property that will purposefully remain natural with minimal human management can provide a variety of quality habitat and vegetative diversity on this property.

Forest management, as recommended within this Plan, involves encouraging the development of diverse, multiple aged forests with a variety of tree sizes, ages, and species. Active forest management has perhaps the best potential for maintaining a mosaic of healthy forested stands and diverse habitats in a forested landscape that is continuing to increase in age, and in many places is becoming more homogeneous in structure.

5.7.4 Forests & Water Quality

Forest ecosystems are extremely effective at absorbing, retaining, and utilizing nutrients. They have complex and effective systems for reorganizing and reestablishing themselves following disturbance. Such disturbances include fires, wind and ice/snowstorms, insect or disease outbreaks, floods, or even man made disturbances such as forest management. Younger forests are very effective in this regard, while mature forests can reach more of a steady-state and lose the ability to retain excess nutrients.

Having a large amount of forest cover in older stands dominated by trees at risk of massive, simultaneous loss (such as frequently occurs in this area during major hurricanes or ice storms) risks the overall health of the forest. Where it makes sense to do so, working toward developing and maintaining forests with multiple age-classes of trees, can help prevent nutrients from reaching rivers, ponds, reservoirs and other important water bodies following major storms. Therefore, the forest ecosystem can also serve as both a short and long-term nutrient filter and sink if "above ground vegetative biomass is periodically harvested to ensure a net uptake of nutrients".[52]

However, forest management can also harm water quality if not done properly[53]. The greatest risk is through erosion and sedimentation during road construction and use. Permanent roads contribute the most sediment, while temporary forest roads which are properly designed, constructed, utilized, and stabilized following use, have little impact. The use of best management practices (BMPs) during forest management activities has been shown to be highly effective in minimizing potential negative impacts of forestry[54].

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[52] Vellidis, Lowrance, and Hubbard. "Processing of Pesticide and Nutrient Inputs by a Restored Riparian Forest. In Versatility of Wetlands in the Agricultural Landscape". Kenneth L. Campbell, Ed. American Society of Agricultural Engineers, 1995.

[53] Chapter 5, Effects of Forest and Grassland Management on Drinking Water Quality for Public Water Supplies: A Review and Synthesis of the Scientific Literature, George E. Dissmeyer, 2000.

[54] Water, Woods and People: A Primer. Some effects of human actions on water resources of the eastern forest. 1995. James H. Patric. Artistic Printers, Greeneville, TN. 80 pages.

Forest management is not the only potential reason for a reduction in water quality. Forest roads and trails used for other purposes, including recreation, can lead to erosion and potential sedimentation of nearby overland accessible waters.

Long-term experience and results of many experiments have shown "overwhelming evidence that neither the productivity of forest soil nor the quality of forest water are substantially lessened during or after responsibly managed harvesting of wood products".[55] The positive effects of a managed forest – including when managing for diverse wildlife habitat – far outweigh the potential negative effects. For this reason, the vast majority of public drinking water watersheds in Connecticut have active forest management programs, including some nearly 100 years old. The same qualities sought for these public water supplies are also beneficial to smaller watercourses.

5.7.5 Coarse Woody Material

As a forest develops and trees become stressed by competition, drought, disease, insects, or severe weather, some trees begin to die. As this happens, columns of rot can develop in these trees. Following the development of rot, insects often find their way into the tree, which in turn attracts predators including woodpeckers. The woodpeckers create larger openings in the trees, which can lead to the development of cavities. Cavities are useful as shelter and feeding habitat for many small mammals and birds.

As trees die, some remain standing and continue to rot, becoming what are known as standing dead snags or cavity trees. Standing dead trees provide habitat and a source of insects that birds and other small mammals will eat.

As these trees, or pieces of them fall, down woody material is created. Larger pieces (greater than 4" inches in diameter) are considered to be coarse woody material or CWM. Smaller pieces of down woody material are referred to as fine woody material. Coarse and fine woody material are both important as habitat features and for the purposes of nutrient cycling on the site.

CWM often contains enough woody material for colonization by insects, which in turn become food for other species. Additionally, CWM can provide habitat for salamanders and other wildlife that use it for cover. Also, as CWM decomposes, it holds significant amounts of water and can act as a good germination site for seedlings. Fine woody material when aggregated (i.e. slash piles) can act as nesting and foraging areas as well as cover for many species.

Wildlife biologists, ecologists, mycologists, foresters, and fuels specialists are some of the people interested in CWM because it helps describe the quality and status of wildlife habitats, structural diversity within a forest, fuel loading and fire behavior, carbon sequestration, and the storage and cycling of nutrients and water.[56]

As a forest matures, large trees die and fall to the ground increasing CWM. While forest management generally results in a net increase in CWM, the increase is generally in fine woody material that has less value than large diameter material, and is much more ephemeral as it decomposes relatively rapidly. Wherever safety is not an issue, leaving large snags and cavity trees during management activities helps to ensure a supply of coarse and fine woody material over a longer time frame than a typical logging

[55] Patric, J.H., Harvesting effects on soil and water in the eastern hardwood forest. Southern Journal of Applied Forestry.

