Management Plan

Alice Newton Street Memorial Park and the Fitzgerald Tract Woodbridge, CT

Yale School of Forestry and Environmental Studies

2009

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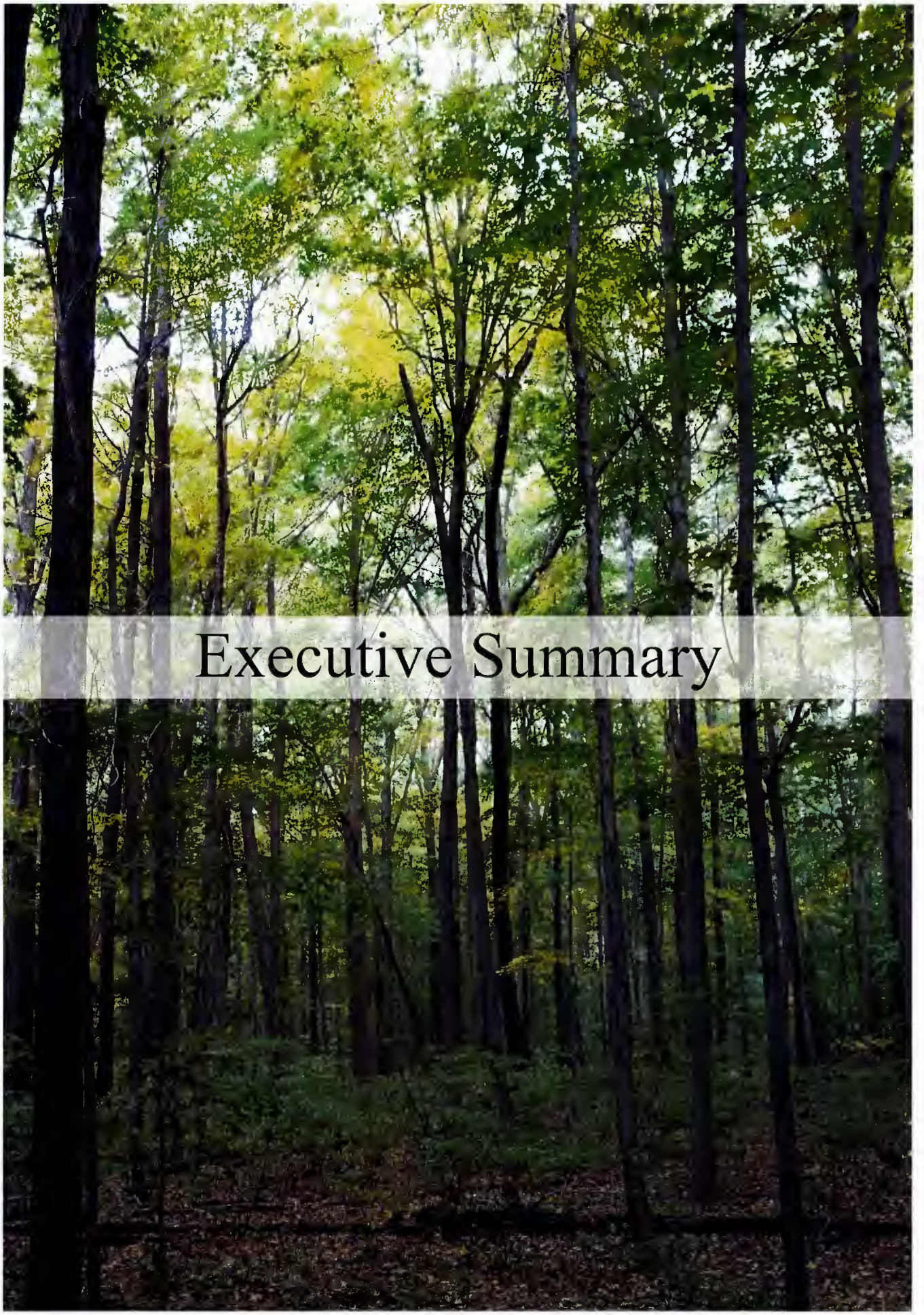


Executive Summary

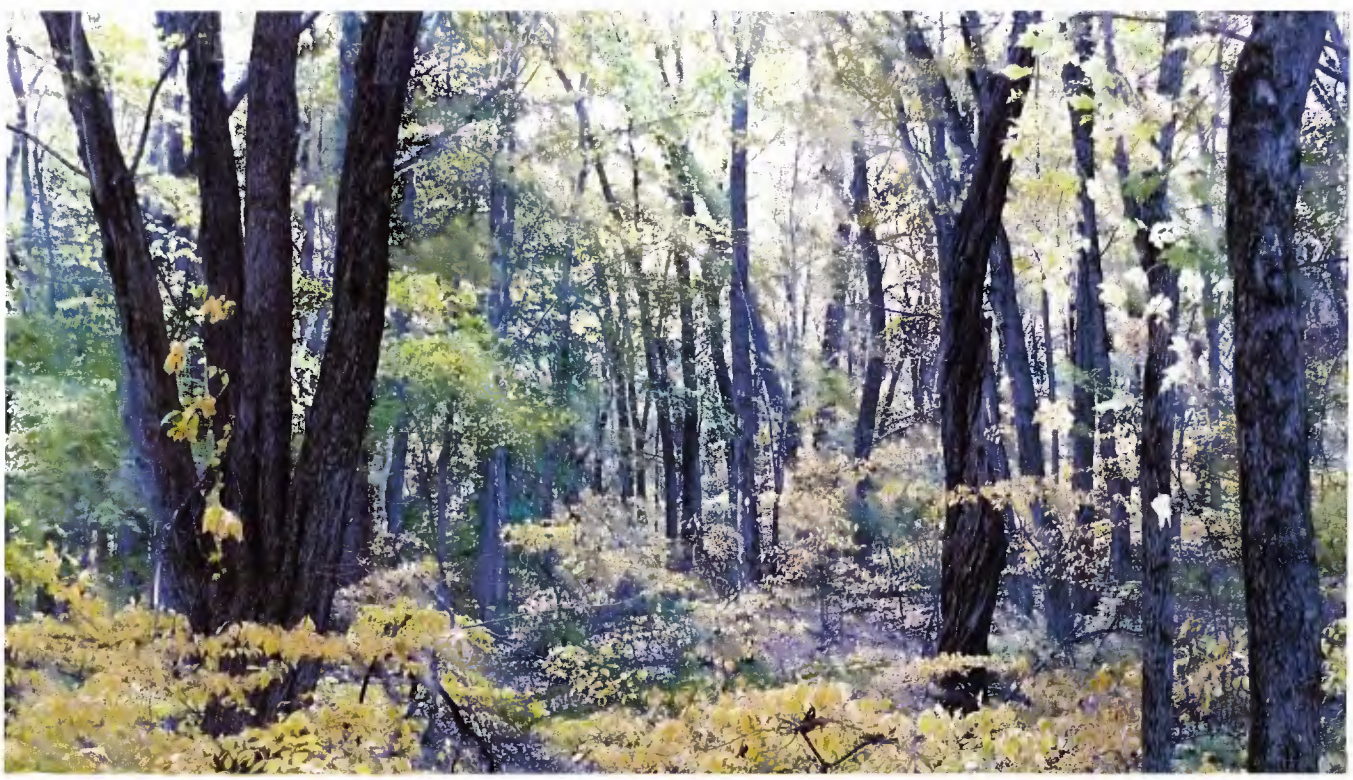
1. Executive Summary

Alice Newton Street Memorial Park (ANSMP) and the Fitzgerald tract are beautifully preserved open spaces located in the heart of Woodbridge, Connecticut. Alice Newton Street Memorial Park was deeded to the town of Woodbridge in 1928 with the directive that "land shall be used for park, forest and kindred purposes only" or to "establish a preserve therein for the protection of fish, game and wildlife." Today, this land is used extensively by the citizens of Woodbridge as a place for hiking and enjoying nature. It is truly a refuge for both the citizens and wildlife of Woodbridge. In contrast, the Fitzgerald tract was given to the town without restriction. The land is open for the development of public works, such as the firehouse, and has more varied uses than ANSMP. Community gardens and the fit trail for health-conscious users provide for different community needs. Together, ANSMP and the Fitzgerald tract service the recreational needs of the citizens and provide a diversity of ecologically intact habitat for wildlife.

To best preserve the properties for the future, the Woodbridge Conservation Commission contracted our team of students through the Yale School of Forestry and Environmental Studies to create a long-term management plan. We began by researching the historical context of the properties and characterizing landform on the basis of aerial photos and maps of the soils, bedrock, and hydrology. We then completed an in-depth biophysical analysis of the properties, paying special attention to forest inventory and dynamics, distribution of invasive species, and potential for wildlife habitat. We classified thirteen stands, the basic unit for management, on the basis of our remotely sensed and ground-truthed data. The properties are a mosaic of wetland, forested woodland, and meadow, which provide a diversity of habitat for wildlife. Next, we conducted a stakeholder analysis to understand the social context and usage of the properties. Our management recommendations reflect the values and concerns of our client and other stakeholders.

Recommendations are divided between ecological and user group prescriptions in order to address the dual purposes of the properties. In addition, they are prioritized by importance to the properties, the relative ease of completion, the ratio of cost and effort expended to results yielded, and the projected timeline. The recommendations are briefly outlined on the following page.

The final part of the management plan places the properties in the context of the open space network of Woodbridge. Taking a bird's eye-view elucidates the specific niche of these properties and how they play into the greater landscape of protected areas. This plan is a first step in inventorying all of Woodbridge's natural resources and establishes a productive relationship with the Yale School of Forestry and Environmental Studies.



1.1 Ecological Prescriptions

High Priority

- Calculated management of invasive species which targets control efforts to tractable issues and insidious species. Maximizes invasive species potential for wildlife habitat.

- Preservation of the ANSMP shrub meadow by a rotational mowing regime and planting of native, mast-producing shrubs.

Medium Priority

- Execution of a patch selection cut in portions of the Fitzgerald tract to enhance forest structure, diversity, and habitat. Administration of a community fuelwood program and creation of a wildflower meadow as possible byproducts.

- Sale of a conservation easement to the South Central Connecticut Regional Water Authority on a portion of the Fitzgerald tract.

Low Priority

- Continuation of the passive protection of the wetlands and consideration of wetlands with respect to other active management prescriptions.

- Consideration of forest resilience to catastrophe with respect to other active management prescriptions.

1.2 User Group Prescriptions

High Priority

- Maintenance of the forest trails to ensure the safety of park users including removal of hazardous snags and filling in of washed out trails.

- Delineation of the property boundaries by blazing.

- Construction of a dog park and reformulation of the leash laws in order to designate a safe place for dog exercise while protecting park users and wildlife.

Medium Priority

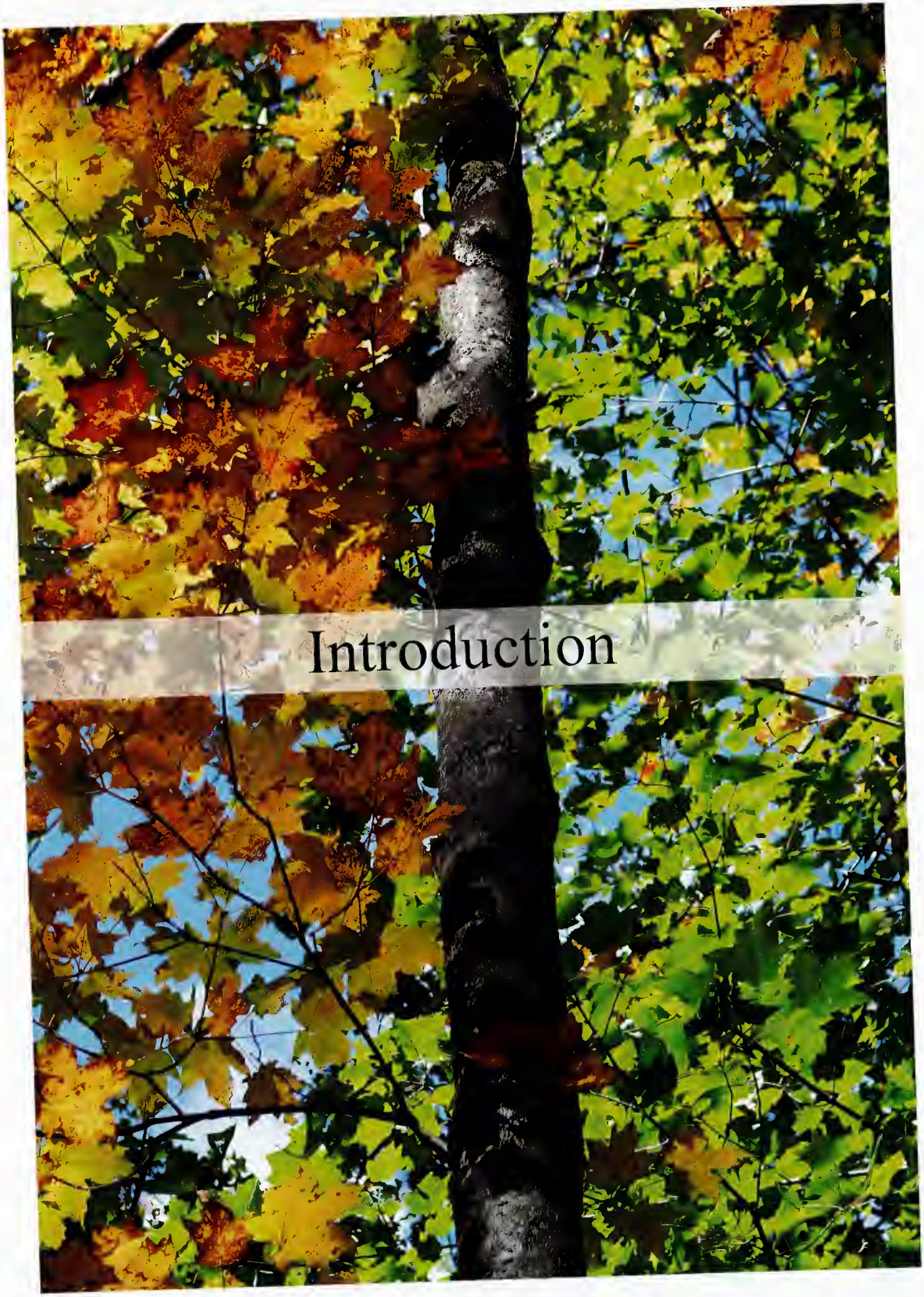
- Construction of infrastructure improvements including fit trail maintenance, new forest trails, and distance markers.

- Placement of educational signage along trails to increase community understanding of such topics as invasive species, succession, and habitat types.

Low Priority

- Removal of the ice hockey rink.

- Planting of a visual landscape barrier in the firehouse buffer area.



Introduction

2.1 Overview

The town of Woodbridge actively conserves a number of properties. Alice Newton Street Memorial Park and the Fitzgerald tract are both centrally-located public open spaces within the town. The Conservation Commission of the town of Woodbridge requested a management plan from the Yale School of Forestry and Environmental Studies to assess the current ecological state of both properties and to inform decisions on how to best use each property.

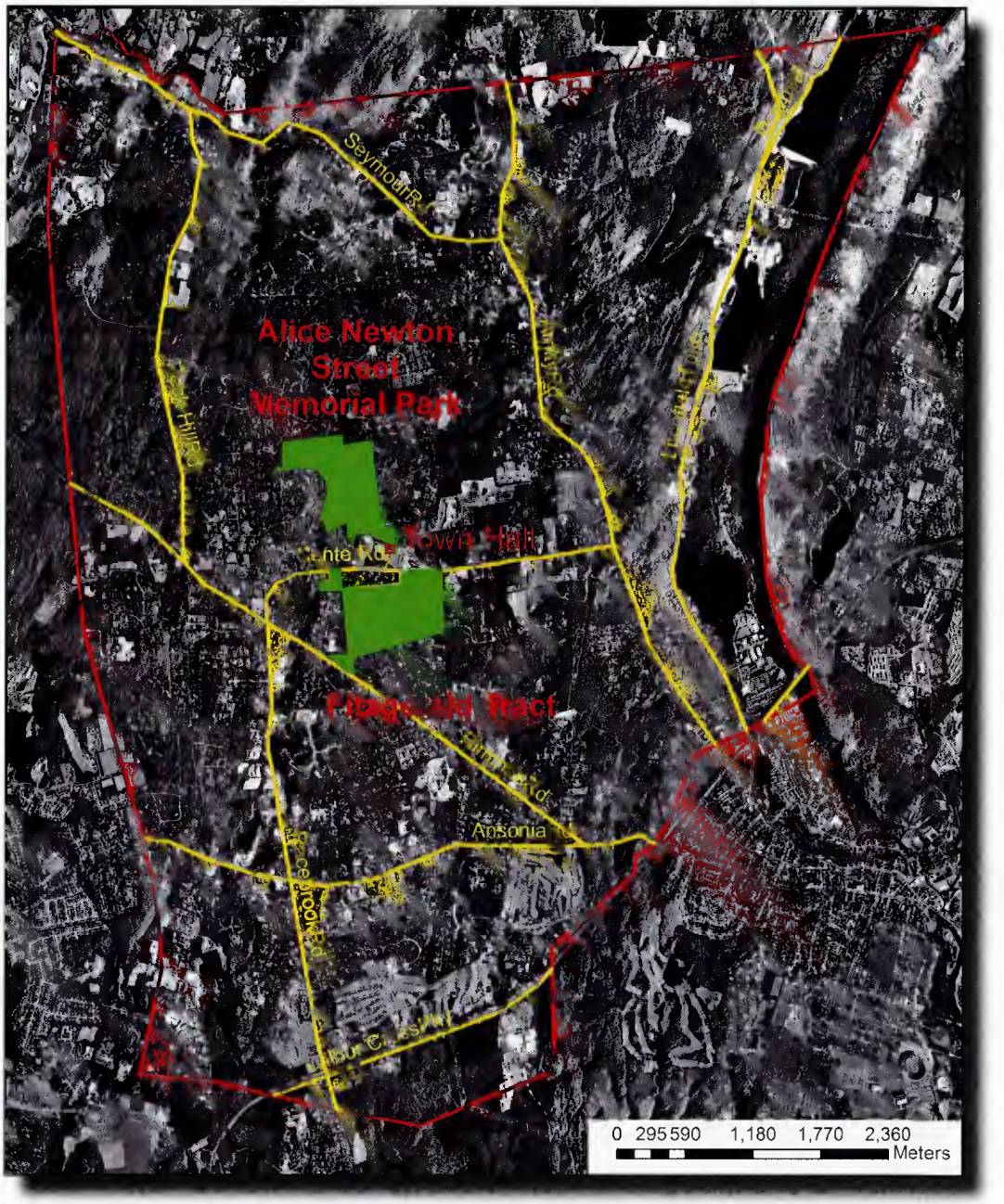
2.1.1 Alice Newton Street Memorial Park

Alice Newton Street Memorial Park is a 94-acre property adjoining the Woodbridge Town Hall. It was handed over by a town clerk, Newton H. Street, to a group of trustees that became the Woodbridge Park Association in order to conserve the area of land for use as a park or forest (see Appendix 1). Development is expressly forbidden on this property. There are various trails running through the forest, marked with signs and blazes on the trees.

Adjacent to the northwest corner of Alice Newton Street Memorial Park, is a 21-acre property owned by the Woodbridge Land Trust. For the purposes of this study, *Alice Newton Street Memorial Park* refers to both the official park lands as well as this adjacent property.

The major ecosystem represented by the Alice Newton Street Memorial Park is forest. There is one major swamp area and many riparian corridors running through the forest, as well as a small shrub meadow planted with red cedars. The soil is characterized by Charlton glacial till, with some Ridgebury, Leicester and Whitman soils along the wetlands and at low elevations. The bedrock consists of Wepawaug Schist.

Alice Newton Street Memorial Park is an invaluable resource for the town of Woodbridge. The community benefits from recreational uses already, but because of its ecological diversity, there are many potential educational opportunities.



Map 2.1 - Geopolitical features of Woodbridge, including the open spaces of Alice Newton Street Memorial Park and the Fitzgerald Tract

2.1.2 Fitzgerald Tract

The Fitzgerald property was sold to the town of Woodbridge following the death of David E. Fitzgerald, Jr. (see Appendix 2). Development is permitted on this 133-acre property under the auspices of the town of Woodbridge, and the land has multiple uses. There is the potential for public works, and three acres of the property were recently used to build a new fire station for the town. The center of the property is used for community gardening and an experimental chestnut orchard, and can be reached by car through the access road off of Beecher Road. A parking lot and a tarmac court that can be frozen over and used for ice-skating in the winter occur off of the access road. There is an area of actively-managed grassland—and sometimes farmland—surrounded by an exercise circuit.

However, most of the land has been preserved as forest. Trails run throughout the forest and are marked with blazes on the trees. Forest soils are characterized by Charlton-Chatfield Complex with Woodbridge Fine Sandy Loam in the lower elevations. The bedrock consists of Wepawaug Schist.

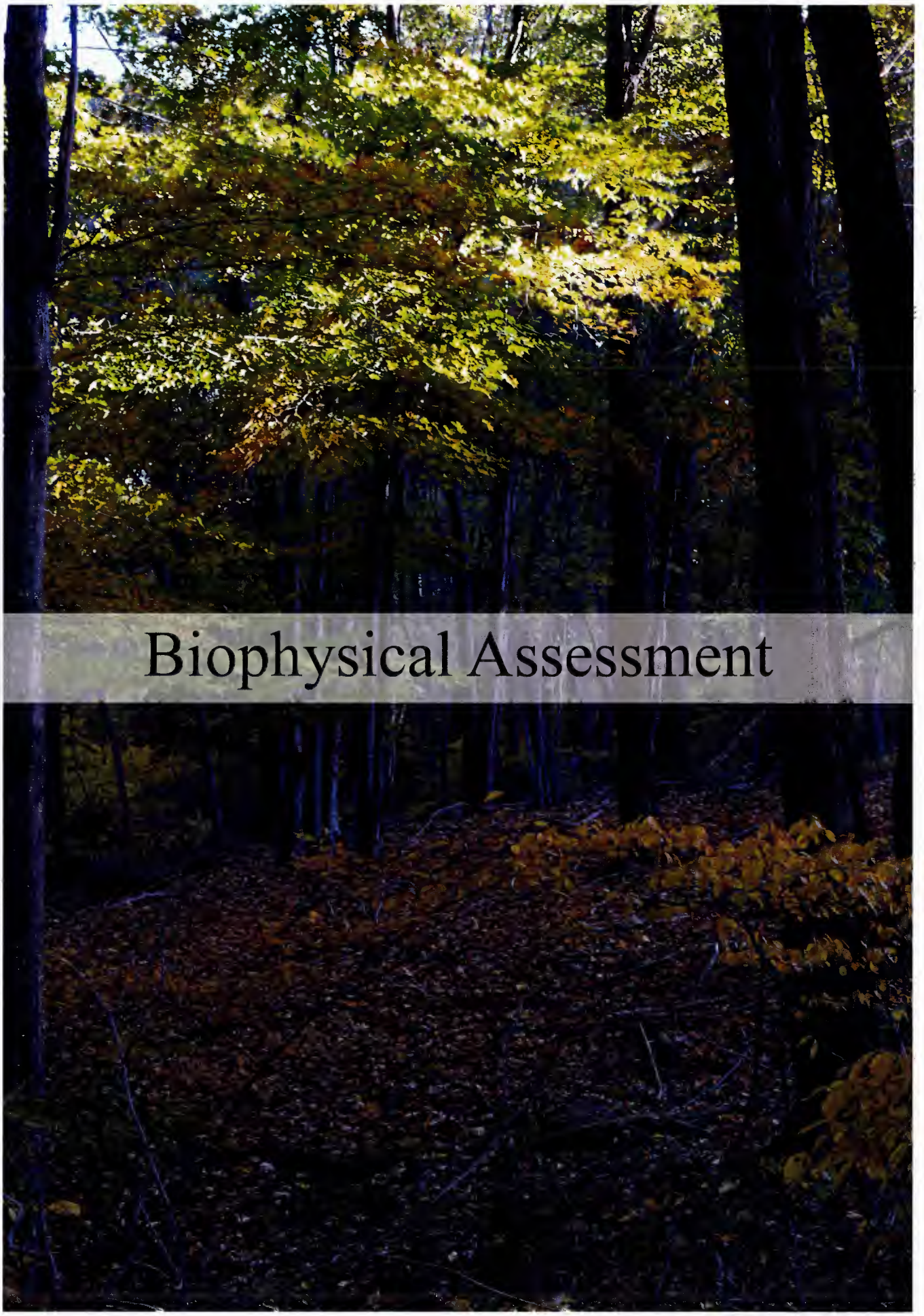
The Fitzgerald property is not only one of the most heavily-used recreational resources in town but also has great ecological value. The South Central Connecticut Regional Water Authority would be open to purchasing a watershed easement if offered by the town of Woodbridge for the protection of the watershed. The area also has the potential for more educational use by nearby schools.

2.2 Land Use History

The landscape of Woodbridge has been evolving since the arrival of English settlers over 300 years ago. Land in the area surrounding present-day Woodbridge was purchased from the Quinnipiac and Paugasset Native Americans in the 1600s. Since then, the land has been altered by people for natural resource extraction, clearing and cultivation, and construction. Originally this included farmsteads, which were later replaced by factories, and more recently, the residences and municipal buildings which define the town.

The area of present-day Woodbridge was not considered ideal farmland due to the rocky glacial till, so settlers did not move into the area as quickly as they did into the nearby Central Lowlands. It was not until the mid-17th century that the first settler – Richard Sperry – moved into the area to manage a parcel of land that eventually became known as Sperry's Farm. By the time Woodbridge became an official town in 1783, around 2,000 residents lived in the area. The number of people that could be sustained by farming or other agrarian activities in Woodbridge was limited, so the population remained constant for many years as younger generations moved away to start their own families elsewhere. In the mid-19th century, a few small factories were built in Woodbridge for products such as candlesticks, nails, and especially matches. As the city of New Haven grew and relied more heavily upon rural satellites for goods and services, Woodbridge prospered. In the early 20th century, Woodbridge maintained some of its agricultural heritage through the dairy industry, but after World War II, Woodbridge was overcome by suburban development and many of the open pastures were abandoned. The forests in Alice Newton Street Memorial Park and the Fitzgerald tract reflect much of Woodbridge's rich history.