[56] Mount, J. R. "Water, Wildlife, Recreation, Timber…Coarse Woody Debris", USDA Forest Service GTR, PSW-GTR 181, 2002.

operation does. In addition, the purposeful retention of some large CWM can help recruit additional features which will be more long-lasting and have greater ecological impact.

General management guidelines for coarse woody material (CWM)[1]

1. A volume of at least 200 cubic feet CWM per acre is recommended.
2. Larger pieces of CWM are more valuable than smaller pieces.
3. CWM scattered across a site is more valuable than if it is concentrated (with some piles).
4. It is important to maintain a full range of CWM decay classes (from hard to crumbling).
5. Coniferous CWM is generally more long lasting than wood from deciduous trees.
6. For long-term management, consider the distribution and quantity of future CWM sources, including retention of snags and cavity trees where safety is not an immediate concern.

5.7.6 Invasive Species

Non-native invasive species are those that have evolved elsewhere and were either purposefully or accidentally relocated from their native range. Many invasives are now well established on the landscape of Connecticut and have significant ecological and economic impacts. Invasive plants are very aggressive and can (and on some portions of the property within this Plan have) easily out-competed native vegetation changing the appearance, species composition, utility, and in some cases the chemical composition[57] of the forest.

Human activities, such as intentional planting, land disturbances, and overuse of land for agricultural, commercial, and recreational purposes, have and continue to improve the odds for the invasion and establishment of these species. Complete removal of an invasive species may be possible if a population is isolated or small. However, once most species become established, measures to control their spread are often costly and labor intensive. Because these species do not recognize property boundaries, cooperation among landowners may be important to control spread.

Disturbed areas, field edges, riparian areas, and some of the more recently abandoned agricultural land (especially in the northwestern part of the property) are frequently areas where invasive species have been able to gain a foothold, and should therefore be monitored regularly for these species. In particular, riparian area and areas near old homesteads on this property seem to contain the highest concentrations of invasive plants, especially barberry.

5.7.7 Forest Management

At its best, forestry attempts to mimic and manipulate natural forest development to produce a healthier and more valuable[58] forest. This manipulation can improve wildlife habitat, create or enhance recreational opportunities, and help develop a certain aesthetic for a forest. Area and date-specific details of recommended management activities are provided in Section 4 of this Plan.

Important considerations when engaged in a long-term forestland management program include:

1. Sustaining site quality by preventing erosion to keep the soil and its nutrients in the forest and out of wetlands and bodies of water.

2. Obtaining desirable regeneration through various silvicultural methods to encourage new trees to germinate and develop to take the place of the older forest as it ages and proceeds toward maturity.

3. Retaining high quality trees by focusing growth on the healthiest, most vigorous trees with the greatest potential to respond positively to an increase in growing space (i.e. additional sunlight).

4. Increasing structural complexity by creating canopy openings for regeneration and residual trees to fill.

[57] Garlic mustard is known to be allelopathic which means that it emits chemicals that interrupt the growth of other vegetation. In addition, it may also create changes to the chemical functionality of the soils in which it grows.

[58] In this case, value has nothing to do with economics, but instead focuses on the value of the property for housing as many individuals of as many species as feasible while maintaining or – ideally – enhancing important ecological services the property provides.

5.8 Appendix D: New England Forest Disturbance, Development & Management

The major natural disturbance regimes in Connecticut consist of hurricanes, wind, ice, insects and diseases, and, to a much lesser degree, fire. Mild events can create small gaps in the canopy, while more serious events can destroy whole stands. Although mild events are much more typical, infestations of native and nonnative insects, such as the gypsy moth and hemlock woolly adelgid, have had dramatic effects on the forests of southern New England.

5.8.1 Major Disturbances

Pre-European settlement, most of the region's forests were primarily shaped by periodic severe hurricanes that tended to topple large swaths of mature forests, leaving seedlings and saplings to regrow. (Since 1600, southern and central New England have been subjected to three destructive hurricanes, the most recent in 1938.) This "top-down" stand disturbance pattern led to the establishment of forests with trees capable of surviving in partial shade when young and then "responding" when released, either by quickly growing in height and crown width, or by sprouting new stems when damaged as older, larger trees were toppled by storms.

While hurricanes were likely the dominant natural disturbance factor in this area, fire has also played a role. Neither of these stand initiation events commonly killed or removed all of the older trees from extensive areas. Fires and all but the strongest hurricanes leave "skips" where small clusters, groves, or even small stands of older trees survived. It is likely that a two-aged stand condition was somewhat common. Some less severe storms, as well as localized wind-bursts (micro-bursts), damage from ice storms, occasional insect or disease outbreaks, or even occasional twisters helped create some forests where groups of older and younger trees were intermixed.