Stone walls remain as a relic of previous land use



Biophysical Assessment

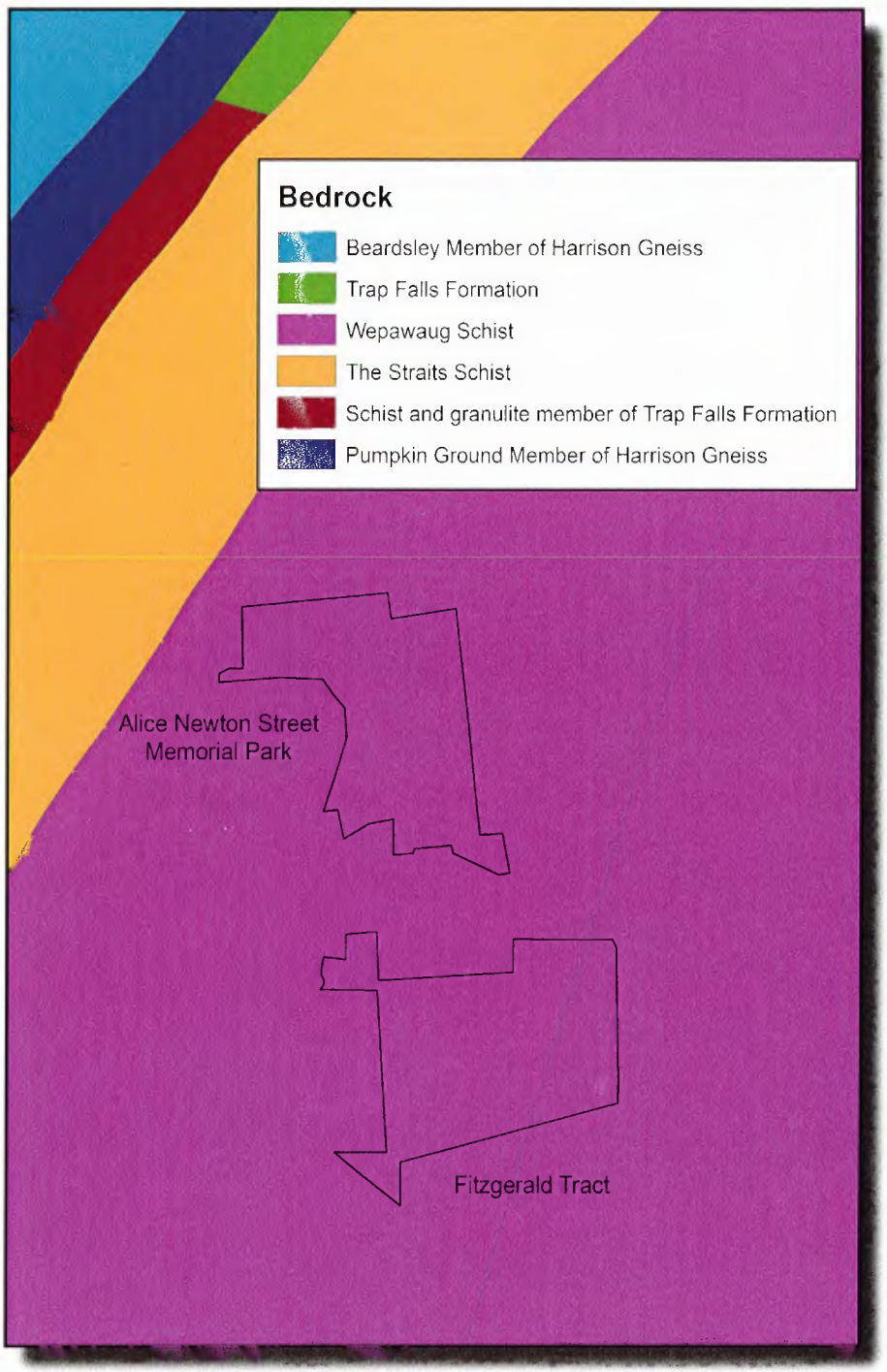
3.1. Geology

There are two components to the geology of the glaciated northeast – the bedrock geology and the surficial geology. Each will be discussed as it pertains to the Alice Newton Street Memorial Park and The Fitzgerald Tract.

3.1.1 Bedrock Geology

There are three major physiographic (geologic) regions in Connecticut: the Western highlands (where the properties are located), the Central lowlands (from New Haven north to Massachusetts), and the Eastern highlands (lying east of New Haven). The Western highlands are composed mostly of ancient Paleozoic metamorphic rocks. This means that they have been altered or metamorphosed since they were originally formed as sedimentary or igneous rocks.

The underlying bedrock controls the shape of the land (elevation, slope, and contours) in Alice Newton Street Memorial Park, and, to a lesser degree, in the Fitzgerald tract. Geologists have mapped a single rock formation underlying the properties (Map 3.1). This major rock type is known as Wepawaug schist: a dark grey, fine-layered rock composed primarily of mica and quartz (Fritts, 1965; Bell, 1985). This rock type has been inferred from general regional mapping, and from observation of rocky outcrops within the bounds of the properties. In Alice Newton Street Memorial Park outcroppings of metamorphic rocks occur at higher elevations in the northwestern corner of the tract. In the Fitzgerald tract outcroppings occur in the southeastern part of the property. Glacial erosion and natural erosion likely help to expose the underlying bedrock at higher elevations.

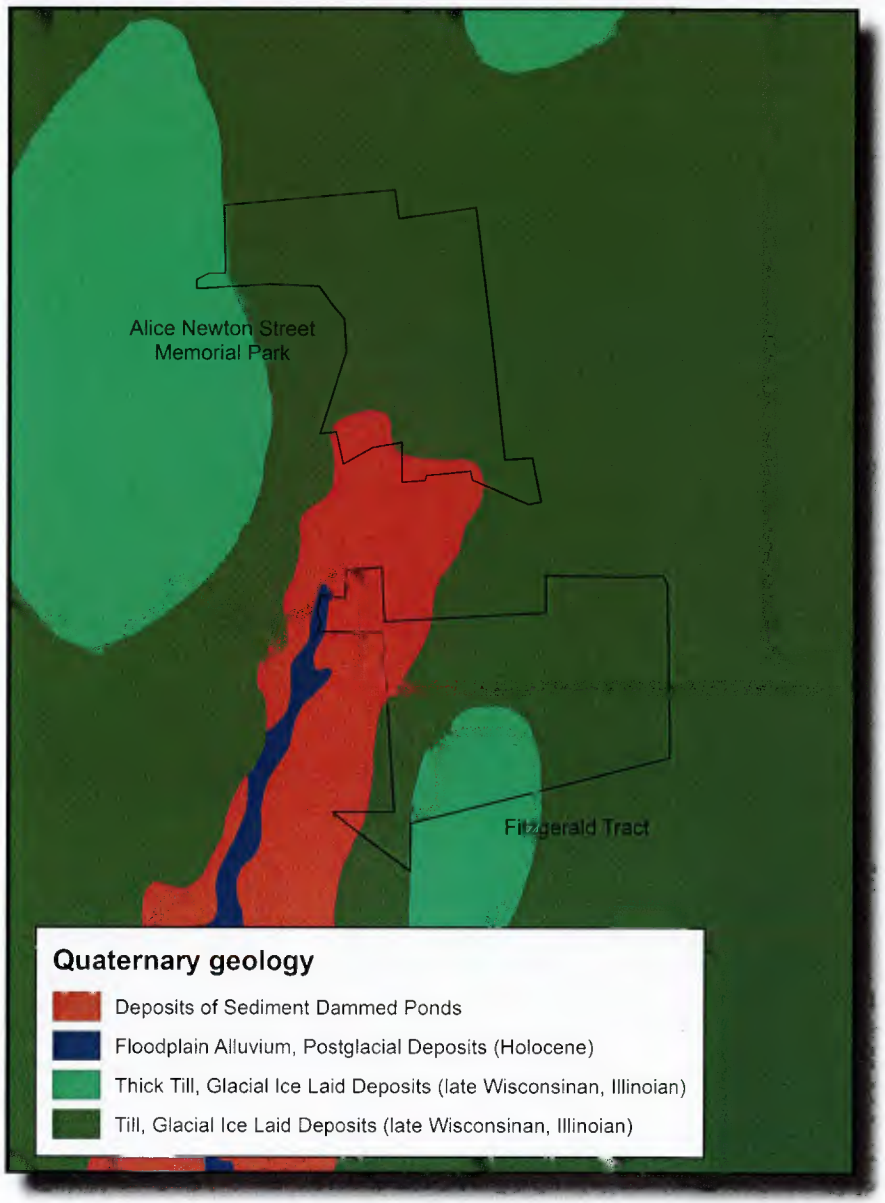


Map 3.1 - Bedrock Geology
Wepawaug schist underlies both properties, controlling the shape of the land

3.1.2 Surficial Geology

All of present-day New England was within the glaciated extent of North America. This means that it was covered with a continental glacier for tens of thousands of years up until about 20,000 years ago when the ice melted off of southern New England. The continental glacier originally moved southward out of Canada. As it scoured the landscape it picked up and carried material with it from north to south. Two types of material were deposited: the material dragged along underneath the ice and the material lifted and incorporated into the moving ice. The material dragged beneath the ice and left behind after the melt is called lodgment till. Lodgment till was "lodged" between the moving ice and the bedrock and thus is very compact. The material found within the ice is called ablation till and was deposited over the landscape as the ice melted (Map 3.2). It is from these two types of material that most of the soils have developed. Since the bedrock north of the properties (continuing well into Vermont) is similar to the type of bedrock beneath the property, the chemical character of the surficial geology is similar to that of the underlying bedrock. The coincidence of chemistry between the soils and bedrock is a result of the glaciation rather than the weathering of the bedrock.

Underlying till types have guided the evolution of soil types since glaciation. Soils on the lodgment till tend to have a hard pan, a compacted layer of till which moderately restricts agriculture, while those on ablation till do not. There is also a limited amount of water-deposited sand and gravel along the valley sides. These were left by meltwater streams that sorted the sediments and deposited them through the valleys as the glacier receded.



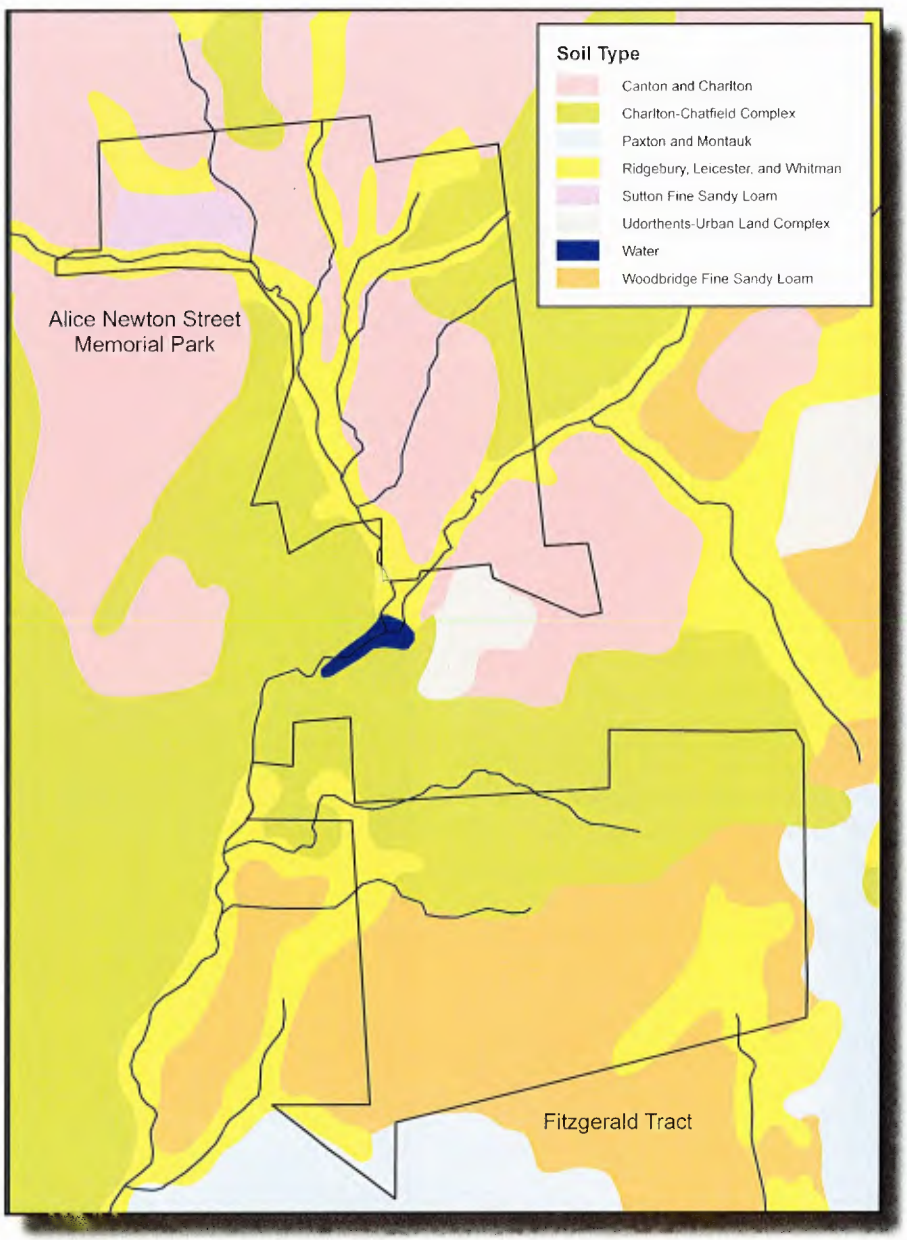
Map 3.2 - Quaternary Geology
Glacial till is the primary substrate of the properties.

3.2. Soils

Soils may best be described by three dimensions: 1) the type of parent (glacial) material that the soil formed in; 2) the drainage class of the soil; and 3) the depth to bedrock. There is only one type of parent material on the properties: the ubiquitous glacial till, manifesting itself in multiple forms. There are four drainage classes present: well drained, moderately well drained, poorly drained, and very poorly drained. As the soils are currently mapped, no series are shallow to bedrock and only one is moderately deep. For the purpose of this classification it is important to note that two or more soil series listed together implies that the particular landscape complex has multiple soils in irregular areas too small to map individually.

The poorly and very poorly drained soils (The Ridgebury, Leicester and Whitman Complex) occur in depressions and drainage ways on uplands and in valleys. They are very stony fine sandy loams and have moderate available water capacity. These soils are classified as wetland soils and are subject to wetland regulations.

The moderately well drained till soils are mapped as the Sutton series and the Woodbridge series (Map 3.3). In this setting, the soil series have a seasonally perched water table. They can also have a hardpan (a layer that restricts vertical drainage), as occurs in the Woodbridge series. Woodbridge soils can be stony and are found at the top or base of drumlins (elongated hills) and ridges with gentle slopes. A drumlin can be seen in the garden and meadow area in the center of the Fitzgerald property. Sutton soils are found on slight depressions and on the sides of hills and ridges. Stones and boulders can sometimes be seen on the surface.



Map 3.3 - Soils

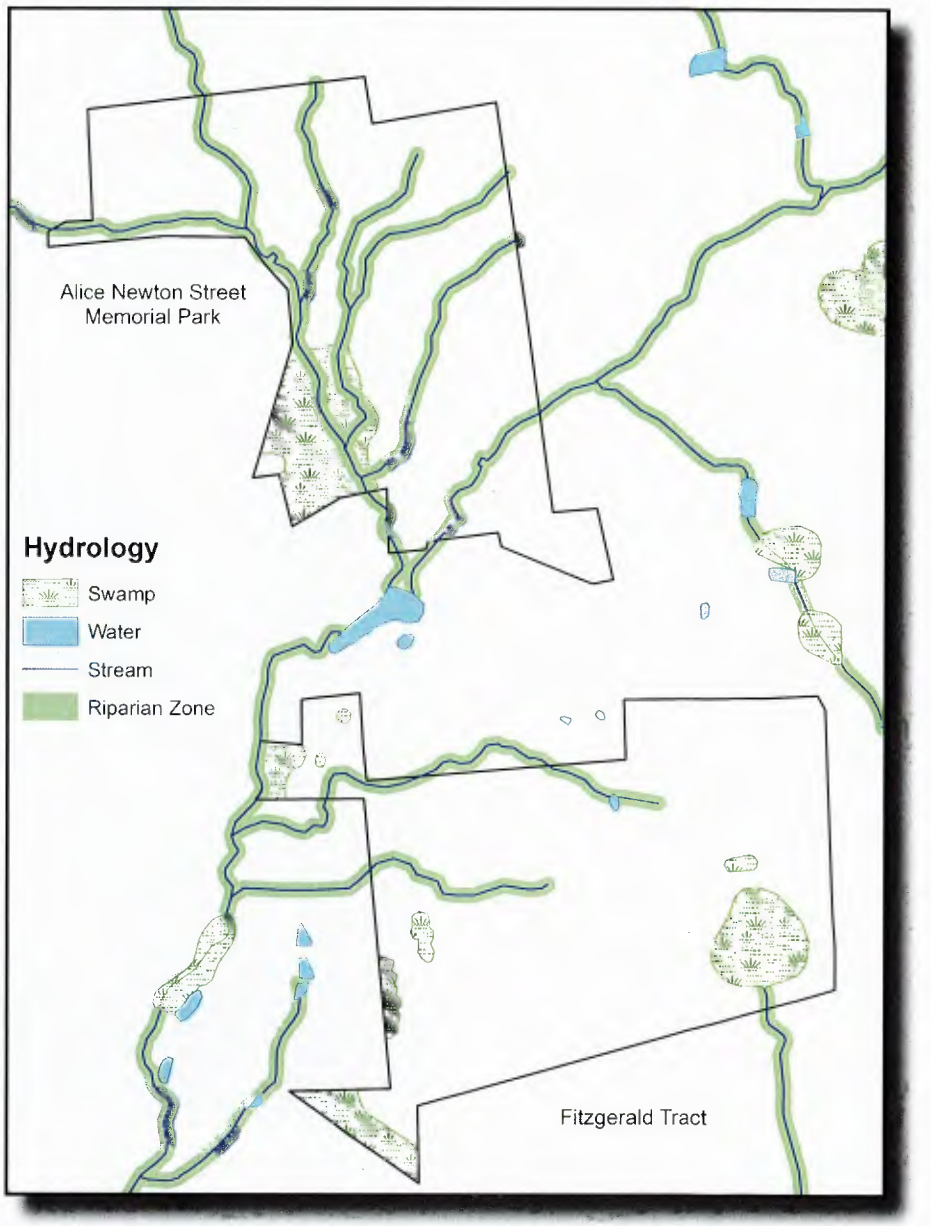
The well drained till soils are mapped as the Canton and Charlton soils, the Charlton-Chatfield complex, and the Paxton and Montauk complex. Well drained implies that there is no seasonally perched water table and that soils freely drain to considerable depth. A restrictive hardpan is absent. Canton and Charlton soils are found on hillsides of varying slopes and stoniness. The Charlton-Chatfield complex has very rocky, moderately deep soils, usually found on hills and ridges. The Paxton and Montauk complex can be found on drumlins, hills and till plains. Compact till underlies these soils creating a moderate to poorly permeable substratum. These characteristics form a landscape with depressions that are sometimes filled with perennial ponds.

3.3 Hydrology

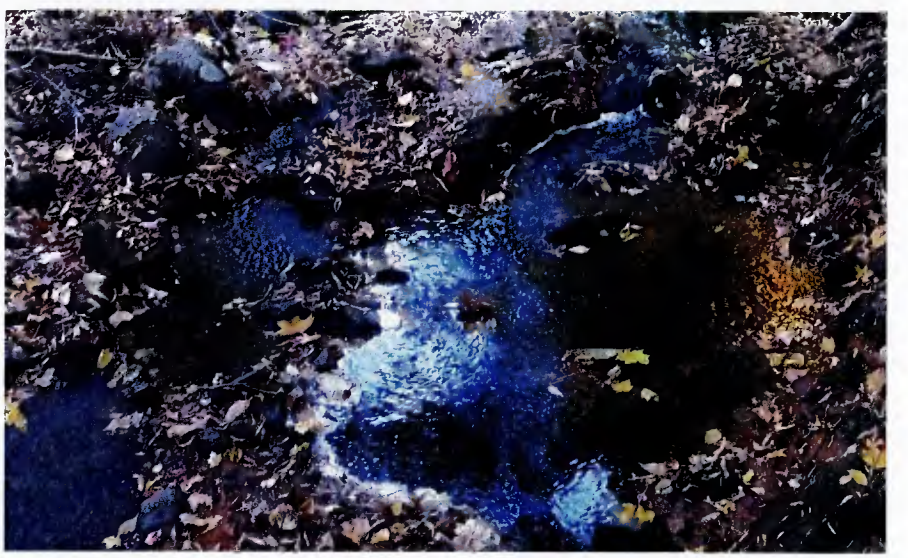
Alice Newton Street Memorial Park and the Fitzgerald tract lie entirely within the watershed of the Wepawaug River. The river flows south through the west side of the Alice Newton Street property and westerly of the Fitzgerald Tract. Smaller streams and tributaries of the river flow through most of Alice Newton Street Memorial Park and through the north and northwest sections of the Fitzgerald Tract (Map 3.4).

The underlying geology and soils of the properties greatly influence the hydrology of the sites. The poorly drained soils of the Ridgebury, Leicester and Whitman complex underlie most of the river channels, riparian zones, and wetlands. These soils and the Paxton and Montauk complex (found in the wetland stand in the Fitzgerald tract) have low water permeability and a layer of compacted till that will not permit infiltration, even when the surface and the subsoil become saturated. Instead, the water will drain along the topographic features and collect in the drainage-ways and natural depressions (Map 3.5).

In the Alice Newton Street Memorial Park water drains from the highest points on the western side into the Wepawaug River. On the eastern side, water will seep and accumulate in the depressions and drainage-ways found at lower elevations along streams and in wetland areas. In the Fitzgerald Tract, water drains into the Wepawaug River from higher elevations in the eastern side. It also accumulates along the river's riparian zone and in the lower elevations and wetlands found in the western side of the property. On the southeastern corner of the tract, water will accumulate and drain into an on-site wetland (Map 3.4 and 3.5). In both properties, the stands found

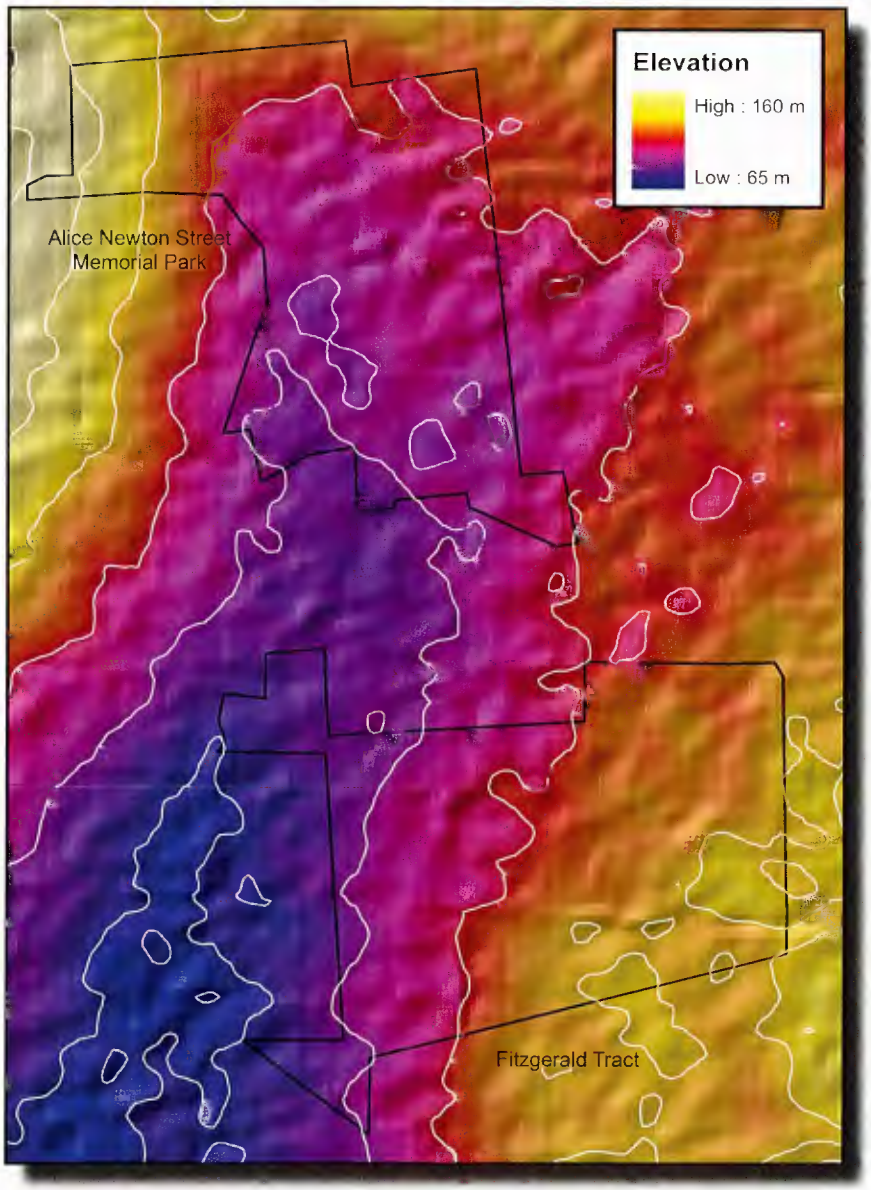


Map 3.4 - Hydrology

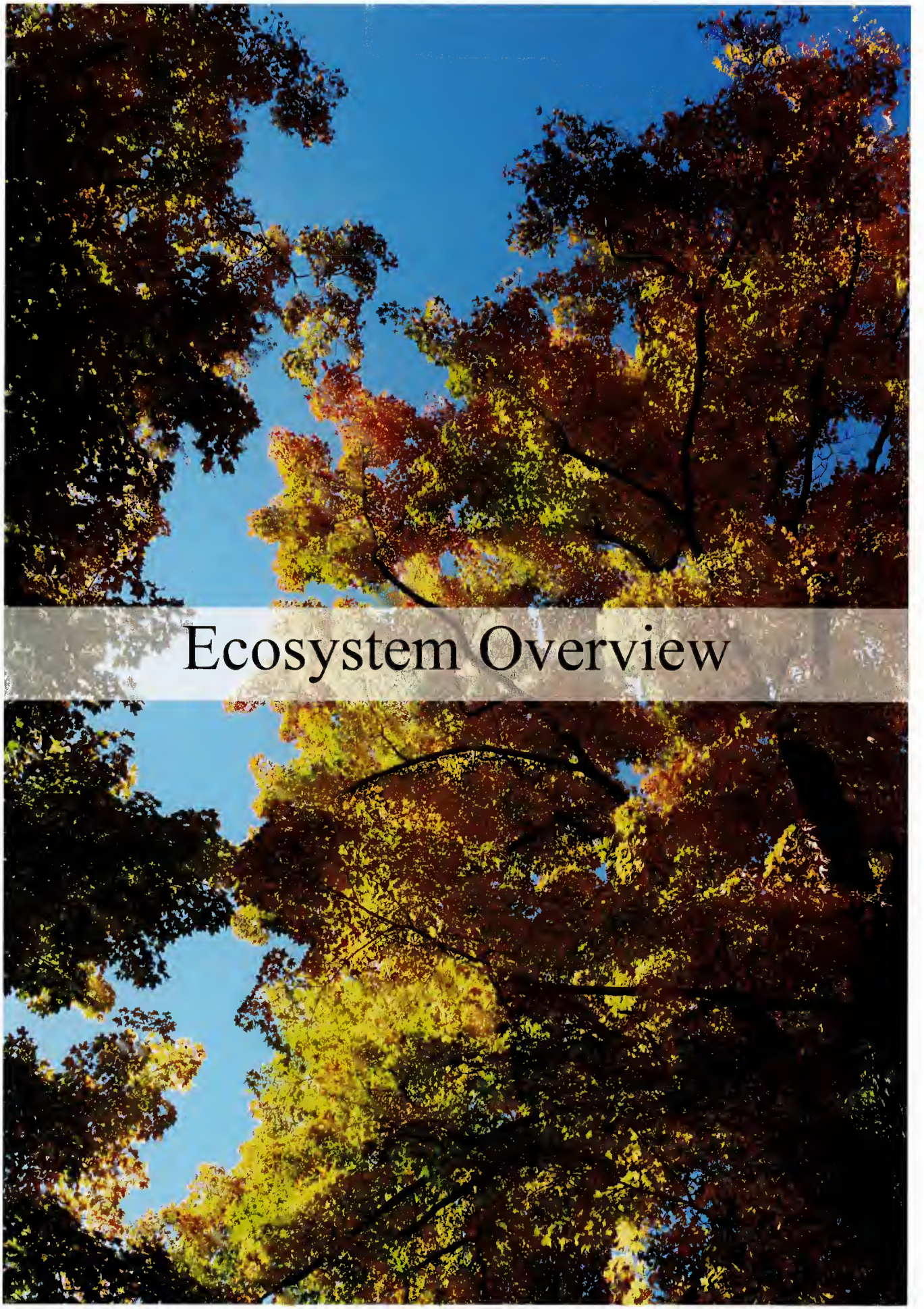


on these hydric soils have a species composition that is compatible with the wetter conditions of the sites (i.e., red maple overstory and an understory dominated by spicebush, sweet pepperbush, and a variety of ferns).

Wetlands and riparian zones are crucial to the integrity of the hydrological resources in these properties. Development in these areas could cause erosion and sediment deposition in the Wepawaug River. This could have water quality implications, as well as consequences for the species that depend on such habitats. Reduction of or damage to the wetlands and riparian zones could also alter the flood regime of the river causing surrounding properties to be more prone to flooding. For these reasons, it is recommended that wetlands and riparian zones be protected: no development or construction should be allowed on such sites.



Map 3.5 - Topography



Ecosystem Overview

4.1. Vegetation Classification

The Alice Newton Street Memorial Park and Fitzgerald Tract have diverse habitats for wildlife. The combination of three distinct habitat types—meadows, ephemeral and perennial wetlands, and forestland—provide a suitable environment for a wide range of species. Classification at the gross level provides a simple framework for understanding the different functions and values of areas in ANSMP and the Fitzgerald. Descriptions of the importance of and wildlife present in these various classes of vegetation follow.

4.1.1 Meadows

Meadow habitat type is found in both properties. The small shrub meadow in the middle of the Alice Newton Street Memorial Park is populated with old field cedar and is a relic of the historical land use. Woody shrubs and herbaceous plants are used by wildlife for nesting, escape cover, and nutrition (Tefft 2006). Over one hundred species of birds, mammals, and reptiles utilize this type of habitat. Some species might be permanent residents, such as the white-footed mouse (*Peromyscus leucopus*) and the black rat snake (*Elaphe obsoleta*), while others, such as turkeys (*Meleagris gallopavo*) and red foxes (*Vulpes vulpes*), might wander through while foraging (Tefft 2006).

The Fitzgerald tract has a larger grass meadow that currently houses the community gardens and experimental chestnut orchard. The open parts of the meadow receive varying amounts of mowing and exhibit a range of the species diversity. Grass meadows host a variety of plant and wildflower species, which in turn support diverse insect communities (Tscharntke and Greiler 1995). Other species which utilize grass meadows include the meadow vole (*Microtus pennsylvanicus*), meadow jumping mouse (*Zapus hudsonius*), eastern box turtle (*Terrapene carolina*), and northern bobwhite (*Colinus virginianus*) (Rothbart and Capel 2006).

In addition to open fields, both types of meadow areas provide edge habitat where they abut forestland. Edge matrix is a distinct community type with its own microclimate, distribution of resources, and set of species interactions. The impacts of edge effects cannot be generalized across species; rather, the ecology of each species interacts with the edge environment to either promote or diminish survival and reproduction (Ries et al. 2004).

4.1.2 Wetlands

The properties contain three types of wetland habitat: forested swamps, vernal pools, and riparian zones. Wetlands in Connecticut are protected by the 1972 "Inland Wetlands and Watercourses Act" which regulates and restricts activities impacting wetlands via municipal inland wetlands agencies.

Forested swamps are found in the southeastern corner of the Fitzgerald tract and the southwestern corner of Alice Newton Street Memorial Park (Stands 4 and 9). These areas have perennially wet soils and are inundated with standing water during parts of the year. Dark, organic soils provide many nutrients for water-tolerant tree and shrub species able to establish in these conditions. Many birds, fish, and invertebrates need swamp habitats to survive, and many more species rely on the resident fauna for nutrition. The wood duck (*Aix sponsa*) is one species which requires forested swampland (US EPA 2008).

Ephemeral watercourses and vernal pools are found throughout the property as a result of the uneven topography and the geology of the area (Stand 3). Many low lying areas are temporarily hydric following rain storms. Areas which are more seriously flooded in the spring are seasonal water bodies known as vernal pools. Because vernal pools are temporary water bodies, fish populations are unable to establish. This makes them ideal breeding habitat for many species of amphibians as egg masses and tadpoles avoid this tyoe of predation. In fact, several species require vernal pools to breed. These are known as obligate vernal pool species and include wood frogs (*Rana sylvatica*), eastern spadefoot toads (*Scaphiopus holbrookii*), spotted salamanders (*Ambystoma maculatum*), marbled salamanders (*Ambystoma opacum*), and fairy shrimp (*Eubranchipus sp.*) (CT DEP 2008).

The riparian zone is the area where terrestrial habitat abuts aquatic habitat. It extends into the terrestrial ecosystem as far as it remains in the aquatic ecosystem's zone of influence. This type of buffer exists along all of the watercourses in the properties. Riparian vegetation stabilizes stream edges, reduces erosion and sedimentation, and helps regulate the temperature of the aquatic ecosystem. Allochthanous inputs from the riparian zones enhance stream microstructure and habitat. Riparian soils filter inputs such as contaminated runoff and play an important role in maintaining the water quality of the site. In addition, it is estimated that 90% of northeastern wildlife species use riparian habitat in some manner. Some species such as beavers (*Castor canadensis*) are reliant on riparian zones and their intrinsic structural complexity. Other species such as red foxes, coyotes (*Canis latrans*), and white-tailed deer (*Odocoileus virginianus*) use them as travel corridors (Hodgman 2006).

4.1.3 Forestland

Upland forest is the most extensive cover type found on the properties, comprising approximately 92 acres of ANSMP and 67 acres of the Fitzgerald tract. Forests provide many ecosystem services which are important for humans (Notman et al. 2006). First, the woody biomass extracted from forests drives the forest product industry. The production and consumption of timber and non-timber products (e.g., paper) is an important domestic industry in the United States. For example, the United States produced approximately 25.1 million cubic meters of sawn hardwood in 2007 while consuming about 24 million cubic meters of it (Howard and Westby 2007). Second, forests provide carbon sequestration. That is, plants remove carbon dioxide from the atmosphere during photosynthesis. In the context of global climate change this service is becoming increasingly important. The EPA estimated that in 2004 United States forests sequestered 11% of all United States greenhouse gas emissions (US EPA 2006). Third, forest watersheds protect the quality of the water supply by filtering contamination from the water. Finally, forests provide areas for aesthetic and recreational enjoyment. This is evidenced by the approximately 640 million acres of forestland available for recreation in the United States (Notman et al. 2006). ANSMP and the Fitzgerald tract contribute in their own way to this total.

Woodlands are also home to many species of wildlife, and various forest attributes can make habitat more or less suitable. Snags (standing, dead trees) and den trees (live trees with a cavity) are used by animals for nesting, food, and shelter. Woodpeckers, for example, excavate nests in dead trees and forage for insects living under the surface. The cavities excavated by woodpeckers and those present in den trees provide excellent shelter and nesting for secondary excavators such as owls, swallows, squirrels, raccoons, and opossums. The average relative snag densities in ANSMP and the Fitzgerald are 0.08 and 0.09, respectively. Another structural attribute of the forest is the presence of coarse woody debris. Coarse woody debris refers to fallen trees and branches on the forest floor. This type of material provides microhabitats for fungi, invertebrates, small mammals, birds, and reptiles. It also has an important role in forest productivity, the geomorphology of streams and slopes, and long-term carbon storage (Stevens 1997). The final structural feature of forest important to wildlife is stone ledges. Exposed rocky outcroppings and ledges are excellent places for reptiles including turtles and snakes to bask. The northwestern corner of Alice Newton Street Memorial Park has extensive outcroppings of bedrock ideal for this purpose.

Trees and woody shrubs are the primary vegetation in forests. Together, they provide the food and cover necessary to support wildlife. Prevalent hard mast (nut) producing trees found in the properties include the oaks, hickories, and beech. Soft mast (fruit) producing trees including dogwood and black cherry occur in low densities. Woody shrubs and vines with soft mast found on the properties include high- and low-bush blueberry, Japanese barberry, burning bush, greenbrier, maple-leaved viburnum, Virginia creeper, poison ivy, Oriental bittersweet, privet, grape, and winterberry holly. Despite the fact that Japanese barberry, burning bush, privet, and Oriental bittersweet are invasive species, they are excellent sources of food. In addition, the dense ground cover of Japanese barberry is ideal for ground-nesting birds and small mammals, and burning bush and Oriental bittersweet add vertical complexity to the forest habitat.

4.2. Observed wildlife species

Wildlife was not explicitly sampled in the properties; rather, ad lib observations of fauna were made during the course of property assessment. The following species were observed on the properties:

Turkey vulture sightings occured on multiple days of field assessment

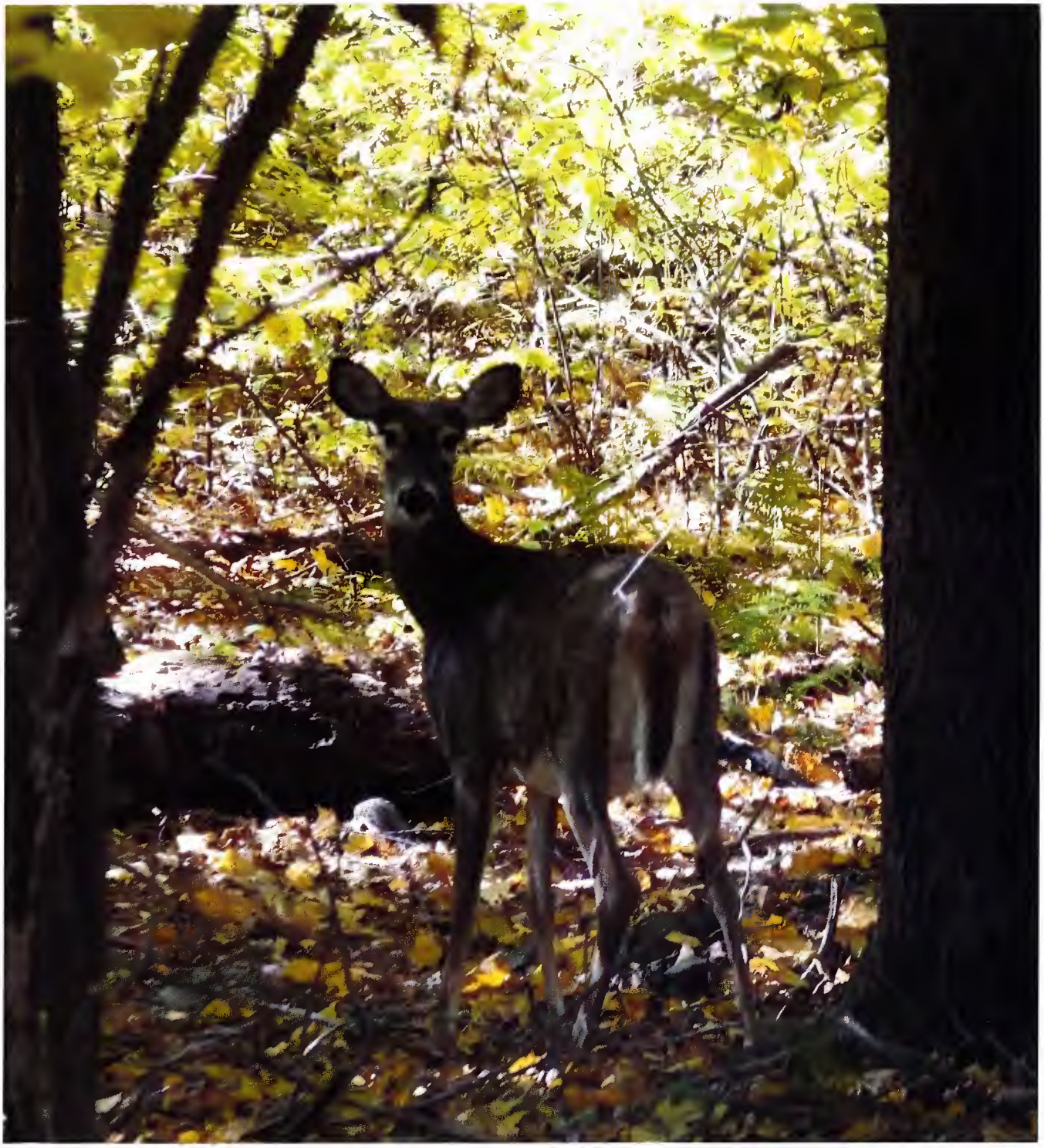
	Common name	Scientific name	Comments
Mammals	Gray squirrel	*Sciurus carolinensis*	
	Eastern chipmunk	*Tamias striatus*	
	White-tailed deer	*Odocoileus virginianus*	Heavy browse in areas indicates large population.
	Virginia opossum	*Didelphis virginiana*	Found deceased.
	Meadow vole	*Microtus pennsylvanicus*	Found deceased.
	Coyote	*Canis latrans*	
Birds	Pileated woodpeckers	*Dryocopus pileatus*	Annual cavity excavation is an excellent source of habitat for other cavity-dwelling animals (Bonar 2000).
	Downy woodpeckers	*Picoides pubescens*	
	White-breasted nuthatch	*Sitta carolinensis*	
	Turkey vulture	*Cathartes aura*	
	Canada geese	*Branta canadensis*	Migratory.
Reptiles	Eastern ribbon snake	*Thamnophis sauritus*	Prefers wetland or riparian habitat.
Amphibians	Wood frog	*Rana sylvatica*	Obligate vernal pool species.
	Spring peeper	*Pseudacris crucifer*	Facultative vernal pool species.

Table 4.1 - Wildlife Species Observed on the Properties

One of the spring peepers found in the wetlands

4.3. Potential Wildlife Species

The computer program NEWILD (Thomasma et al. 1998), developed by researchers associated with the United States Forest Service, was used to generate a list of 278 potential species that could utilize the habitats found on the two properties. Habitat characteristics were input into the program, which uses a matrix approach to relate habitat attributes to wildlife species. The species output was then cross-referenced with the local ranges of wildlife to determine which species are likely to occur in Woodbridge. A total of 111 species may utilize the properties (see Appendix 3 for species list).



This white-tailed deer was found in Alice Newton Street Memorial Park

4.4. Invasive Species

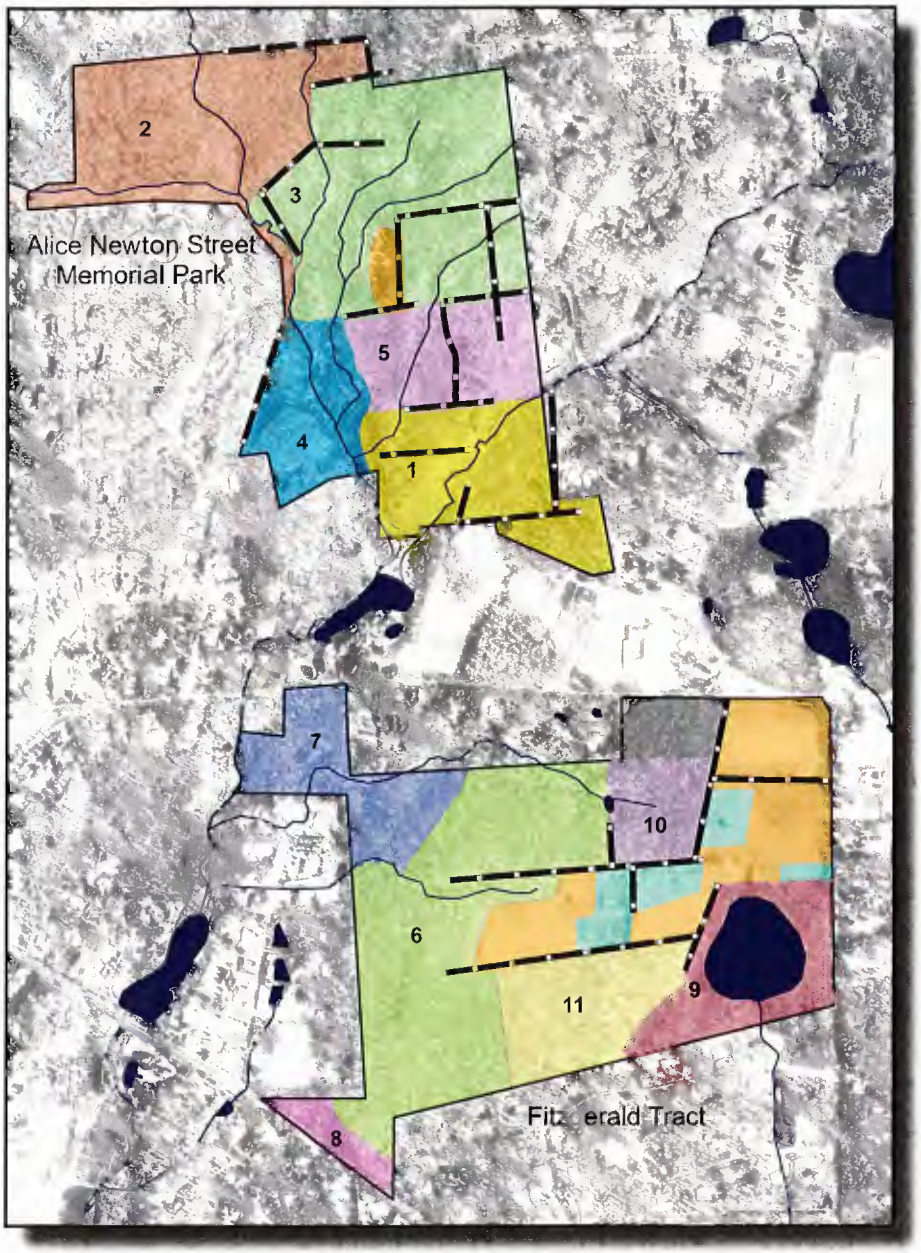
Invasive plants are non-native plants that cause detrimental environmental, economic, or public health consequences. They are often characterized by small seed mass, short juvenile period, and short interval between large seed crops. Typically they are vertebrate dispersed (Rejmanek 1996). A high reproductive rate combined with the ability to disperse wide distances—often by the spreading of vegetative fragments as well as seeds—means that invasive species recruit very quickly. In addition, they are usually able to establish and flourish under a wide variety of site conditions. The Connecticut Invasive Plants Council has developed a list of non-native plants that cause (or have the potential to cause) environmental harm in minimally-managed areas.

Invasive plants often crowd out and outcompete native plants. Their competitive advantage may derive from taking advantage of mutualistic fungi in their exotic range (Richardson et al. 2000) or experiencing freedom from their native enemies (Keane and Crawley 2002). The presence of invasive plants may damage entire communities by altering ecosystem processes including nutrient cycling, hydrologic regimes, and fire regimes (Levine et al. 2003).

Most of the invasive plants in Alice Newton Street Memorial Park and the Fitzgerald tract are present in high-impact areas such as along trails and in the fields. Detailed descriptions of the invasive species found within the Alice Newton Street Memorial Park and the Fitzgerald tract are included in Appendix 4.

Pachysandra terminalis *is one of the invasive species found in Alice Newton Street Memorial Park and the Fitzgerald tract*

4.5. Stand Delineation



Map 4.1 - Stands
The properties were divided into eleven stands, shown here with stone walls

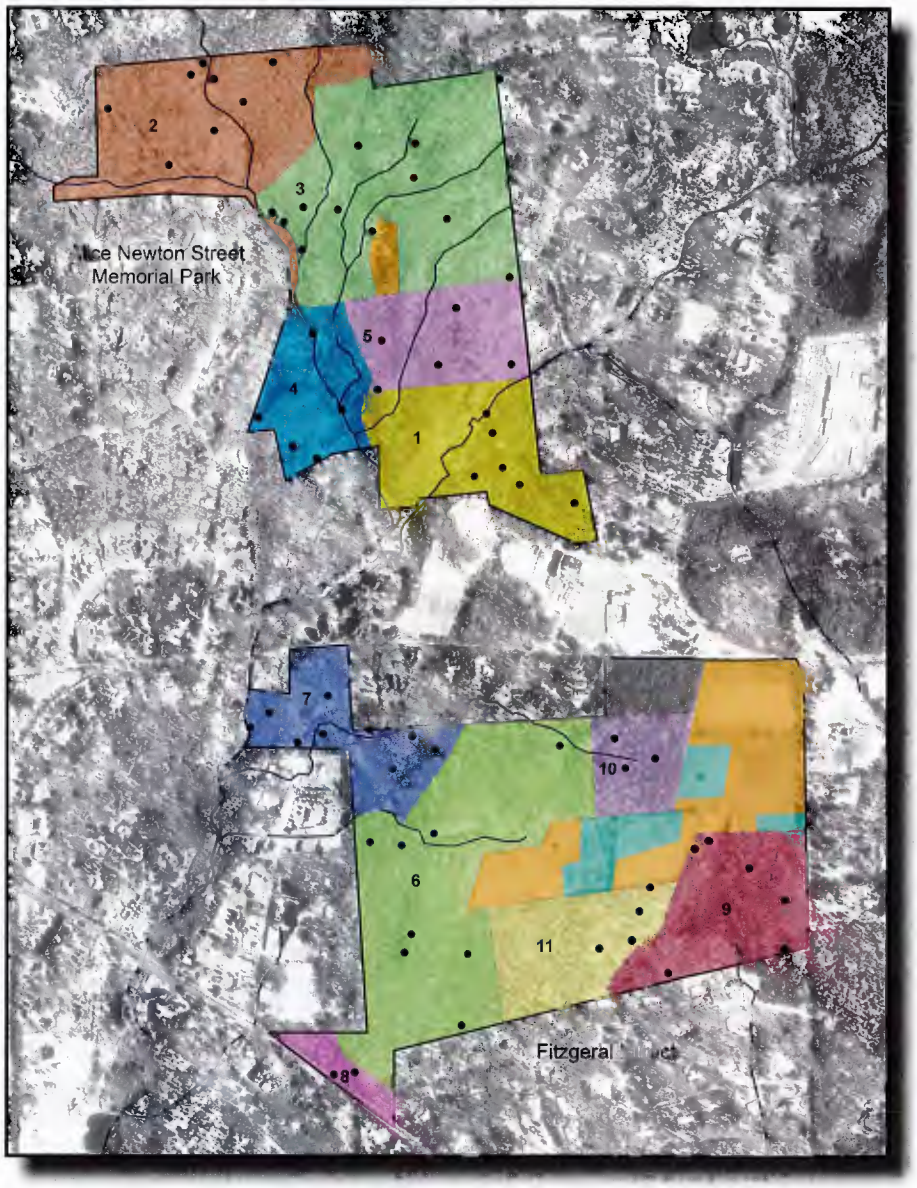
A stand is a parcel of land characterized by its relatively uniform biophysical characteristics. Stand delineation stratifies the landscape at a gross level so that more subtle variation can be detected during sampling. It creates tractable management units and generates an ecologically-relevant framework for discussing the different areas of the properties. The process of stand delineation occurred in two steps. First, aerial photos from the Connecticut DEP were analyzed for features such as stone walls, wetland features, and coniferous species. These photos were input into ArcGIS and overlaid with data on landform characteristics such as soils, bedrock, topography, and hydrology. The properties were initially parsed into stands on the basis of this information. Next, stand boundaries were extensively ground truthed. This entailed walking the properties and observing the landscape in order to see if the boundaries predicted by physical traits were grounded in biological evidence. Stand boundaries were adjusted as necessary to reflect the reality of the forest structure and to distinguish more subtle features of the landscape that were not detectable by landform analysis alone. The properties were divided into eleven stands at the completion of this process (Map 4.1).