The effect of fires set by Native Americans on forest structure and composition is subject to some debate. At one extreme is the contention that the pre-settlement forests throughout the state were in a savannah or semi-savannah condition. At the other extreme is the contention that fires set by Native Americans had no effect on upland forests.

The pre-settlement forest was also shaped by a complex pattern of geology, landforms, and soils. The resulting forest, when viewed at the landscape scale, likely consisted of a shifting mosaic of forest stands and habitats. Portions of the landscape protected from fires and windstorms, such as deep ravines, developed multiple-age stands of shade-tolerant beech, sugar maple, and hemlock. Fire-dependent pitch pine/oak barrens communities developed where soils were dry and sandy. Beaver meadows added small openings. Some areas also likely had some level of openness due to Native American activities such as agricultural clearings, fuel wood gathering, and periodic fires next to small settlements.

5.8.2 Minor Disturbance

In general, mild events that create small-to-moderate openings in the canopy allow the release of advanced regeneration, and, if the openings are large enough, the establishment of less shade tolerant species. Larger scale disturbances, such as the death of large areas or whole stands of hemlock trees, often lead to a dramatic change in the composition of the forest (i.e. conversion from conifer dominated stands to hardwood dominated stands).

Mild events tend to have very little impact on plant animal communities as they are adapted to and often times are dependent on small disturbances to meet their needs. Larger scale disturbances can be much more troublesome. Often times they can lead to extreme changes in the plant and animal communities

(i.e. birch often colonizes sites where hemlock has died, resulting in loss of habitat for species requiring mature conifer forests). However, not all changes are negative. For example, major events that lead to stand replacement can be very beneficial to many species of wildlife that require early successional habitat.

It is most probable that the combined effects of natural and human-caused fires in the pre- settlement forests were modest and varied. Even an occasional (once every 20 or more years) fire in mixed-species upland forests will reduce the amount of thin-barked maple and birch, and favor the development of thicker-barked oak trees. Further, Connecticut's forests contain many species of shrubs with thin bark or aromatic, easily burned twigs that are killed to the ground or completely with a light ground fire. The resultant reduction in low shade favors oak and hickory, which can survive in the understory far better when there is a relatively open shrub layer.

Contemporary forest composition, in an era of nearly complete fire exclusion, is having a drastic decrease in oak and increase in birch and maple. While this trend is partially caused by harvests that until recently generally removed more oak than maple, the trend has been evident for decades in smaller, younger trees and in the understory of stands with little or no cutting. Fires set by Native Americans must occasionally have encountered large concentrations of wind-thrown trees that were dead sufficiently long to burn vigorously. Thus it is safe to assume that the upland forests of Connecticut were impacted occasionally by fires of sufficient duration and intensity to maintain oak trees in parts of the landscape that might favor maple, beech, and birch as well.

5.8.3 Forest Development

Nearly all of the forests within this region developed from abandoned agricultural fields or pastures. Soon after fields were abandoned, trees began to reclaim these areas (the "stand initiation" stage of forest development). This stage takes hold immediately after agricultural lands are allowed to go fallow, and can continue as long as the canopy remains open enough for seedlings to become established.

Some forests in the region started following timber harvests that removed most or all of the previous forest. Even-aged forests that arose after clearcutting for charcoal dominate northwestern Connecticut, and some forests in southwestern Connecticut have the same origin. Others may have been cleared, regrown as described above, and then been subject to harvests of varying intensity and now resemble sprout-origin post charcoal stands. Trees with multiple stems growing from the same root system characterize these sprout origin stands.

Regardless of the method of stand initiation, a canopy will close as some trees begin to die and others begin to express dominance and expand their crowns. This stage of forest development is known as "stem exclusion", which can take several decades. After 100 years, approximately 97% of the original seedlings have typically died, and 3% have grown into the trees of a mature forest.

The exact numbers vary from forest to forest, but the process of forest maturation is the same. Each time a tree dies surrounding tree crowns expand to fill in the canopy opening. When the opening is large, understory trees will fill the gap. This stage of development is known as "understory reinitiation". Eventually, all the trees we see in the forest today will die and be replaced by their progeny in the understory. This overall process of forest development has occurred on this property over the past 80 to 100 years.

5.8.4 Forest Management

In general, recommended forest management involves encouraging the development of diverse, multiple aged forests with a variety of tree sizes, ages, and species over relatively small areas. This can be accomplished by using uneven-aged regeneration techniques (which most closely mimic mild disturbance events), even-aged regeneration techniques (which most closely mimic major disturbance events), and by using shelterwood methods (which mimic "top-down" stand replacement events). These methods can be applied in mixture in various spatial patterns, which are more natural than large, uniform treatments in appearance and in resulting stand structure.

The forests derived from such treatments should contain a variety of species and age classes, which are generally less susceptible to insect infestation or disease epidemics, and which may be more capable of recovering (closed forest canopies) following major wind events. Active management can thus minimize the risk and impact of inevitable forest disturbances by developing spatially, structurally and temporally diverse forests.