4.6. Sampling Design

Stratified random sampling was used to sample the Alice Newton Street and Fitzgerald Tracts. Stands were delineated to determine stratification based on historic aerial photographs and rapid field assessment. A 66' x 66' grid was overlaid on the delineated site map. Sixty-six vertices were randomly chosen as plot centers using Hawth's Analysis Tools for ArcGIS (Beyer 2004). 1/20th acre fixed radius plots (radius=26.3') were used for overstory sampling and smaller 1/1000th acre square plots (side=6.6') were used to sample the understory. See Appendix 5 for the data sampling sheet.

4.6.1 Observational Data

Stand development stage and cover type were assessed qualitatively before beginning quantitative measurement. Presence and abundance of invasive species were noted. Wildlife, potential wildlife habitat, and indicators such as scat, tracks, nest, and browse were recorded. Consideration was also given to human use of the property. In each plot, the feasibility for conservation, trail placement or increased recreation was evaluated.



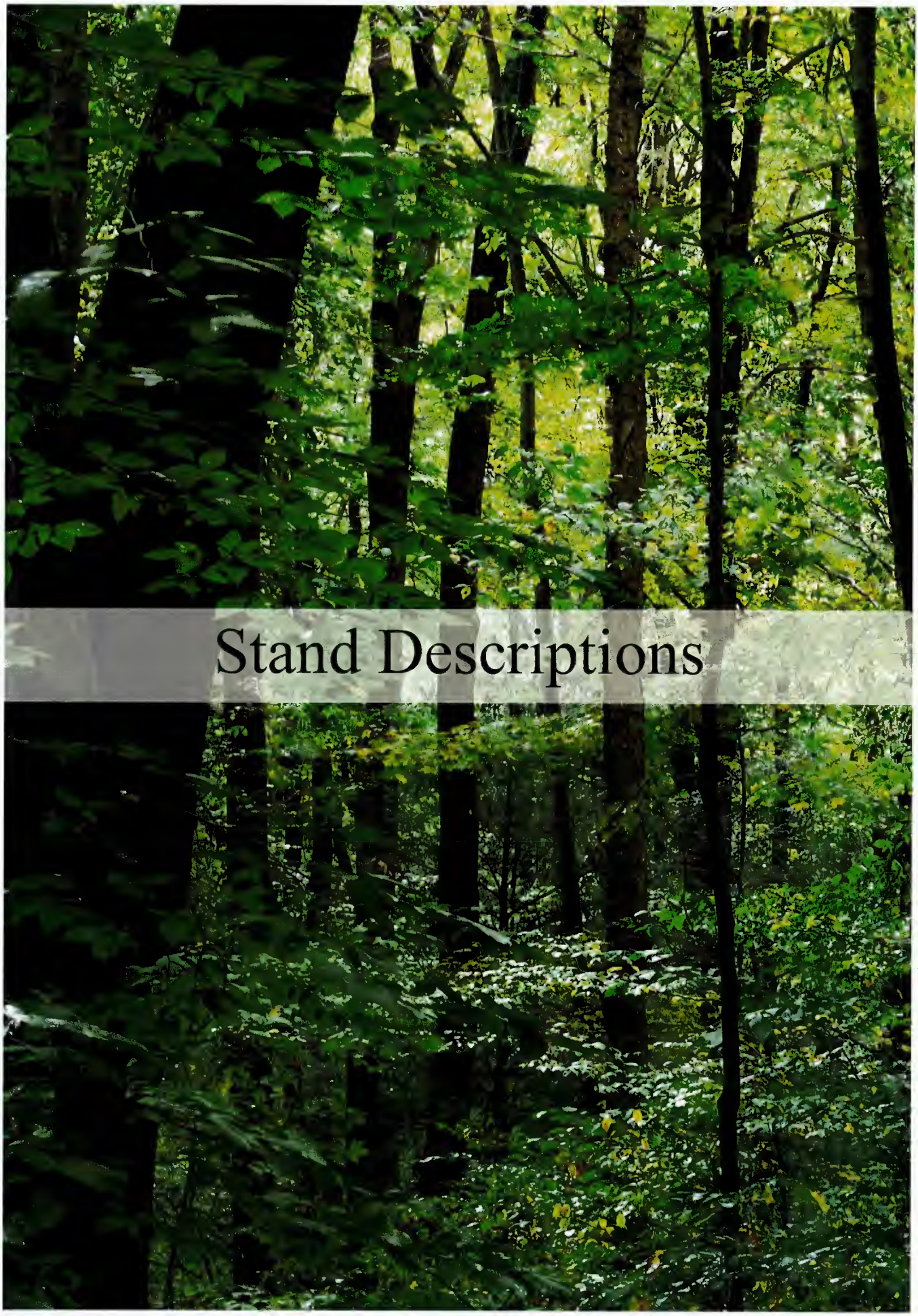
Map 4.2 - Sampling Sites
Sixty-six sites were randomly selected and sampled across the two properties

4.6.2 Overstory Sampling

Overstory data was collected within each 1/20th acre fixed plot. Each tree with a diameter at breast height (DBH) over 4" was identified and recorded. DBH for each tree was measured to the nearest inch using a Biltmore stick. Height was measured for the two trees with the largest DBHs using the stick-eye method. Dead trees were classified as snags (DBH greater than or equal to 10", unless clear signs of wildlife use were observed) and live trees with cavities were noted as den trees. Visible signs of habitation by wildlife, such as bird nests or raccoon holes, were recorded. Pathogens impacting tree health were also noted, such as hemlock wooly adelgid, beech bark disease, or gypsy moth infestation.

4.6.3 Understory Sampling

Understory data was collected in a smaller 1/1000th acre square plots located at the center of each fixed plot. Species and corresponding percent cover were recorded by percent cover classes (0, 1, 5, 10, 25, 50, 75, 90, 95, 99, 100%) beginning with the least cover species. Special note was made of indicator, invasive and unique species. Regeneration of tree species and woody shrubs were also measured within this smaller plot. Seedlings (greater than 1 ft and less than 4.5 ft) and saplings (greater than 4.5 ft and less than 4" DBH) were classified by species. Coarse woody debris was measured for each circular fixed plot along a 52"6' north-south transect beginning at the plot center. At each intersection, the diameter was measured and binned according to size class (2-4", 4-10", over 10"). Meadow areas on the properties were assessed qualitatively. Observational data focused on identifying invasive, indicator, unique or sensitive species. The potential for forest encroachment on the meadows was also noted.



Stand Descriptions

5.1 Stand Overview

Woodbridge has a diversity of habitats. There are a variety of upland, wetland and meadow stands in both Alice Newton Street Memorial Park and the Fitzgerald tract.

In Alice Newton Street Memorial Park there are three upland stands (Stands 1, 2 and 5). Sugar maple is an important component in all these stands, with black birch also prevalent in Stands 2 and 5. Oaks are present in all of the Alice Newton Street Memorial Park stands, forming an especially important part of the canopy in Stand 5. Stand 3 is much wetter than the upland stands and has been classified as a Red Maple Seepage Slope. This stand has many small streams. The diverse species mix along these riparian corridors is important for wildlife and should be protected. Stand 4 is the wettest stand in Alice Newton Street Memorial Park. This swampy area is dominated by red maple and other wetlands species. The final stand (Stand 12) is a meadow located in the center of the property.

The Fitzgerald tract has much more open meadow than Alice Newton Street Memorial Park, providing valuable wildlife habitat (Stand 13). The property also has a range of wet and dry habitats. Stands 8 and 9 are the wettest stands, dominated by wetlands area. The canopy in these stands is patchy where standing water is deepest. Stand 7 also has fewer wet areas. While depressions in the uneven topography form vernal pools, small hills provide drier habitat. The remaining stands (Stands 6, 10, and 11) provide upland habitat. Streams running through these areas create a few small wetlands as well as important riparian habitat.

While many of the stands share similar characteristics, species composition and land use history vary between them. Stand are classified according to the following information:

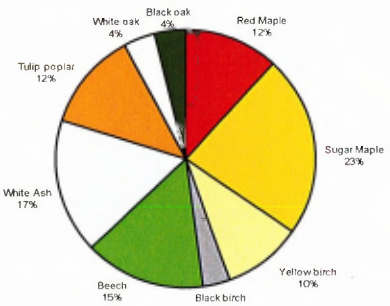
5.1.1 Stand Diagram

Stand diagrams visually capture forest composition. Their purpose is to provide a general idea of dominant trees in the stand, as well as their relative heights and frequencies. Trees are represented schematically to aid differentiation between species. Species of importance are represented in the diagram. Not all species present in the stand are represented.

5.1.2 Stand Description

This text outlines the multiple aspects of stand structure and is divided into various sections. First, *Stand History* is presented where it is known or has been inferred, along with stand ages. Stand ages were collected by taking cores from large trees in the stand and counting their rings. Next, forest structure is discussed. The *Canopy* section presents information such as height and diameter on the species most prevalent in the forest canopy. The *Subcanopy* section provides similar information for the smaller trees in the stand. This information is often indicative of future stand composition as the subcanopy will become the canopy in the future. The *Understory* section addressed ground cover in the stand, highlighting important species. Species biodiversity and species equitability indicators are important measures of the total species present in the understory and the relative prevalence of each. These numbers were calculated following the Shannon-Weaver method. Finally, the *Invasives* section provides a overview of invasives present in the stand. Further information on invasives can be found in Section 7.2.1 and Appendices 4-7.

5.1.3 Importance Value

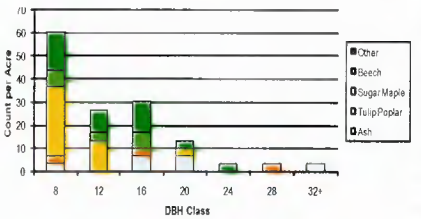


Importance values for each species were calculated based on relative basal area, relative density, and relative frequency. Importance values are represented as percentages. As importance values take into account basal area, density, and frequency, they do not convey information about the size or distribution of a species. Two species can be represented very differently within a stand, but have similar importance values. For example, a few large oaks within the stand may have the same importance value as more frequent but smaller black birch. All species sampled are represented in the pie chart.

5.1.4 Diameter at Breast Height Distribution (DBH)

This chart displays the density of trees in each diameter class. Within each class, major species are represented with different colors. All other species are included in the "other" category. Diameter classes represent

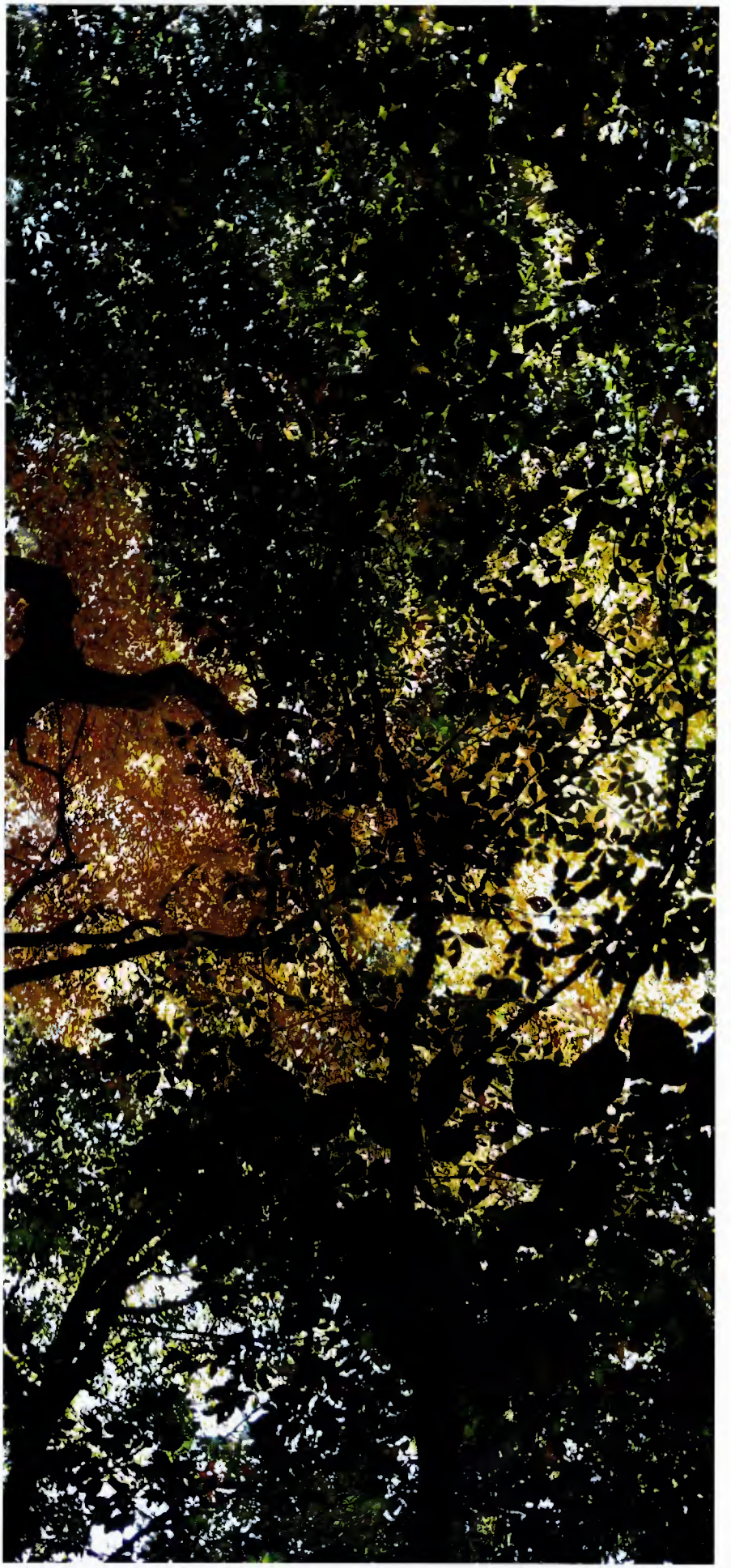
tree diameters binned into 4" groups. For example, the 8" diameter class contains trees with diameters of 4-8", while the 16" class represents trees with 12-16" diameters. Trees with diameters under 4" were not measured in overstory plots.



5.1.5 Table

The table presents important stand metrics which are useful for comparison between stands. It lists the size of the stand in acres, the number of plots in the stand, and the percentage of area sampled. In some stands a smaller percentage of the stand was sampled. The higher the percentage sampled, the more likely the data will accurately represent the stand. The stand basal area and the stem density are also listed. Stand basal area, the cross-sectional area of trees measured at breast height per acre, expresses the degree to which an area is covered in trees. Stem density, on the other hand, neglects tree size and measures only the frequency at which different species occur in the stand.

Four metrics exist for understory comparison. Biodiversity and equity indicators quantify existing understory species. Regeneration density measures the number of seedlings and saplings per area. Relative snag density is an indicator of wildlife habitat. Snags, dead trees which remain standing, provide valuable wildlife habitat.



Stand 1: Hemlock

Location - This stand is located in the southeasternmost corner of Alice Newton Street Memorial Park. To the north it borders an older forest stand. On all other sides it is bounded by private property with well-marked boundaries.

History - This area used to be open pasture, abandoned around 70 years ago. Large wolf oak trees with their wide spreading crowns indicate that this area was once open. The forest has since grown up around them. When abandoned, the first trees to colonize the field were old field pine. This early successional species has since been overtopped and replaced by a canopy of ash and tulip poplar. Shade tolerant hemlock are found in the subcanopy. These trees have suffered from an attack of wooly adelgid, which likely began in the 1980s. The infection was later stifled, perhaps by an unusually cold winter. Currently the trees have about half their foliage. Spruce and yew were underplanted in the subcanopy 30-40 years ago. The motivation for this underplanting may have been to create a visual buffer between the main trail and nearby houses.

Canopy - Emergent ash and tulip dominate the canopy with importance values of 17% and 12% respectively (Fig 5.1). The ash has an average height of 100 ft, while the tulip poplar has an average height of 120 ft. Occasional wolf oaks are present in the stand with an average height of 100 ft. Yellow birch is prevalent along riparian zones in the stand, with an importance value of 10% (Fig 5.1).

Subcanopy - Sugar maple and beech dominate the subcanopy. Competition between the two creates a mosaic of the species rather than an even distribution. Hemlock, spruce, and yew are also present in the subcanopy. Sugar maple is the most numerous species, accounting for 50% of 8"stems (Fig 5.2). Beech has an importance value of 15% (Fig 5.1). This figure may underrepresent the predominance of beech in this stand as many beech stems had a DBH of less than 4" and only trees with a DBH above 4" were considered for importance value calculations. Additionally, the clonal nature of beech causes it to grow in clumps, which are more difficult to represent accurately given the small number of sample plots.

Understory - This stand is the least diverse in Alice Newton Street Memorial Park. Dominated by spicebush, it has the low species equitability of 0.94 (Table 5.1). The understory also contains Canada mayflower and white wood aster.

Regeneration - Beech is the only species regenerating in this stand. In the future, beech will gain importance within the stand. When current subcanopy beech become part of the canopy, they will shade out other species. Only shade-tolerant beech will be able to regenerate, eventually leading to the development of a pure beech stand.

Wildlife Habitat Potential - This stand is heavily browsed, indicating heavy use by the deer population. It has extremely stony soil with small boulders distributed across the ground which are ideal basking locations for reptiles. The relative density of snags is 0.09 (Table 5.1), and there is a large amount of fine woody debris. Much of the stand is dry except for a main riparian corridor.

Invasives - Burning bush, privet and barberry, as well as a few Norway maples, occur alongside trails. Within the forest, invasives are not a major problem. Invasives may be found along the trails because of disturbance and unintentional spreading by people and dogs.

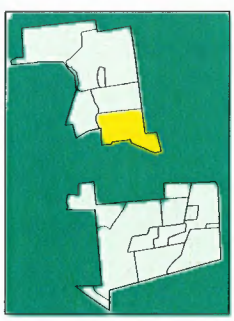


Figure 5.1 - Importance Values

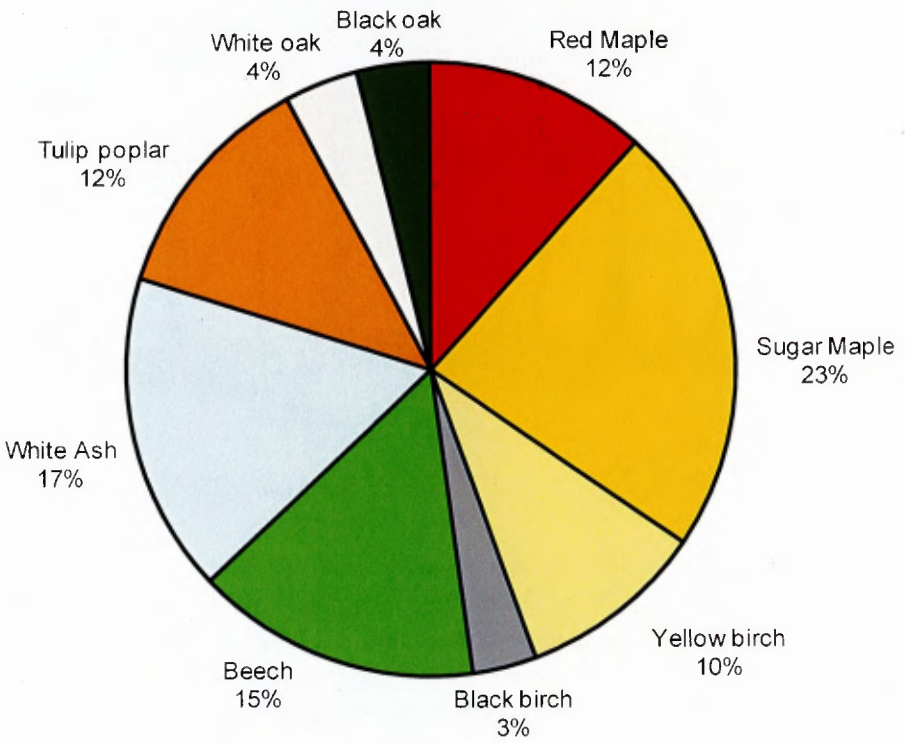


Figure 5.2 - DBH Distribution

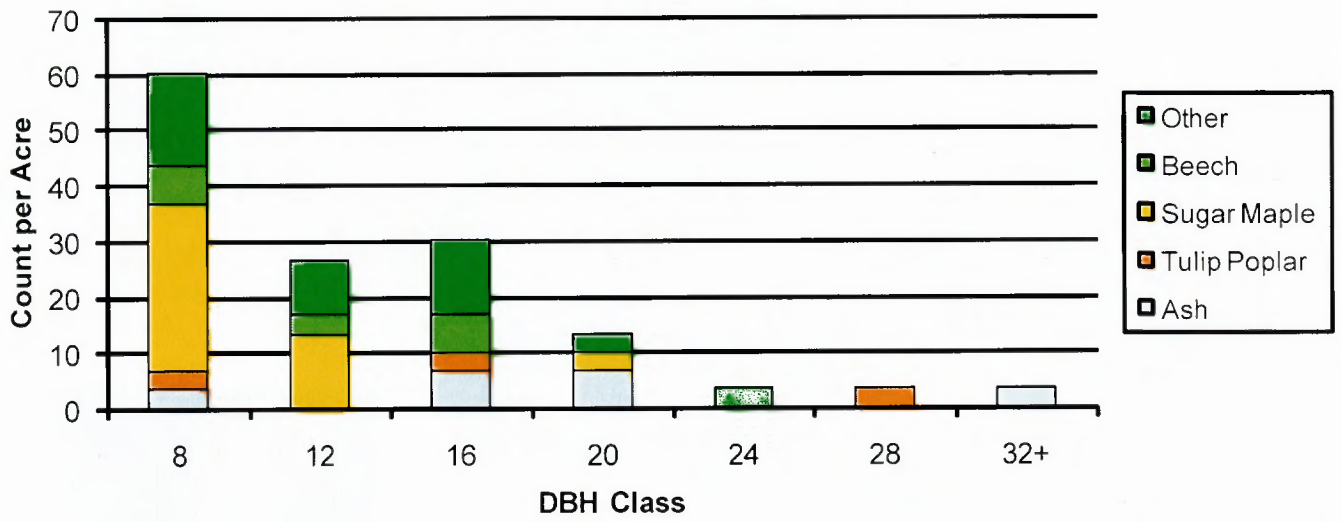


Table 5.1 - Important Stand Values

Stand Number	Stand Area (acres)	Number of Plots	Percent Sampled	Average Tree/ acre	Average Stand Basal Area (ft^2/acre)	Regen-eration Density	H Value (Diver-sity)	J Value (Equita-bility)	Snag Relative Density
1	21.3	6	1.41	137	125	2000	2.55	0.944	0.09

Stand 2: Steep Slope

Location - This forest is located in the northwesternmost corner of Alice Newton Street Memorial Park. To the east this stand transitions into a wetter red maple stand. On all other sides the property is adjacent to private property with poorly marked boundaries. Land within this stand belongs to both the Woodbridge Land Trust and the Woodbridge Park Association.

Hydrology & Geology - This stand lies on a steep slope with the highest elevation along the western boundary of the property. The hill slopes down to the Wepawaug River running north-south through the property. Wepawaug Falls are located in this stand. The geology west of the stream is significantly different from other areas of the property. The till is much shallower with many exposed bedrock outcroppings. The main stream is confined by the underlying bedrock geology, and as a result does not fan out as it does further downstream. A few small streams run down the hill in rocky channels to feed into the main watercourse.

Canopy - Oak and black birch form the canopy. Black birch makes up 38% of the 8" trees sampled and 47% of the 12" trees sampled, with a stand importance value of 27% (Fig. 5.3). These trees range in height from 70-100 ft. In the many riparian zones indicator species such as yellow birch are also present.

Subcanopy - The subcanopy is dominated by competing beech and sugar maple. Sugar maple has a stronger presence, with a stand importance value of 22% (Fig. 5.3). True understory tree species such as witchhazel and hophornbeam are present in this stand.

Understory - The understory is fairly diverse, consisting mostly of wintergreen, maple-leaved viburnum, and grass species. Tree clubmoss and highbush blueberry are also well-represented

Regeneration - Sugar maple is the only species regenerating in this stand.

Wildlife Habitat Potential - Large, rocky outcroppings; a high density of snags (0.12) and coarse woody debris (Table 5.2); and thick barberry cover make this stand an excellent habitat for a variety of wildlife. Reptiles including lizards, turtles, and snakes can bask on the exposed bedrock; cavity nesting birds and mammals can build homes inside dead trees and logs; and ground-nesting birds and small mammals can find refugia beneath the thorns of the barberry. Native high bush blueberry provides soft mast for consumption by wildlife. The steep slope and lack of trails likely minimizes human disturbance in the area allowing wildlife to thrive here.

Invasives - Large areas are densely thicketed with Japanese barberry.

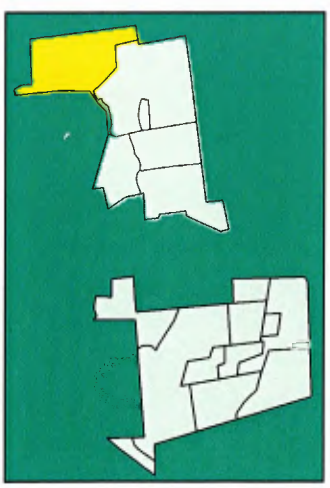


Figure 5.3 - Importance Values

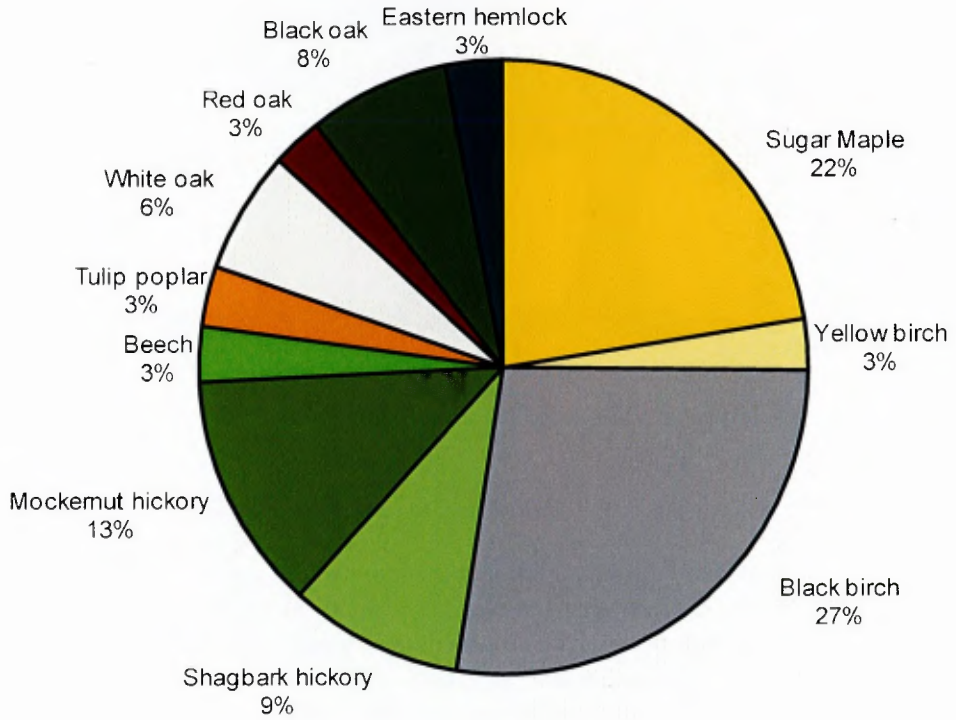


Figure 5.4 - DBH Distribution

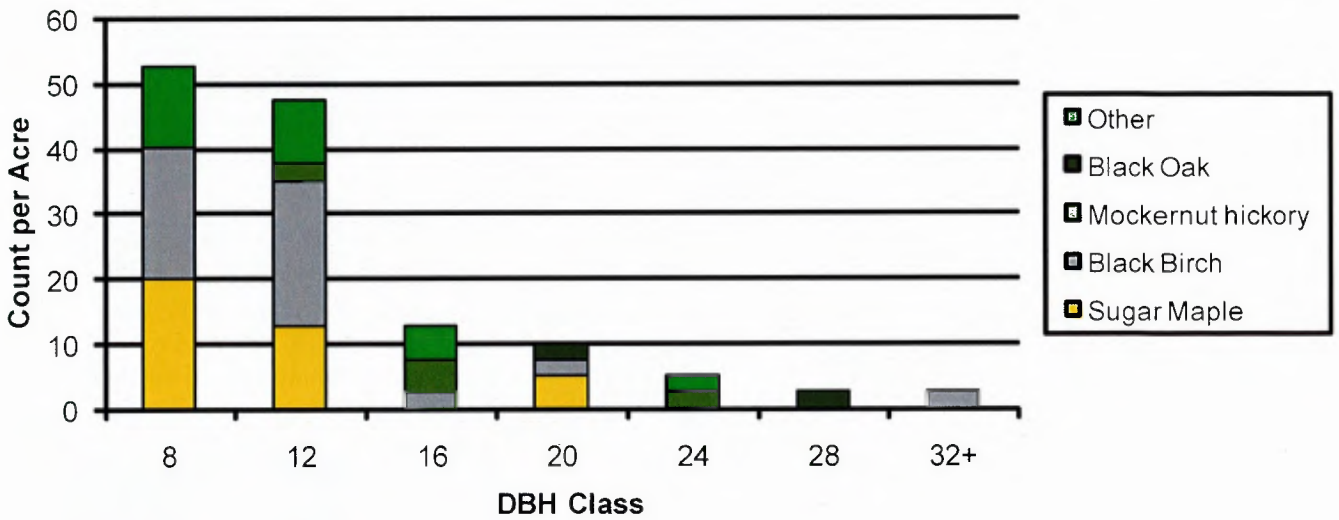


Table 5.2 - Important Stand Values

Stand Number	Stand Area (acres)	Number of Plots	Percent Sampled	Average Tree/ acre	Average Stand Basal Area (ft^2/acre)	Regen-eration Density	H Value (Diver-sity)	J Value (Equita-bility)	Snag Relative Density
2	30.0	8	1.33	133	119	1667	3.07	.955	0.12

Stand 3: Red Maple Seepage

Location - This large red maple forest is located in the northeastern corner of Alice Newton Street Memorial Park. To the south it is bounded by old stone walls which delineate it from an older forest stand. Its northwest corner is also delineated by old stone walls. To the north and east the property lies adjacent to private property with well marked boundaries.

Hydrology - This stand is characterized by many small meandering streams which fan out over the gently sloping landscape.

Overstory - The canopy in this stand reflects the wet conditions. It is primarily composed of red maple, including both wolf red maple and second growth red maple. The wolf trees have an average height of 110 ft, while the second growth red maple heights range from 60 to 90 ft. The plots sampled indicate that red maple has an importance value of 15% (Fig. 5.5). However, this is likely an underrepresentation of the dominant species. This discrepancy may be due to random placement of plots in drier hummocks rather than lower, wetter areas. Additional error may be attributed to initial difficulties in maple species identification. Sugar maple and black birch are also found in the canopy. Data collected by coring dominant canopy trees indicate that the stand is around 90 years old. The stand contains many riparian zones in which indicator species such as yellow birch and musclewood can be found.

Subcanopy - Sugar maple and black birch dominate the subcanopy with an average height of 60 ft. As the subcanopy grows, sugar maple and black birch will play increasingly important roles in the forest. However, as red maple is so well suited to this habitat, it will continue to dominate the stand.

Understory - The diversity of understory species is greatest in this stand. The species evenness is fairly low, however, with the understory dominated by New York fern, Japanese barberry, spicebush, and sedge species. The moist soil provides a good habitat for fern species: New York fern, hay scented fern, cinnamon fern, and Christmas tree fern are all found in this area.

Regeneration - Beech and sugar maple are the dominant regeneration species. There is also some birch regeneration.

Wildlife Habitat Potential - This stand is heavily browsed. Many streams course through the stand generating a significant amount of riparian habitat. This stand has the lowest density of snags compared to any other in the properties (0.03) (Table 5.3). Species which would otherwise utilize the riparian habitat for foraging, such as raccoons, might be deterred by lack of den trees. Dense thickets of Japanese barberry in the northern portions protect those areas from white-tailed deer as they generally find it unpalatable (Ehrenfeld 1997).

Invasives - Invasives are a major component of the understory in this stand. Large areas are densely thicketed with barberry. Burning bush is very common along the trails.

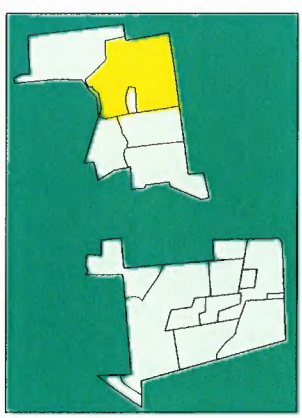


Figure 5.5 - Importance Values

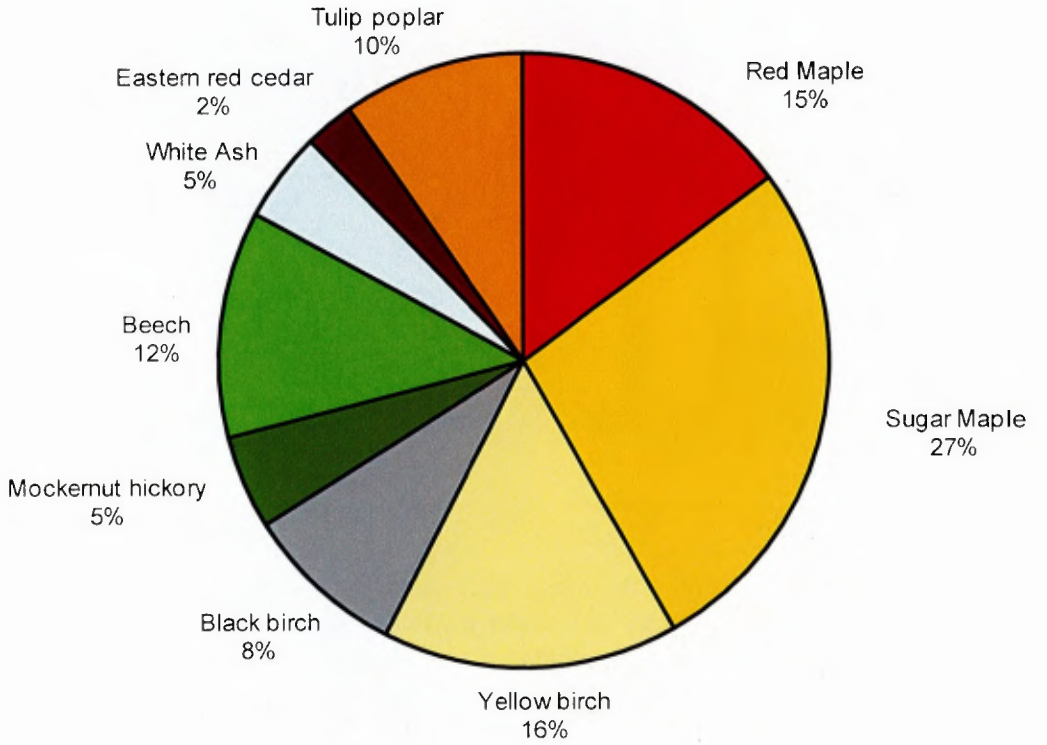


Figure 5.6 - DBH Distribution

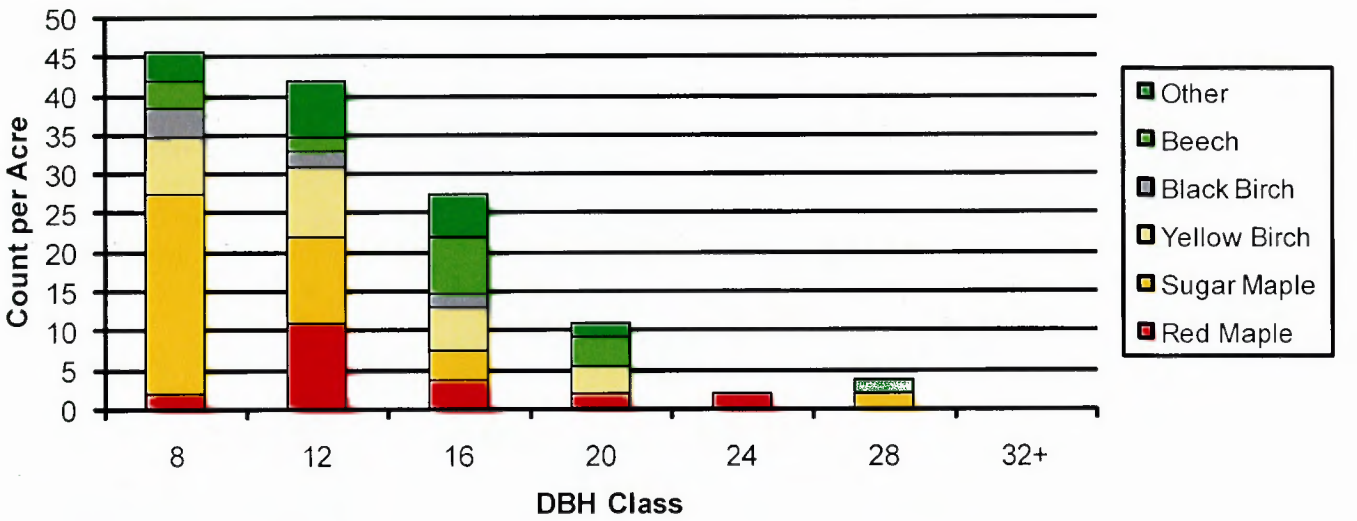


Table 5.3 - Important Stand Values

Stand Number	Stand Area (acres)	Number of Plots	Percent Sampled	Average Tree/ acre	Average Stand Basal Area (ft^2/acre)	Regen-eration Density	H Value (Diver-sity)	J Value (Equita-bility)	Snag Relative Density
3	40.2	11	1.37	131	105	2222	3.07	0.953	0.03

Stand 4: Red Maple Swamp

Location - The red maple swamp is located on the southwestern side of Alice Newton Street Memorial Park. Its interior eastern boundary is delineated by the hydrology of the area. The western boundary borders private property. A large portion of the western boundary is marked by old stone wall, but other segments of the boundary are not clearly marked.

Topography & Hydrology - This stand is wet and swampy. Multiple streams run north-south through this stand. The generally flat topography causes the streams to fan out into many small channels. On a smaller scale hummocks create drier elevated areas and wet, muddy depressions. Many small streams connect the different wetlands.

Overstory - The canopy is a single layer which is much lower than the canopy in the neighboring forest. The waterlogged soils make it difficult for trees to grow strong root systems. As a result, large trees are more likely to blow over. The stand has an especially high concentration of smaller trees with over 100 stems per acre in the 12" size class (Fig. 5.8). Most other stands have less than half the density in this size class, with counts per acre under 50. There are very few large trees; only one tree sampled was over 20". Red maple dominates the stand, with an importance value of 23%. The occasional wolf red maple has an average height of 80 ft and serves as a seed source for younger red maples in the stand. Large red maple trees have ages between 80 and 95 years old. Younger red maples make up 46% of the sampled 12" size class (Fig. 5.8) and have an average height of 60 ft. Ash and tulip poplar are emergent species. Elm, black birch, yellow birch, and sugar maple are also present in the canopy. Tree cores indicate that the majority of these species are younger, between 45 and 60 years old. There is also a significant presence of red oak in the canopy, which accounts for 50% of the 16" size class (Fig. 5.8). Beech dominates the 8" size class, accounting for 44% of 8" trees sampled.

Understory - Spicebush is prevalent in this stand. Three-lobed violet, tree clubmoss, and grass species are also well-represented in an even species distribution. The species evenness is greatest in this stand, with a value of 0.98 (Table 5.4).

Regeneration - White ash was the dominant species sampled among seedlings and saplings. There was also some red maple regeneration.

Wildlife Habitat Potential - Forested swampland provides good habitat for some reptiles and many amphibians. Connecticut is home to thirteen species of salamanders and ten species of frogs. Several of these species exploit this type of habitat. The extensive windfall generates coarse woody debris, but very few snags (relative density of 0.04) remain standing due to the unstable, shallow rooting (Table 5.4). The coarse woody debris decays quickly in the swampy environment.

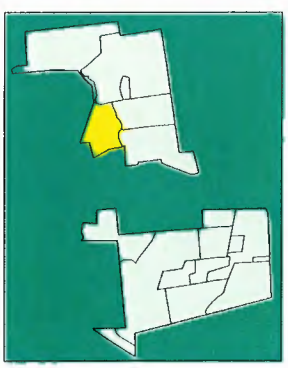


Figure 5.7 - Importance Values

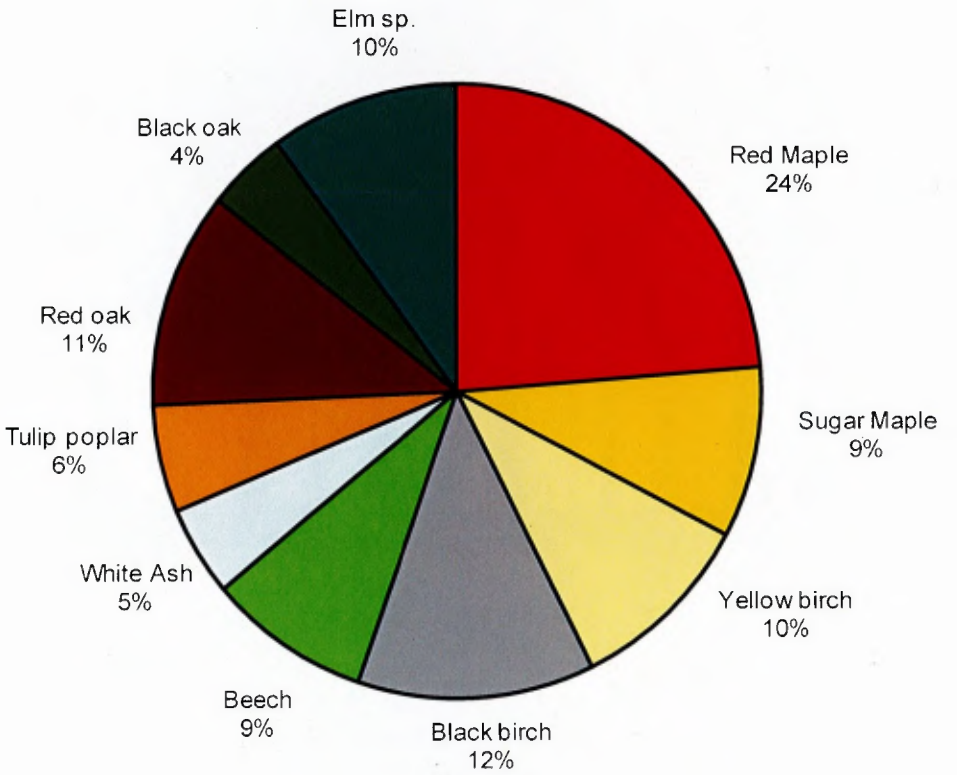


Figure 5.8 - DBH Distribution

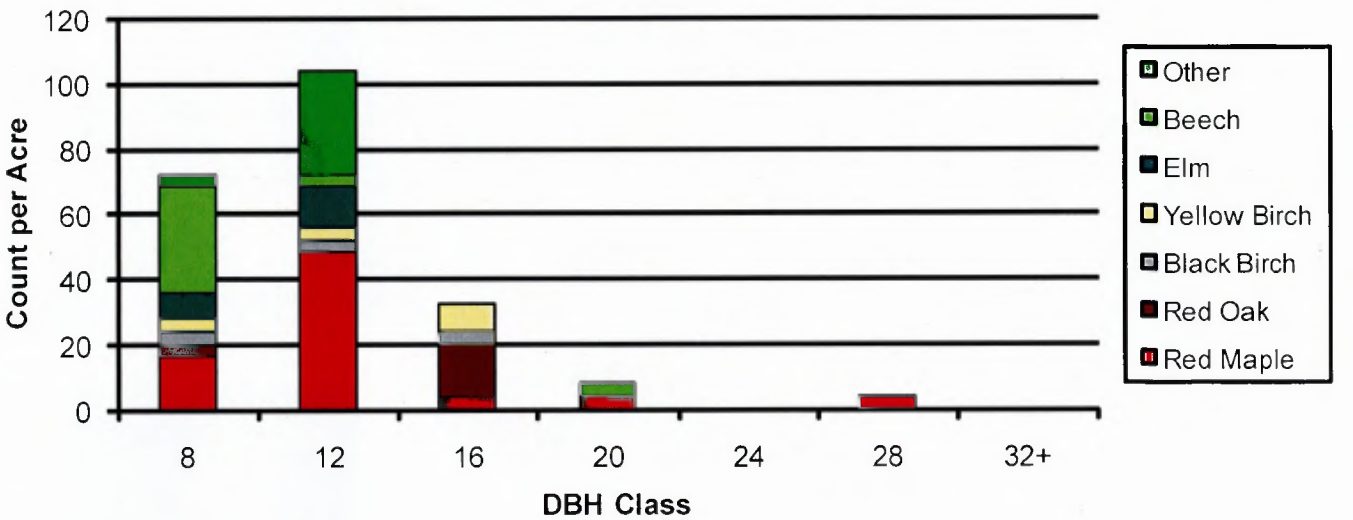


Table 5.4 - Important Stand Values

Stand Number	Stand Area (acres)	Number of Plots	Percent Sampled	Average Tree/ acre	Average Stand Basal Area (ft^2/acre)	Regen-eration Density	H Value (Diver-sity)	J Value (Equita-bility)	Snag Relative Density
4	13.1	5	1.91	200	144	3000	2.89	0.981	0.04

Stand 5: Old Oak Forest

Location - This forest is located in central eastern Alice Newton Street Memorial Park. To the north, south and west it borders other stands. The eastern side is adjacent to private property. The boundary is very clearly marked by the boundary trail.

History - This stand has been forested for much longer than the other stands on Alice Newton Street Memorial Park. The lack of wolf trees indicate that this land was not grazed recently. This forest has a nearly uniform large oak canopy at least 80 years old. Oak cores indicate that some canopy trees are over 110 years old. Since then, pole black birch (4-10") have filled in gaps where disturbances have occurred.

Canopy - The canopy is dominated by large old oaks with an average height of 100 ft and a stand importance value of 12% (Fig. 5.9). Pole black birch is also present in the canopy with an importance value of 19% (Fig. 5.9). It is especially dominant in areas where the canopy was disturbed. Birch makes up 37% of 8" trees and 62% of 12" trees (Fig. 5.10). Pole black birch in this forest has an average height of 80 ft. Hickories are also present in the canopy with a net importance value of 13%. Mockernut, pignut and shagbark hickory are all represented.

Subcanopy - Sugar maple and beech dominate the subcanopy.

Understory - Burning bush and maple-leaved viburnum are important in the understory. The species richness and evenness are both relatively high in this stand, with hay-scented fern, spicebush and winterberry holly also appearing.

Regeneration - There is very little regeneration in this stand. Some shade-tolerant white pine seedlings were found.

Wildlife Habitat Potential - This stand has a high relative snag and den tree density (0.12) and an average amount of coarse woody debris. The stand is relatively dry, lacking any significant riparian corridor. Thick barberry ground cover increases the browsing pressure on other woody shrubs in the stand. The oaks and hickories generate plentiful quantities of hard mast. The abundance of snags and den trees likely attracts species such as flying squirrels, owls, and bats.

Invasives - Japanese barberry grows in dense thickets in this stand.

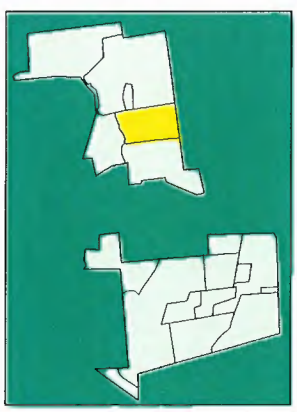


Figure 5.9 - Importance Values

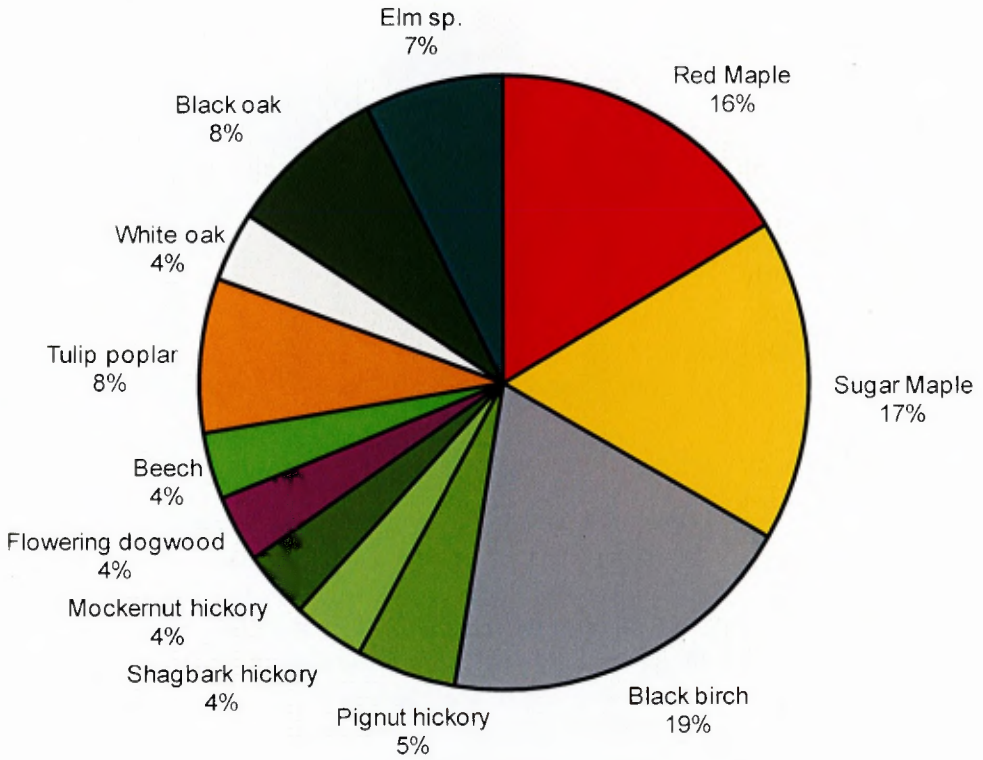


Figure 5.10 - DBH Distribution

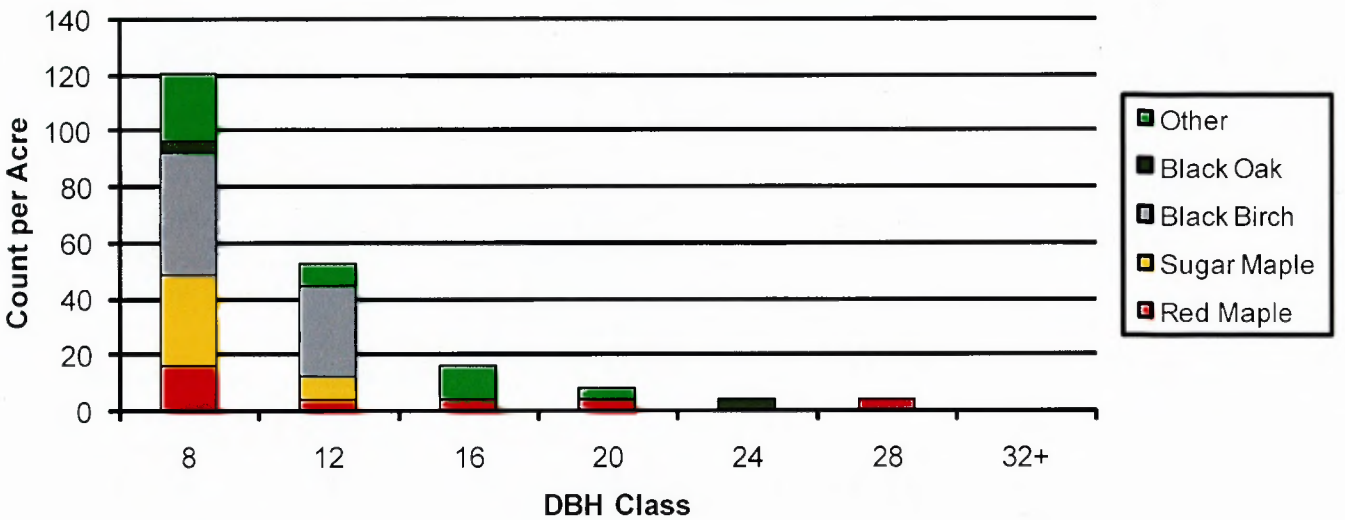


Table 5.5 - Important Stand Values

Stand Number	Stand Area (acres)	Number of Plots	Percent Sampled	Average Tree/ acre	Average Stand Basal Area (ft^2/acre)	Regen-eration Density	H Value (Diver-sity)	J Value (Equita-bility)	Snag Relative Density
5	15.0	5	1.67	204	116	Negligible	2.82	0.974	0.12

Stand 6: Black Birch, Tulip Poplar & Oak

Location - This stand wraps around the northern and western areas of the Fitzgerald Tract. To the north and west it is bordered by private property with an unmarked boundary. Much of the interior edge is bounded by the meadow and community gardens. The northeast corner is delineated by an old stone wall separating it from a much younger forest. The southeastern boundary is less clearly defined as the stand transitions into a similar old forest stand dominated by tulip poplar and oak.

History - An old uniform canopy and lack of wolf trees suggests that this stand has been forested for much longer than many other stands in the Fitzgerald tract and Alice Newton Street Memorial Park. Cores from canopy birch and oak trees indicate the stand is approximately 80 years old. This stand developed out of open pasture land which may have been partially abandoned. Many trees in this stand have holes and scarring at their base. Wound tissue indicates that the pasture was burnt periodically to keep the area open for grazing. Coppiced trees, when many stems grow out of a single stump, also indicate clearing. These trees may have been cut for fuelwood in the past. The northeastern corner of the stand is delineated by an old stone wall. Wolf sugar maples growing along the wall serve as the seed source for a cohort of younger sugar maples in this area of the stand.

Hydrology - The topography slopes downwards along the western border of the stand causing a wetter area. A stream also runs parallel to the northern boundary of the stand. In these wet areas, riparian species such as musclewood, elm and yellow birch are prevalent.

Overstory - This stand has an old, uniform canopy of black birch. Tulip poplar and oak are also prevalent in the canopy. Black birch accounts for 43% of the 16" size class (Fig. 5.12), with an average height of 110 ft. Emergent tulip poplar are present in the canopy with an average height of 120 ft. Oak (primarily red) forms an important component of the canopy. With an average height of 110 ft, red oaks make up 50% of the 20" size class (Fig. 5.12). Ash is also present in the canopy.

Subcanopy - Sugar maple dominates the subcanopy with an importance value of 25%. It accounts for 66% of the sampled 8" size class and 35% of the 12" trees (Fig. 5.12). Beech also plays an important role in the subcanopy and has an average height of 50-60 ft. The understory is very open, due in part to shade from dense beech cover.

Regeneration - Black birch and beech are the primary recruitment species with very few seedlings or saplings of other species. Due to the low recruitment rates in the stand and the clonal nature of beech, beech will eventually dominate the stand.

Understory - Maple-leaved viburnum dominates this stand. As a result, this stand has the lowest species equitability (0.93) of either Fitzgerald or Alice Newton Street Memorial Park (Table 5.6). Burning bush and spicebush are also important. Shadbush, winterberry holly, downy arrowwood, and silvery glade fern are also present.

Wildlife Habitat Potential - This stand consists mostly of dry, forested upland with some riparian and wetter habitat occurring along the boundaries. Snags occur at very low density (0.04). There is almost no dead and down debris (Table 5.6). There is very little groundcover or woody shrubs in the understory limiting the amount of forage and shelter available. These features make this relatively poor wildlife habitat.

Invasives - Along the northern border multiple garden species such as pachysandra form large creeping invasive mats in the forest adjacent to homes.

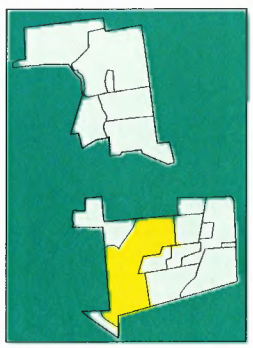


Figure 5.11 - Importance Values

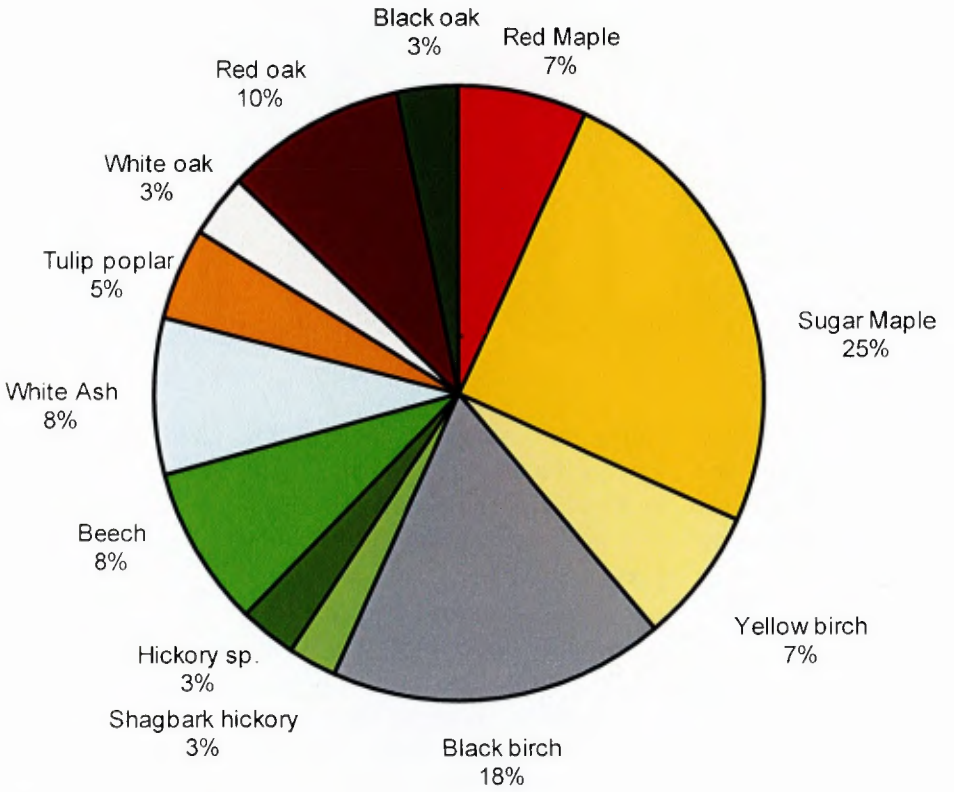


Figure 5.12 - DBH Distribution

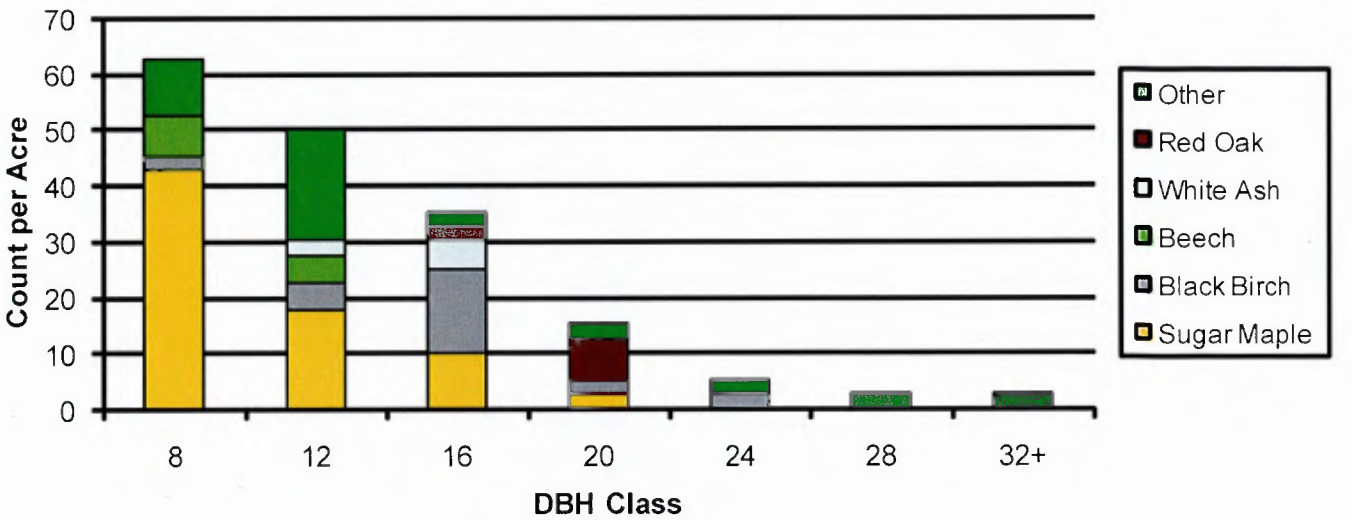


Table 5.6 - Important Stand Values

Stand Number	Stand Area (acres)	Number of Plots	Percent Sampled	Average Tree/acre	Average Stand Basal Area (ft^2/acre)	Regen-eration Density	H Value (Diver-sity)	J Value (Equita-bility)	Snag Relative Density
6	43.9	8	0.91	173	149	3200	2.78	0.927	0.04

Stand 7: Old Field Red Maple & Cedar

Location - This stand is located in the northwestern corner of the Fitzgerald tract. The northernmost boundary is a main road with a trail access point. The remainder of the boundaries border private homes or forest. These boundaries are all either unmarked or poorly marked. In the southeast corner of the stand, the topography begins to slope upward.

History - The stand is united by its common history of anthropogenic modification. At one point this was likely more homogeneous forested wetland. It was later drained and cleared as a pasture. Remains of this drainage system are visible as eroded channels. The topography was further altered when soil was removed from large borrow pits. This soil was likely used to improve and elevate the road above the wetland.

Topography & Hydrology - The topography has many mounds and depressions which defines the surface hydrology. Seasonally inundated depressions create a network of vernal pools. Others are flooded year round. Many of these wetlands abut streams.

Overstory - In wet areas, red maple dominates the overstory. Old-field red maple is present along with a younger cohort which makes up 31% of 8" trees (Fig. 5.14). Sassafras, ash, shagbark hickory and emergent tulip poplar are also found in the canopy. In riparian zones, species such as elm and yellow birch persist. Older trees have an average age of 70 years. Large grapevines growing up these older trees indicate that these trees originally grew in a meadow. Younger trees began to grow in around 50-60 years ago. The subcanopy is very dense, with over 140 stems per acre in the 8" size class. This is the highest 8" stem count of any stand sampled.

Atop the drier, elevated features, there are pockets of old-field red cedar. These account for 11% of 8" trees and 7% of 12" trees at the stand level (Fig. 5.14). However, these trees are clustered on drier soils. Red cedar is an early successional species which grew in 50-60 years ago and has now been overtopped by the hardwood forest. A shade-intolerant species, most of the red cedars are dying. In the future, sugar maple will become increasingly important in these upland areas. They currently account for 33% of 12" trees and 77% of 16" trees sampled (Fig. 5.14).

Understory - The understory diversity is relatively high. However, the equitability of species is much lower, with spicebush and skunk cabbage dominating the forest floor. Mountain laurel and Japanese barberry are also present.

Regeneration - The dominant regeneration species are sugar maple and white ash. Beech and elm seedlings were also found.

Wildlife Habitat Potential - This stand contains vernal features embedded in a mosaic of upland and wetland habitat. Vernal pools are critical habitat types for obligate species and make this stand very valuable. There is an extensive presence of mast-producing invasives. Native shrubs such as high-bush blueberry are also represented. The density of snags (0.09) and amount of coarse woody debris is about average.

Invasives - Invasives are abundant. Barberry dominates the understory and is concentrated in scattered dense thickets. Burning bush is also a major component of the landscape, particularly along the trail leading into the park. Invasive Norway maple trees are found along the trail.

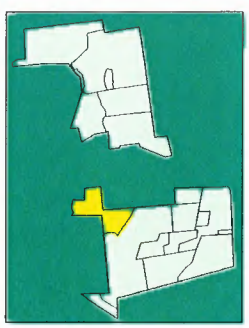


Figure 5.13 - Importance Values

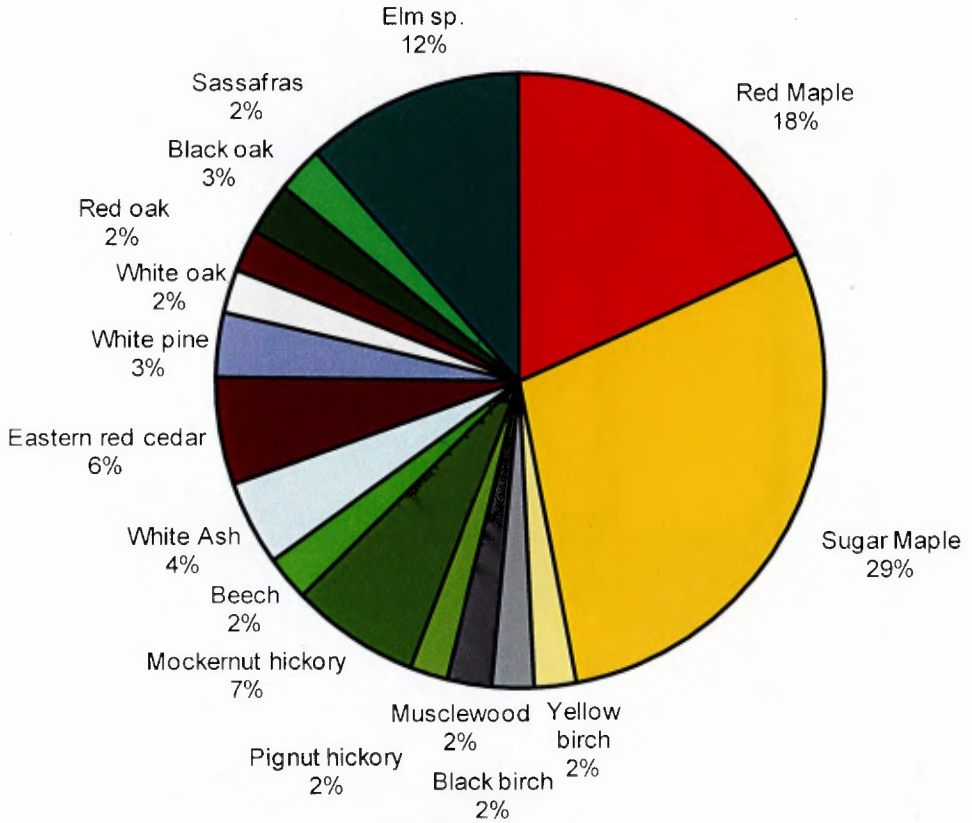


Figure 5.14 - DBH Distribution

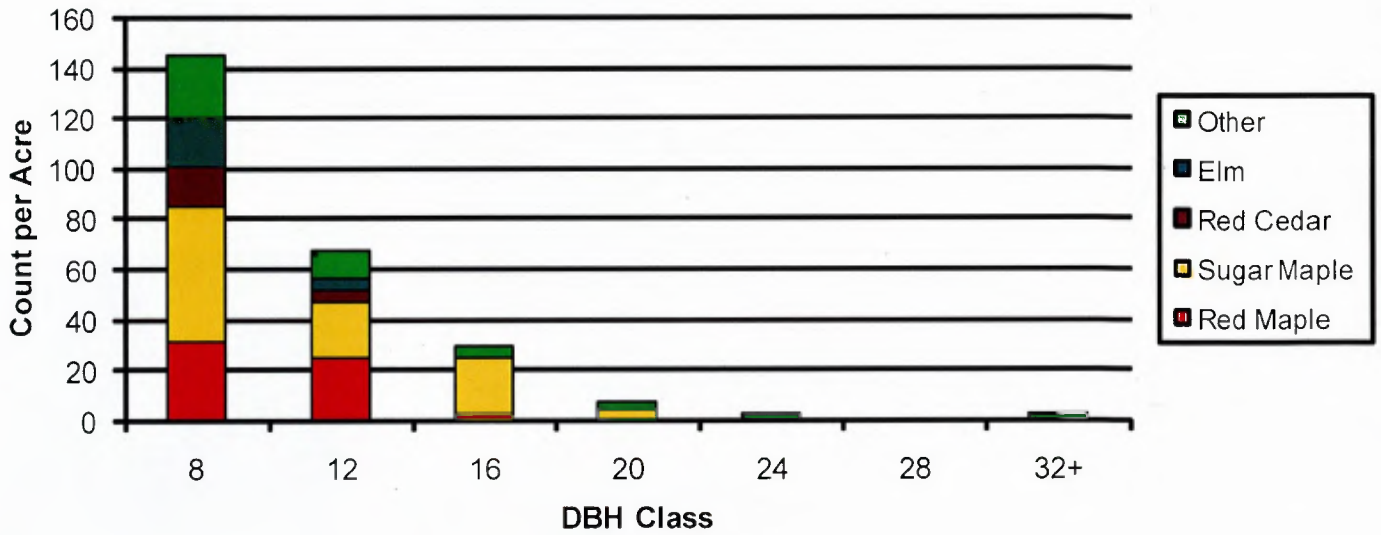


Table 5.7 - Important Stand Values

Stand Number	Stand Area (acres)	Number of Plots	Percent Sampled	Average Tree/ acre	Average Stand Basal Area (ft^2/acre)	Regen-eration Density	H Value (Diver-sity)	J Value (Equita-bility)	Snag Relative Density
7	14.7	9	3.07	251	132	1500	3.22	0.955	0.08

Stand 8: Wetland

Location - This wetland stand is located in the southwesternmost corner of the Fitzgerald tract. It is bounded by a road along the southwestern side and borders poorly marked private property on the northern and eastern sides. It connects to the rest of the Fitzgerald tract in its northeastern corner. There the topography slopes upward towards a drier forest stand.

Canopy - The young, single-layer canopy varies with the hydrology. In the wettest areas the canopy is low and open. The stand has extremely low stem counts for larger trees, with 20 stems per acre in the 12" size class and less than 10 stems per acre for all classes 16" and above (Fig. 5.16). The relatively open canopy is largely composed of red maple and tulip poplar. Basswood, elm, sugar maple, and black birch are also present. Red maple dominates the stand with an importance value of 37%. It accounts for 54% of 8" and 100% of 12" trees sampled. The tallest red maple trees have heights ranging from 90- 100 ft. Tulip poplar, an emergent canopy species, has an average height of 110 ft.

Understory & Invasives - The species evenness in this stand is greater than in any other, with a value of 0.98 (Table 5.8). However, most of the well-represented species are invasives, including multiflora rose and Japanese barberry. Spicebush and American willowherb are also present.

Regeneration - The primary regeneration species is red maple.

Wildlife Habitat Potential - This stand is quite small and extremely open. There is some barberry groundcover, but herbs are grasses are more dominant. There are not many standing snags (density of 0.06) (Table 5.8), which is related to the high number of large, fallen logs. The small size of the stand and its adjacency to the road likely limit the amount of wildlife usage in the stand.

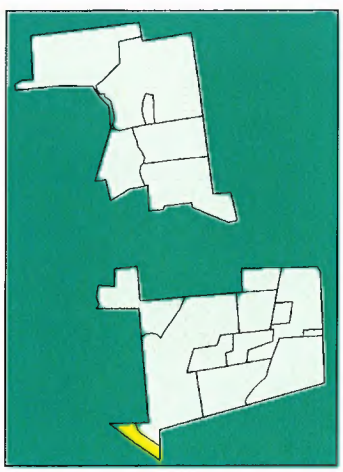


Figure 5.15 - Importance Values

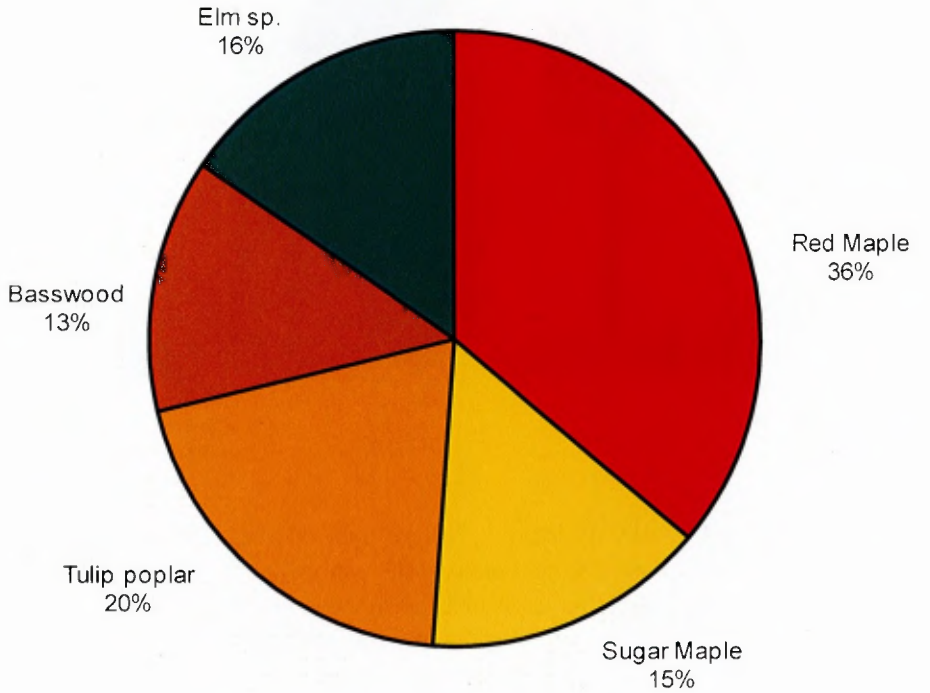


Figure 5.16 - DBH Distribution

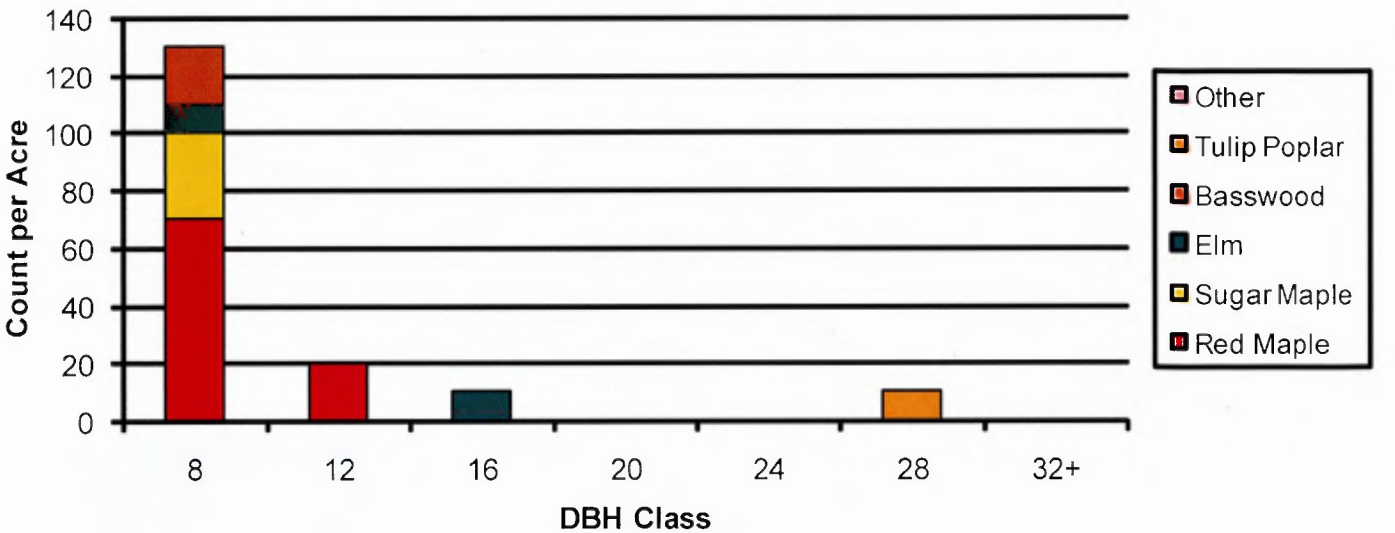


Table 5.8 - Important Stand Values

Stand Number	Stand Area (acres)	Number of Plots	Percent Sampled	Average Tree/ acre	Average Stand Basal Area (ft^2/acre)	Regen-eration Density	H Value (Diver-sity)	J Value (Equita-bility)	Snag Relative Density
8	3.44	2	2.91	180	89	1000	2.66	0.968	0.06

Stand 9: Sweet Pepperbush Wetland and Swamp

Location - This large wetland and swamp is located in the southeast ern corner of the Fitzgerald Tract. The stand is bounded by a road to the east. To the north it is bordered by a parking lot, seasonal outdoor ice rink, and meadow. Private property borders the stand to the south. The western edge of the stand is marked by a stone wall.

Hydrology - This stand is characterized by a network of vernal pools, wetlands and swamps. Moist soils are found in even the "driest" areas. The site has very poor drainage due to its flat topography. Local variations in topography allow rainwater to accumulate in small depressions, forming a network of vernal pools. Wetter areas are inundated year round leading to anaerobic soil conditions. In the wettest areas the canopy is low and non-uniform, creating small patches of open wetlands.

Canopy - Red maple dominates the canopy with an importance value of 32% (Fig. 5.17). It has an average height of 80-90 ft and makes up approximately 60% of trees in the 12", 16" and 20" size classes (Fig. 5.18). The oldest red maple cored was over 100 years old. Several oak species are also prevalent in the canopy, and together have an importance value of 15% (Fig. 5.17) and average height of 110 ft. These oaks range in age from 70 to 90 years old. Elm is also present in the canopy.

Tree heights are significantly reduced in the wettest areas where standing water is present year round. In these areas, trees can only survive on small elevated hummocks. Extremely wet soils lead to reduced stability of tree roots, making tress more likely to blow over during severe storms. Such canopy disturbances allow increased sunlight, providing opportunity for regeneration. This high frequency of disturbance lowers the average age of the canopy.

Understory - Sweet pepperbush, an obligate wetland species, grows in extremely dense thickets in the wettest areas, excluding other understory species. In the drier areas the understory is dominated by clubmoss, spicebush and a variety of ferns, such as hay-scented fern and New York fern. Greenbrier and grass species are also well-represented.

Regeneration - Black cherry was the primary regeneration species.

Wildlife Habitat Potential - This wetland habitat has both ephemeral and perennial features appealing to many species of reptiles and amphibians. There is a high density of snags and coarse woody debris of all size classes. These features provide excellent protection in addition to the impenetrable thicket of sweet pepperbush which limits the movements of park users through the stand.

Invasives - Invasive Japanese barberry is present along the stand boundary with the meadow and community garden.

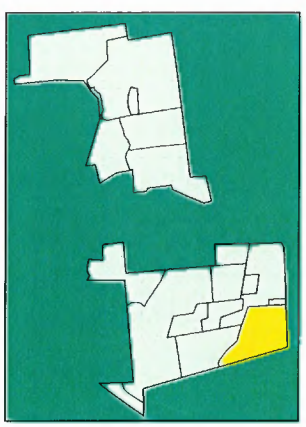


Figure 5.17 - Importance Values

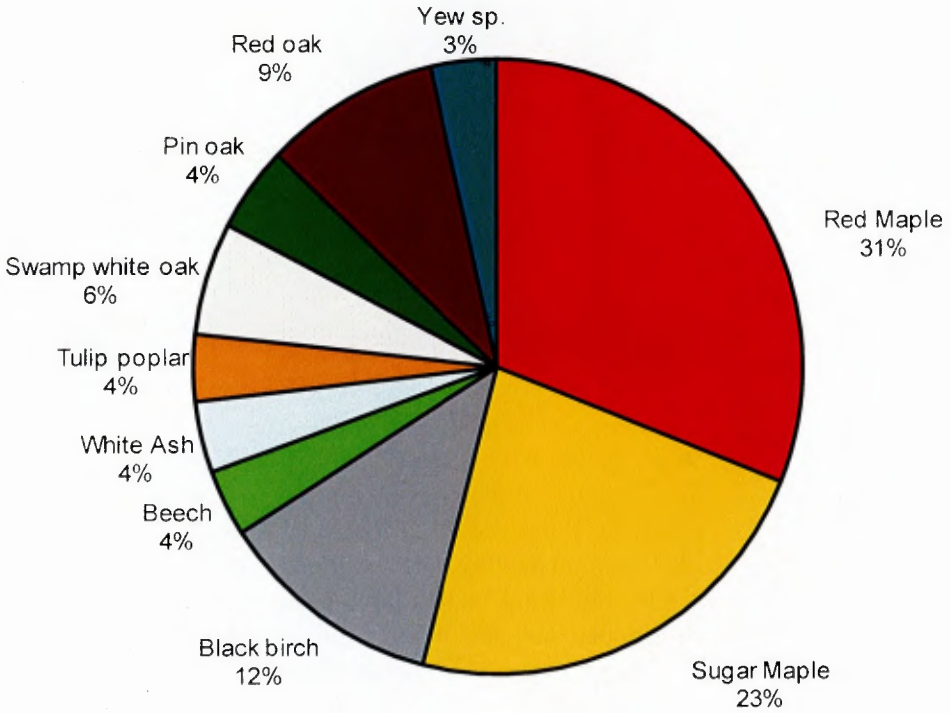


Figure 5.18 - DBH Distribution

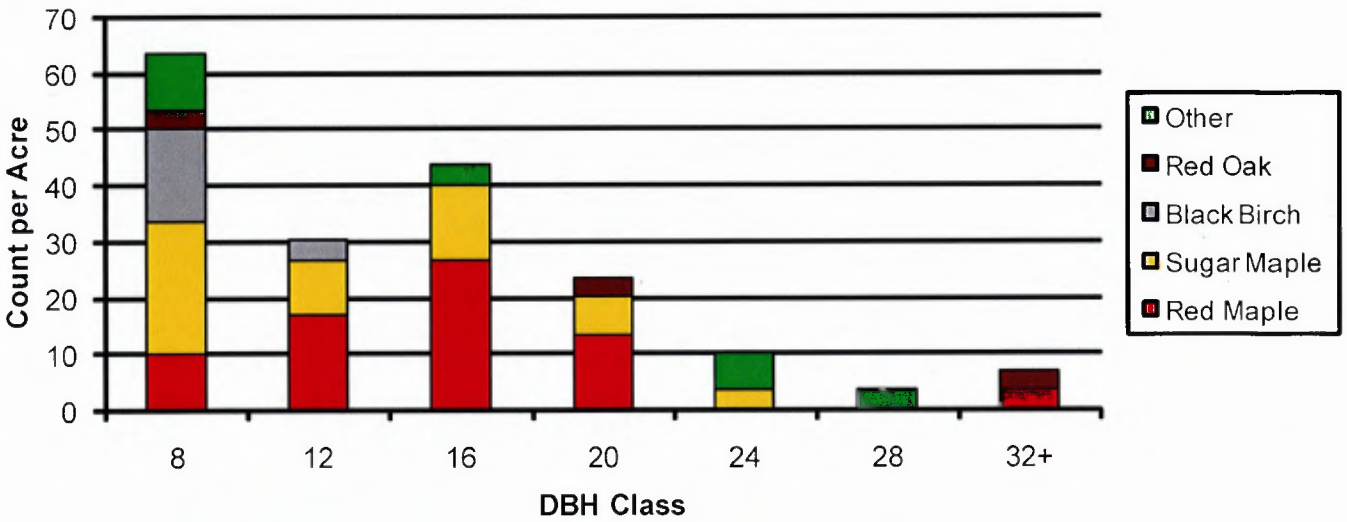


Table 5.9 - Important Stand Values

Stand Number	Stand Area (acres)	Number of Plots	Percent Sampled	Average Tree/ acre	Average Stand Basal Area (ft^2/acre)	Regen-eration Density	H Value (Diver-sity)	J Value (Equita-bility)	Snag Relative Density
9	17.9	6	1.67	180	203	2667	2.48	0.969	0.10

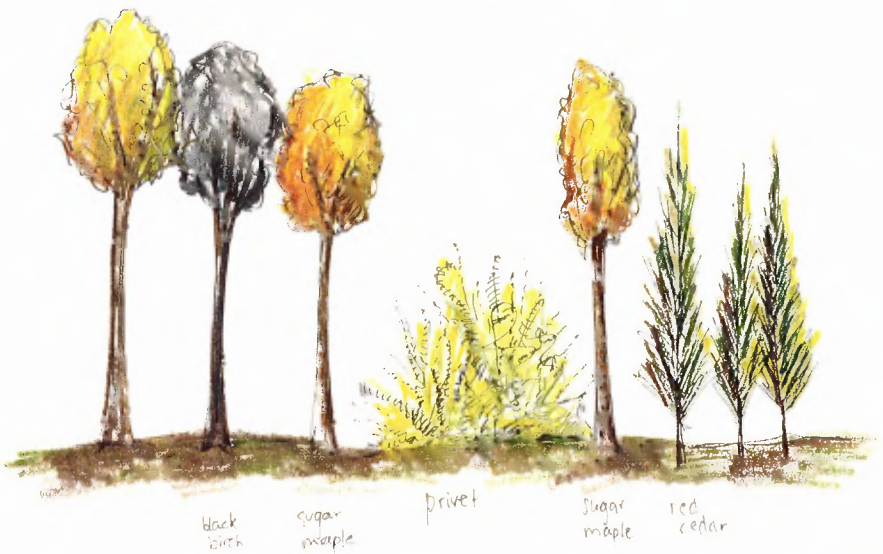
Stand 10: Old Field Cedar

Location - The stand is delineated by stone walls on its southern and eastern sides, separating it from meadows and the community gardens of the Fitzgerald tract. A stone wall along the western border separates this stand from an older forest stand. The northern border of the stand is adjacent to the firehouse.

Hydrology - There is a large pond in the northwestern corner of this stand. It aids stormwater drainage and may also be used by the firehouse. A well-maintained grassy corridor connects the firehouse parking lot to the pond.

Canopy - This stand has heterogeneous cover. However, the distinct areas are united by their common history as a field abandoned around 50 years ago. Four main components can be identified. First, a glade of old-field cedar is located along the eastern border of the stand. Heading into the stand, the species composition changes, though old-field cedar is still present. There is a single young canopy layer. In this area the old-field cedars have been overtopped and are dying. The third area of the stand is located at the center. A disturbance has caused a large break in the canopy, in which a large privet thicket has grown. In the fourth, westernmost area, wolf sugar maples are present along an old stone wall. The canopy continues to be a single young layer primarily composed of maple and birch with a few emergent tulip poplars. The average height of the canopy is 60 ft. In this section a few overtopped old-field cedars are dying.

Old-field cedar is a prominent feature of this stand. It has an importance value of 8% within the stand (Fig. 5.19). This number is low as cedars are not spread at even density throughout the stand, but instead occur in concentrated areas. While there are many cedars in the stand, only the cedars in the cedar glade remain healthy. The remaining shade- intolerant cedars have been overtopped and are dying. This is the natural progression for an abandoned field.



The present canopy consists of young birch, maple, and emergent tulip poplar. Sugar maple is the most prevalent species with an importance value of 46% (Fig. 5.19). The majority of 8" trees sampled were sugar maples. Sugar maple also dominates the older trees, accounting for 100% of sampled trees larger than 20" (Fig. 5.20). The canopy is patchy in many areas, most notably the privet bramble patch. In the future the canopy will mature, growing taller and fuller. Gaps in the canopy due to disturbance will fill in as the forest ages.

Understory - This is the least diverse stand in either Fitzgerald or Alice Newton Street Memorial Park. It has a fairly even distribution of Japanese barberry and hay-scented fern.

Regeneration - No seedlings or saplings were sampled in this stand. Regeneration is very low.

Wildlife Habitat Potential - This stand has excellent habitat potential due to the extensive presence of mast producing invasives, thick groundcover, and large number of fallen and cut cedars. This stand has the highest density of snags (0.16) and the greatest amount of fine woody debris. The stand abuts a permanent pond which contributes an additional resource to the area.

Invasives - This stand is abundant in invasives. The area around the pond is densely thicketed with barberry, making movement in the area difficult. A dense thicket of privet is located in an open canopy area in the center of the stand. Burning bush, barberry and Oriental bittersweet can be found at lower densities throughout much of the stand. Norway maple is prevalent in the stand, with an importance value of 8% (Fig. 5.20).

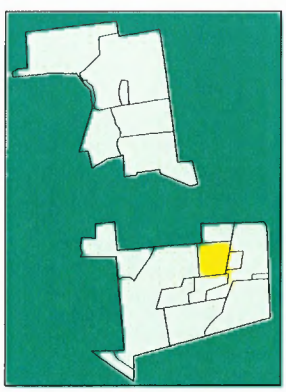


Figure 5.19 - Importance Values

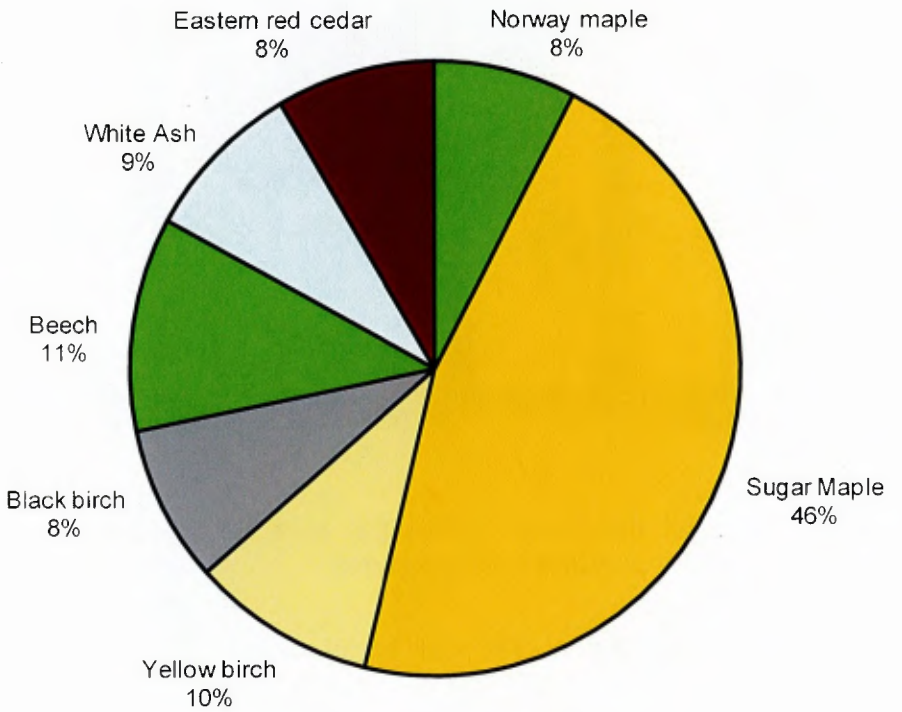


Figure 5.20 - DBH Distribution

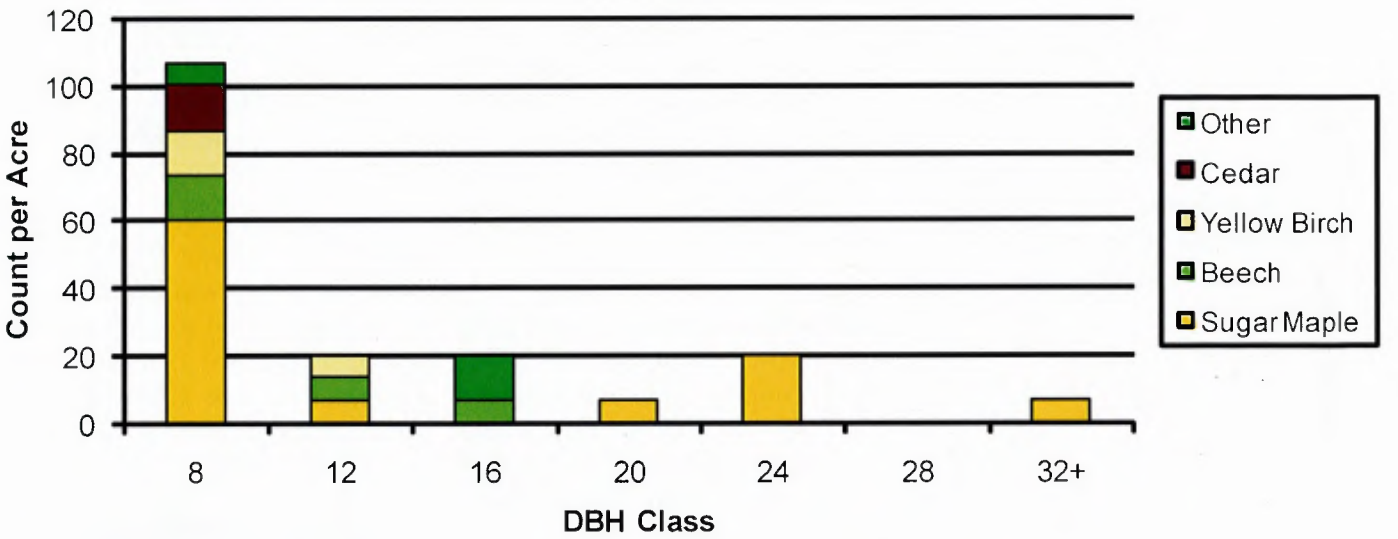


Table 5.10 - Important Stand Values

Stand Number	Stand Area (acres)	Number of Plots	Percent Sampled	Average Tree/ acre	Average Stand Basal Area (ft^2/acre)	Regen-eration Density	H Value (Diver-sity)	J Value (Equita-bility)	Snag Relative Density
10	8.24	6	1.67	180	168	Negligible	1.89	0.970	0.16

Stand 11: Tulip & Oak Forest

Location - This stand of old forest is located in the southern half of the Fitzgerald tract. To the north it is bounded by a stone wall separating it from the meadow and community gardens. On the southern edge it is bordered by private property with an unmarked boundary. To the east a stone wall separates it from the sweet pepperbush wetland and swamp area. The western boundary is less clearly defined as the stand transitions into another old forest stand.

History - An old uniform canopy and lack of wolf trees suggests that this stand has been forested much longer than many other stands in the Fitzgerald tract and Alice Newton Street Memorial Park. This stand developed out of semi-abandoned pasture land. Many trees have holes and scarring at their base indicating periodic burning to keep the area open for grazing. Coppiced trees also indicate clearing, possibly for fuelwood.

Hydrology - The topography slopes down along the southern border of the stand. This area is much wetter than the rest of the rest of the stand. A stream also runs through the stand. Riparian species such as musclewood and yellow birch are prevalent in these wet areas.

Canopy - This stand has an old, uniform canopy of tulip poplar and oak (primarily black and red oak) with an average height of 90-100 ft. Red oaks account for 40% of the 16" trees sampled and 100% of the 24" and 28" trees sampled (Fig. 5.22). Sugar maple is another important component of the forest and is dominant among smaller trees. Sugar maples made up 50% of 12" trees and 67% of 20" trees (Fig. 5.22). Ash and mockernut hickory are also present in the canopy.

Subcanopy - Beech dominates the subcanopy, making up 37% of 8" trees sampled (Fig. 5.22). These trees have an average height of 50-60ft. While sugar maple is also present in the subcanopy, it is out competed by beech.

Regeneration - A dense beech subcanopy significantly shades the understory. As a result few seedlings or saplings of other species are able to recruit, though a few sugar maple and black cherry seedlings were present. Following its current trajectory, the beech subcanopy will someday grow into the canopy. The dense foliage will shade out other species, permitting only shade-tolerant beech to grow. Thus, in the long-term, this area will become a pure beech stand. A major disturbance such as a severe storm or fire is the only natural event likely to disrupt this progression toward beech monoculture.

Understory - Maple-leaved viburnum makes up most of the understory. Spicebush and winterberry holly are important in the midstory.

Wildlife Habitat Potential - This stand is dry upland forest habitat. There is a fair amount of coarse woody debris and an average density of snags. The understory is fairly open. Any mast produced comes from the hickories and oaks which are well-represented in the overstory.

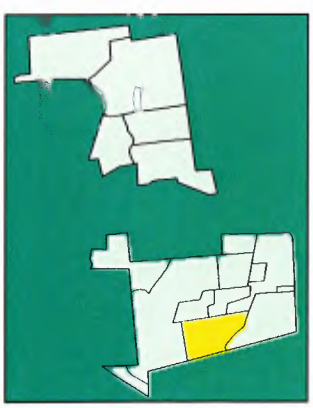


Figure 5.21 - Importance Values

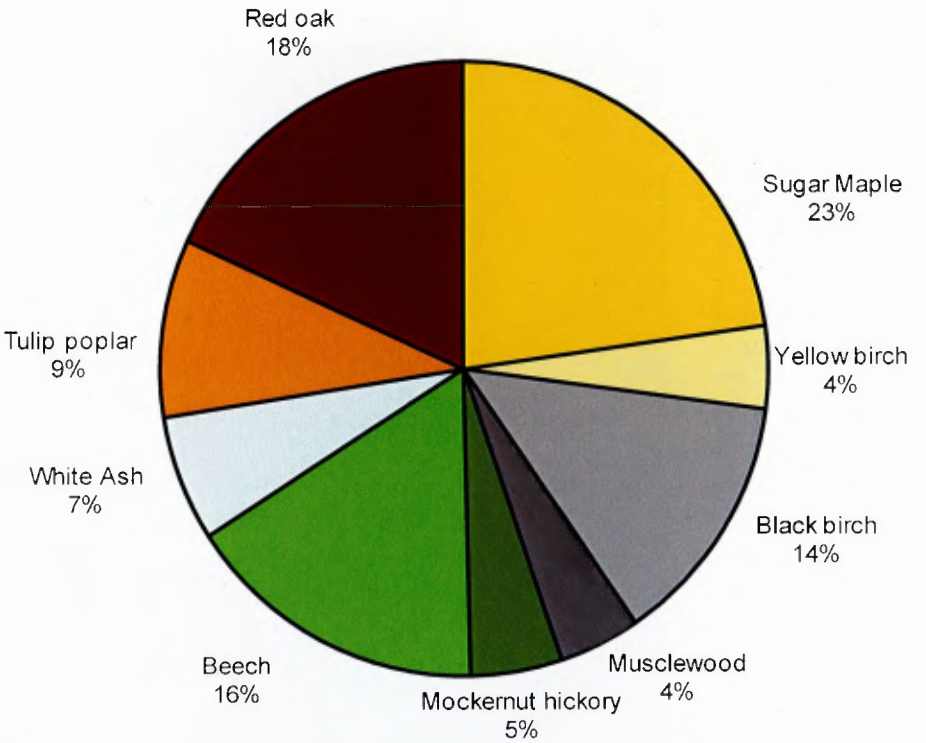


Figure 5.21

Figure 5.22 - DBH Distribution

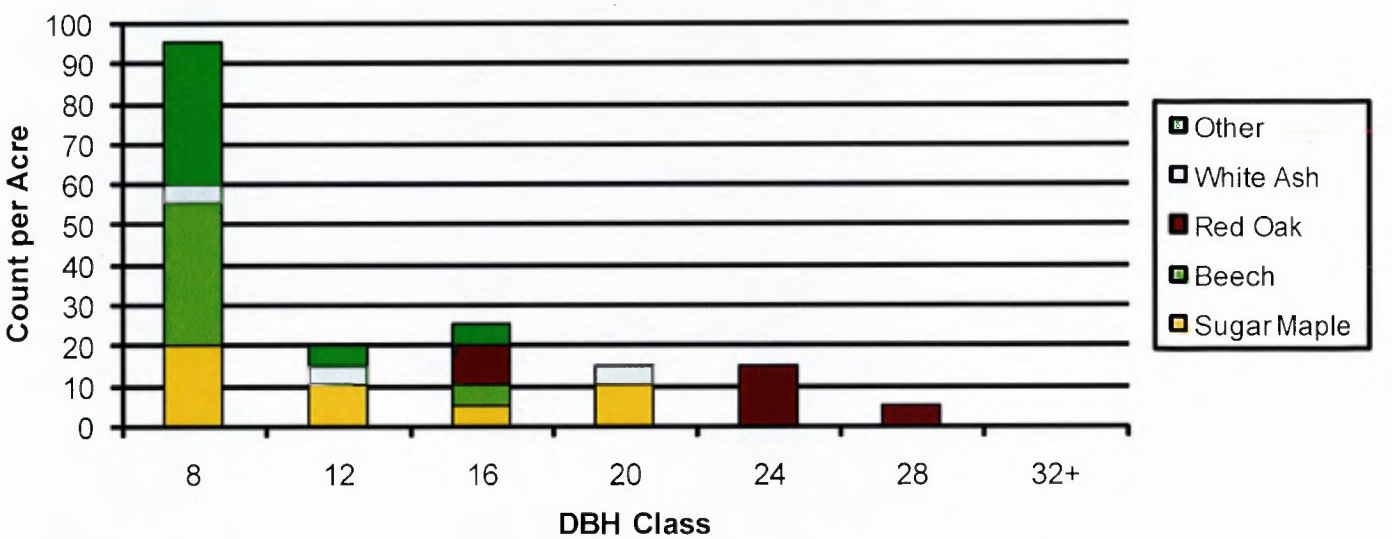


Table 5.11 - Important Stand Values

Stand Number	Stand Area (acres)	Number of Plots	Percent Sampled	Average Tree/ acre	Average Stand Basal Area (ft^2/acre)	Regen-eration Density	H Value (Diver-sity)	J Value (Equita-bility)	Snag Relative Density
11	15.0	4	1.33	175	152	1000	2.20	0.957	0.08

5.3.7 Fitzgerald Meadows

Three distinct areas of vegetation were identified within the Fitzgerald meadows: the wetland near the ice-skating rink, the community gardens, and the fields circumscribed by the Fit Trail.

5.3.7.1 Wetland

Location - The wetland is in the eastern part of the Fitzgerald tract, between the Beecher Road parking lot and the community gardens.

Habitat - This area is a small open wetland. The combination of standing water and direct sunlight provides a unique habitat within the Fitzgerald tract. Cattail is an obligate wetland indicator which thrives in these open pools. Other species are not as well adapted to constant inundation and grow along the edge of the wetland. Dominant species in this area are considered weeds in pastures, orchards, and other agronomic, horticultural, and nursery crops. Many of them are naturally found along roadsides, so they are well-suited to this environment.

Species - There are five dominant plant species in the wetland area: cattail (*Typha latifolia*), goldenrod (*Solidago sp.*), rushes (*Juncus sp.*), switchgrass (*Panicum virgatum*), and New England aster (*Aster novae-angliae*).

Wildlife - Various species of birds and amphibians take refuge in the area.

Invasives - Even though they may be weeds in an agricultural setting, none of the prominent species in this area are considered to be invasive species by the state of Connecticut.

5.3.7.2 Community Gardens

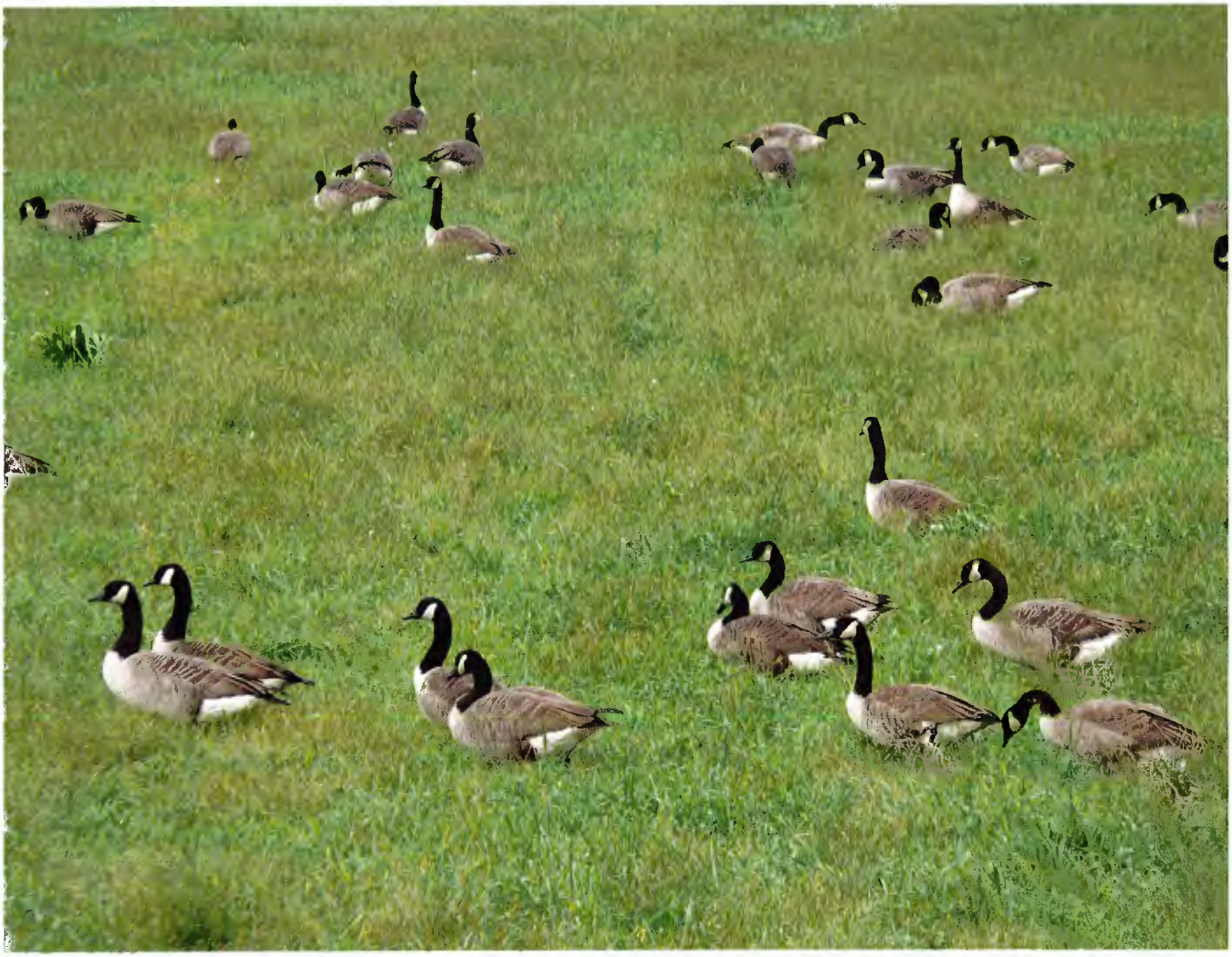
Location - The community gardens lie in the center of the Fitzgerald tract, bordered by forests to the north and south (Stands 10 and 11 respectively) and fields to the east and west.

Habitat - The community gardens are split into individual plots by chain-link fences and are carefully tended by Woodbridge residents. However, just outside the plots, natural borders of various plant species have formed. These plants have also taken over the untended plots.

Species - There are five dominant species surrounding the community gardens: multiflora rose (*Rosa multiflora*), crabapple (*Malus sp.*), goldenrod (*Solidago sp.*), mugwort (*Artemisia vulgaris*), and little bluestem (*Schizachyrium scoparius*). Little bluestem is a dryland indicator species.

Wildlife - Crabapple and multiflora rose both provide food sources for wildlife, especially bird species. The large herbs also provide good cover for birds which were observed in and around the community gardens.

Invasives - Multiflora rose is the only invasive species in this area. It is considered an invasive species and banned noxious weed within the state of Connecticut. Removal of this serious rangeland weed should be considered as the community gardens border multiple larger field and meadow areas.



5.3.7.3 Fields

Location - The open fields extend from the northeastern corner into the center of the Fitzgerald tract. They are bordered by Center Road on the northern edge, Beecher Road on the eastern edge, the firehouse along the northwestern edge, and forests on the remaining sides.

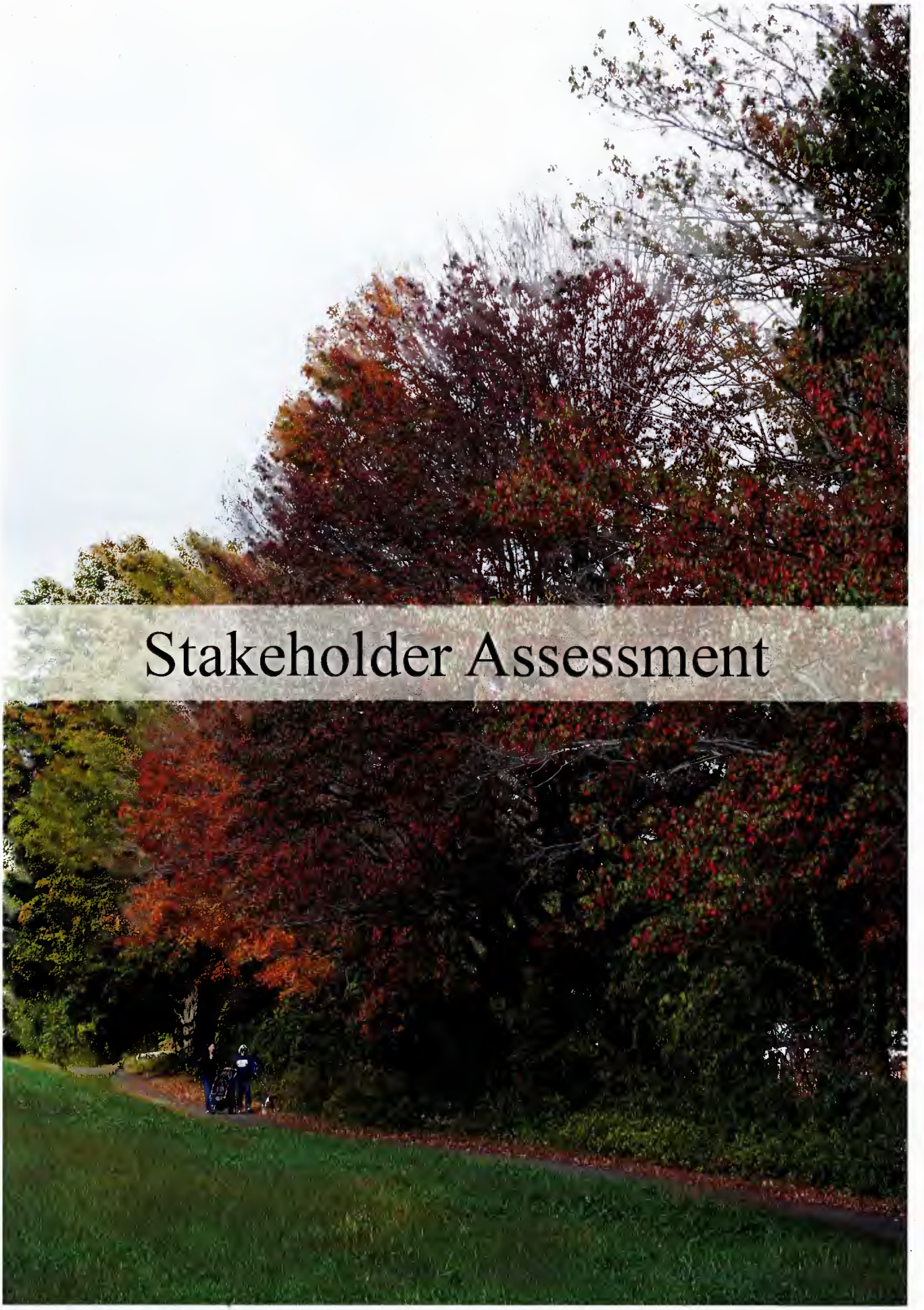
Habitat - The open parts of the meadow receive varying amounts of mowing. While they exhibit a range of species diversity, they are dominated by grass and mugwort.

Species - Timothy grass (*Phleum pretense*) and mugwort (*Artemisia vulgaris*) are two prominent species within the open fields. Timothy grass (*Phleum pratense*) is a perrenial foliage grass cultivated for hay. It has a distinctive flowering spike which releases large amounts of pollen that acts as a common allergen. It generally thrives in nitrogen-rich soil and requires fertilizers if not planted in conjunction with legumes. In order to continue growing Timothy grass for hay production, legumes such as alfalfa could be planted in the fields to boost the nitrogen content in the soil. Fertilizers are another alterantive, but improper application could negatively impact the surrounding forest and water sources.

Mugwort is an aromatic herb and a rhizomatous perennial which makes it difficult to control in perennial crops. In fields of perennial Timothy grass, the underground mugwort rhizomes can persist through the winter and may be difficult to control. This makes mugwort especially difficult to remove by mowing. Although it is not considered an invasive species by the state of Connecticut, mugwort is considered to be a weed of turfgrass, nurseries, and landscapes.

Wildlife - Flocks of migrating Canada geese forage in the fields. Voles were found on the edge of the fields. Meadows host a variety of plant and wildflower species which in turn supports diverse insect communities. Diversifying mowing regimes could provide more habitats for smaller bird species and other mammals and invertebrates.

Invasives - Even though they may be weeds in an agricultural setting, neither of the prominent species in this area are considered to be noxious, invasive species by the state of Connecticut.



Stakeholder Assessment

6.1 Stakeholder Assessment

A stakeholder assessment was conducted to determine the main user groups and the social values regarding the properties. Interviews were conducted with couples, families, groups of friends, and individuals using the properties. Additional interview were conducted with the Conservation Commission and Regional Water Authority. Informal discussions with joggers and hikers using the property also took place throughout the duration of the biophysical assessment. Various themes emerged as concerns or issues of importance to the public.

Stakeholder	Type of Interest	Perspective
Conservation Commission	Environmental	This land should be protected to preserve open space.
Woodbridge Land Trust	Environmental	This land should be protected to preserve open space.
Dog Walkers	Personal	This is where I can bring my dog to exercise.
Fit Trail Users	Personal	This is where I can have a nice outdoor workout.
Gardeners	Personal	This is where I can garden in the company of others.
Families / Social	Personal	This is where my family can enjoy time outdoors together. This is a place where I can meet friends and acquaintances.
Hikers	Personal	This is where I can enjoy nature.
Non-property users	Public	1) The Fitzgerald land is better saved for public works than conservation. 2) I believe they should be preserved as open space.
Water Authority	Economic Environmental	This land can protect the water supply. We would be open to purchasing a watershed easement if offered by the town of Woodbridge.
Local Schools	Educational Recreational	This land has educational value to students. This land is an ideal place for cross-country team workouts and meets.

Table 6.1 - Values of property stakeholders

6.1.1. Conservation Commission

The Conservation Commission is aware that both Alice Newton Street Memorial Park and the Fitzgerald tract serve a variety of users with different interests. They are interested in tailoring the resources the properties offer to serve the needs of diverse user groups. To do this, they must keep in mind the sometimes competing values of conservation and recreation. Different members of the Conservation Commission have a range of ideas about how these property uses are best balanced.

The Conservation Commission highly values the presence of natural habitat in central Woodbridge. They are interested in learning about the specific natural resources found within the town and ways to protect these resources. They value biodiversity and want to learn what impact invasive species are having on the ecosystem. They are also interested in sharing their knowledge of the forest and their joy of nature with others. They would like to improve awareness of the properties in Woodbridge so that more people can take advantage of all they have to offer. They would also like to increase the educational opportunities available on the properties, but they are not yet sure of the best way to do this.

6.1.2. The Woodbridge Land Trust, Inc.

The The Woodbridge Land Trust, Inc. aims to protect the natural resources of the Town of Woodbridge and encourage education and public involvement in conservation. The Trust is interested in the preservation of forested and open land, important water and mineral resources, and other sites of historic value. The Trust works to acquire, protect, and improve such properties. One recent project to improve recreational opportunities mapped town trails. This project was headed by Land Trust Trail Master, Michael Walter. The Trust is also interested in research activities which further its mission of conservation.

6.1.3. Dog Walkers

Dog walking is a popular activity in both the Alice Newton Street Memorial Park and the Fitzgerald tract. The properties are attractive locations for people to spend time outdoors with their pets. Use by dog walkers varies between the properties.

On the Fitzgerald tract, dog walkers primarily frequent the Fit Trail and trails in the meadow area. Prominently posted rules and an abundance of walkers, joggers, and runners along the Fit Trail mean that dog leashing rules are strictly followed. Even when dogs are kept on leashes, there are sometimes conflicts between dog walkers and other

Fit Trail users. One interviewee reported witnessing multiple episodes where leashed dogs attempted to chase or nip at runners, significantly upsetting them. However, for the most part these conflicts are minor and do not escalate into serious disagreements.

In Alice Newton Street Memorial Park, many dog walkers allow their dogs to run off their leashes. Some interviewees reported that leash rules were nearly non-existent in the past, but are now increasingly emphasized. While there is no formal enforcement process, public pressure encourages dog walkers to leash their dogs in the park. Those who once let their dogs run free but now follow leashing rules feel frustrated by the situation. They would like to have a place where their dogs could run around. Dog walkers interviewed expressed interest in creating a dog park in Woodbridge such as those that exist in neighboring communities.

6.1.4. Fit Trail Users

The Fit Trail is located in the northeastern corner of the Fitzgerald tract. People come to the trail to walk, run, and jog. The Fit Trail is a wider, smoother, better maintained trail than many of the forest trails. Fit Trail users choose this trail over the forest trails for a variety of reasons. They prefer the Fit Trail for its convenient location near the parking lot, measured distances, even surface, social benefits, and aesthetic value. Some Fit Trail users never venture onto forest trails, while others prefer a combination of forest trails and Fit Trail.

Some Fit Trail users work out on a tight schedule and prefer the Fit Trail because of its proximity to a convenient parking lot. They choose not to use forest trails because they are perceived as more difficult to access.

Many of the Fit Trail users plan their workout schedules carefully and appreciate the measured distances the Fit Trail offers. These runners, and to a lesser extent walkers, are interested in knowing their exact mileage. This group expressed interest in mileage markers along forest trails. They reported that if they were able to structure a measured workout on forest trails, they would be more likely to venture off the Fit Trail.

Other users choose the Fit Trail because they are concerned about tripping over roots and uneven patches on forest trails. This group included runners and older walkers. Many of the same users who preferred the Fit Trail's smooth paths would like to see the Fit Trail better maintained. Though the gravel trail is for the most part very smooth, there are a few uneven patches as well as segments with poor drainage.

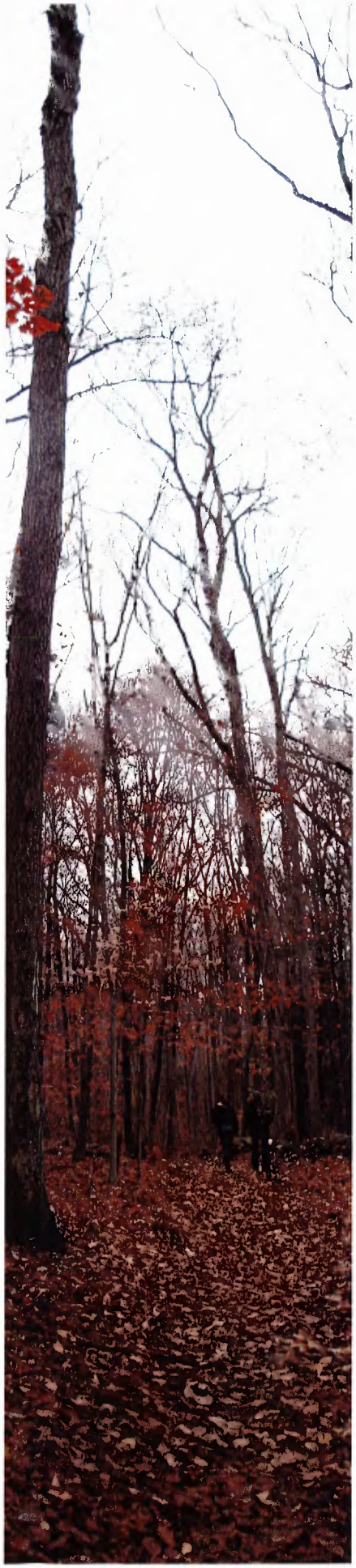
Some Fit Trail users choose the Fit Trail over forest trails because of the large numbers of other users. They enjoy meeting people they would not otherwise see. They enjoy greeting people working in the community gardens. People who come for regular exercise are aware of the schedules and habits of other "regulars" and enjoy the company of others with a shared interest.

A final group prefer the Fit Trail to forest trails because of its openness. They especially enjoy the sunshine in the area as opposed to shaded forest trails. They appreciate the meadow aesthetic but would like to see better maintenance of the areas around the Fit Trail, including the edges of community garden areas.

A final group of Fit Trail users do not use the forest trails because they are either unaware of their existence or unsure of their routes. These people do not know where trail entrances are located. They also worried that they would become lost in the forest. They expressed interest in guided community walks or runs to introduce the main trails. More frequent signs and maps posted within the forest would also help users feel more secure about their whereabouts.

6.1.5. Gardeners

Gardeners are able to rent plots in the community gardens for a small fee. Some choose to work in the community gardens because they do not have space for gardening at their own homes. Others also have gardens at home, but like to come to the community gardens because of positive work atmosphere. They enjoy seeing friends who are working and sharing tips and inspiration with fellow gardeners.



6.1.6. Families & Friends

Many people visit Alice Newton Street Memorial Park and the Fitzgerald tract to see friends and acquaintances or to spend time with their families. The informal setting allows people to say a quick hello or stop for a longer chat. The central location of the properties make them a convenient meeting place. Families enjoy the properties for outings. The whole family can be outdoors together with plenty of space for children to run around. A popular resting spot is the bench on the first bridge along the main Alice Newton Street Memorial Park trail. Many families sit and chat while their children play along the stream. Families also benefit from the aesthetic and educational aspects of the forest. Parents expressed interest in learning more about different habitat types, especially the meadows.They would like to share this information with their children.

6.1.7. Hikers

Hikers describe the Alice Newton Street Memorial Park and Fitzgerald trails as great places to enjoy the outdoors. These hikers love to be surrounded by nature and leave behind the suburbs around them. Some hikers visit on a regular basis while others visit seasonally to enjoy autumn's colorful leaves. Though the properties are most popular in warmer weather, various hikers interviewed reported that they enjoyed the properties most in winter, when the trails are deserted and they can be alone in nature.

6.1.8. Non-Property Users

There are many people in the town of Woodbridge who never visit the properties. There are various reasons for this. Some people felt they were too busy to visit the properties. Others said that they might visit the properties, but had the impression that trail access was difficult. A few people had never heard of the properties. Others had visited them in the past with their families, but were now too old to walk on uneven forest trails. Non-property users have different ideas of what should be done with the properties, specifically the Fitzgerald tract. Some feel that the land should be reserved for public works projects, while others feel that though they do not use the trails directly, the land should be protected as open-space.

6.1.9. Water Authority

The South Central Connecticut Regional Water Authority would like to protect as much land as possible within the watershed for both economic and environmental reasons. A protected watershed leads to more pristine streams and rivers, which in turn produce cleaner drinking water. The Water Authority has an interest in making sure that the Fitzgerald tract is not developed. One way to ensure this would be for the Water Authority to purchase a watershed easement on part of the Fitzgerald tract.

6.1.10. Local Schools

The properties are valuable educational and recreational resources for the Woodbridge school system. Currently, students are involved in monitoring the experimental chestnut orchard each year. School groups can easily visit the properties due to their proximity to school grounds. Educational opportunities for these user groups would be improved if more informative signs and educational plaques existed along forest trails. The high school's cross-country team also uses the forest trail for training during their season.

Management Recommendations

7.1 Rationale

Management recommendations were created with the intent of protecting and enhancing the ecological value of the site and improving the recreational experience of property users. These prescriptions were developed after careful analysis of the Alice Newton Street Memorial Park and Fitzgerald properties. Recommendations are site-specific and should not be generalized to other areas without additional assessment. However, following comparable studies, parallel recommendations could be developed for other open spaces in Woodbridge.

Alice Newton Street Memorial Park (ANSMP) and the Fitzgerald Tract are enclaves of open space located in the heart of Woodbridge. As undeveloped land the properties serve a largely ecological role in the landscape of Woodbridge. In order to preserve the integrity of the land, several ecological prescriptions are recommended. Recommendations are sorted into priority levels based on the need for and ease of immediate action. The highest priority recommendations, managing invasive species and preserving the meadow in ANSMP, will yield immediate results with immediate action. These prescriptions will directly enhance the plant and wildlife communities in both properties while requiring relatively minimal planning and investment. Medium priority recommendations also have important biological goals. However, more extensive preparation is necessary to implement them and the ecological outcomes appeal to the future rather than the present. This class of recommendations includes implementation of a conservation easement on a portion of the Fitzgerald and silvicultural treatments. Finally, low priority recommendations reflect issues that can be managed passively. Low priority recommendations include protecting the wetlands and maintaining a forest resilient to catastrophe.

The other purpose of the properties is to provide the citizens of Woodbridge with an open space for recreation including walking, hiking, and gardening. Thus, the second set of recommendations concerns human use of the properties. High priority recommendations are matters of both legal and safety concern. Again, these priorities can be fixed with immediate action and yield rapid results. They include: filling washed out trails, removing hazardous snags along trail edges, blazing the property boundaries, and establishing a policy on dog-use in the properties. Medium priority recommendations will further enhance the park user experience. These recommendations include making improvements to the fit and forest trails and adding educational signage along the trails. Low priority recommendations are of an aesthetic nature and include planting the firehouse buffer and removing the ice hockey rink.

These recommendations aim to maximize the immediate benefits to the citizens of Woodbridge while preserving the natural community for the enjoyment of future generations. In addition, in their entirety, these recommendations are largely price neutral: some of the recommendations generate money which can be used to fund the others.

7.2 Ecological prescriptions

7.2.1 High priority recommendations

7.2.1.1 Managing invasive species

Invasive species have a reputation for insidiously penetrating ecosystems and destroying native communities (Alvarez and Cushman 2002). Often the knee-jerk response is to remove invasives across the board. However, there are two confounding factors which deserve attention. The first is that not all invasives are equally damaging to communities. In fact, some invasives will actually enhance local diversity and improve wildlife habitat (Strong et al. 2005). The second consideration is the cost and effectiveness of removal. Species may be so entrenched in a community that removal is an intractable problem (Rejmanek and Pitcairn 2002). Informed and calculated control measures will ensure an optimal balance of preserving the native ecology and spending money and effort on control (Westman 1990).

Table 7.1 outlines the costs and benefits of controlling each of the main invasive species present on the property, and our recommendation for each:

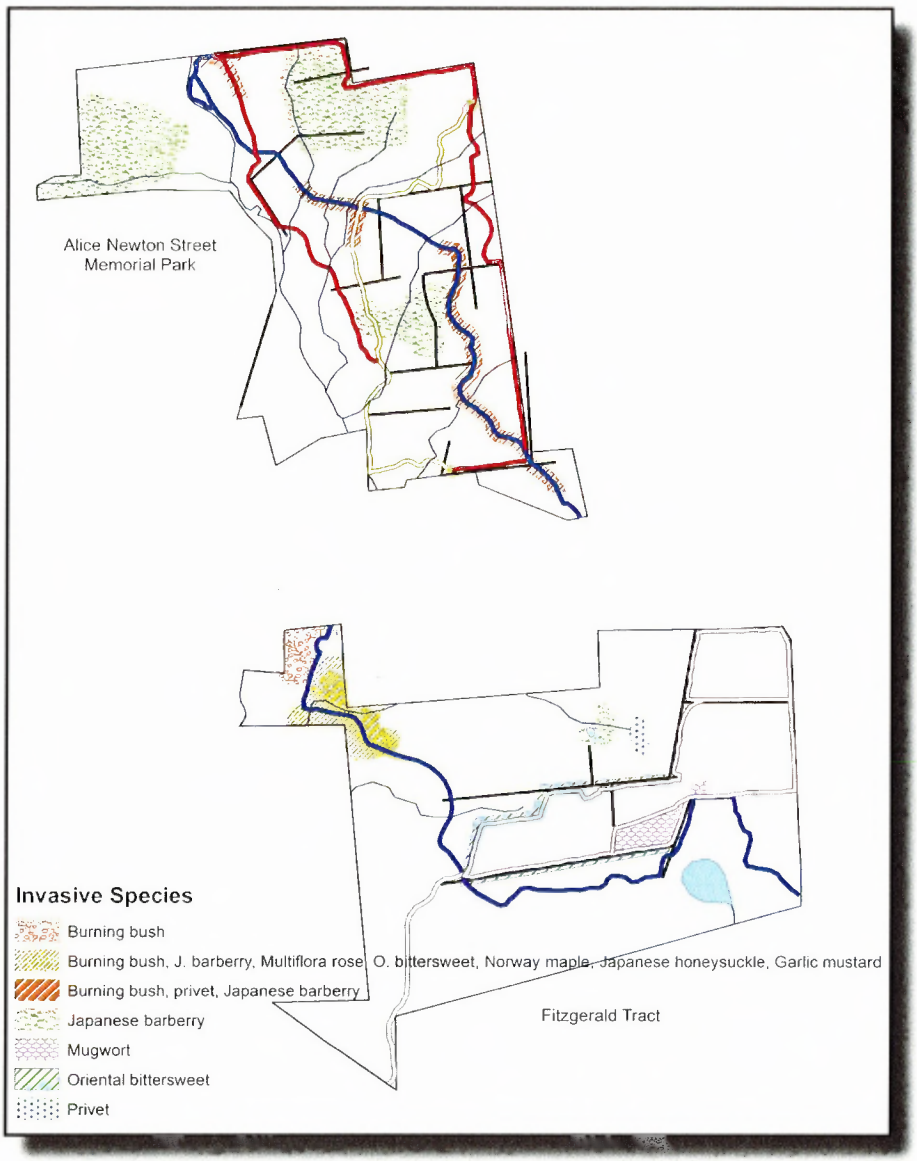
Burning bush: one of many invasive species on the properties

Invasive Species	Presence	Costs	Benefits	Recommendation
Japanese barberry	Occurs extensively in both properties as thick, continuous ground cover and in isolated patches.	Competes with (and may outcompete) native shrubs. Increased soil pH and nitrate concentration creates soil profile amenable to other invasive exotics (Kourtev et al. 1999).	Provides excellent cover for small mammals and ground-nesting birds (Schmidt et al. 2005). Berries are a good food source. Excludes dogs. May increase understory diversity.	Because of its extensive presence and its benefits for wildlife, large patches of barberry should not be removed. However, they should be contained by monitoring boundaries and removing isolated occurrences along trails.
Burning bush	Occurs along the trails in ANSMP and extensively in Stand 7 of the Fitzgerald Tract.	Competes with (and may outcompete) native shrubs.	Berries are a good food source for wildlife into the fall. Adds vertical structure to the understory. Aesthetically pleasing color in the fall.	High removal costs inhibit removal of large patches. To prevent spreading, it should be removed where it occurs in isolation along the trails.
Oriental bittersweet	Occurs along the forest-meadow edge in the Fitzgerald tract.	Aggressive growth can kill host trees by overtopping and girdling (Greenberg et al. 2001).	Provides vertical structure to the canopy which is good habitat for birds. Berries are a good food source for birds (LaFleur 2006).	Should be removed where it occurs in limited quantity internally to the properties. Should be left alone along the meadow edge where it provides good habitat and is unlikely to spread inward.
Pachysandra terminalis	Occurs along property boundaries in ANSMP where it has escaped residential home gardens.	Thick groundcover which excludes other plant species.	Provides habitat for small mammals.	Removal by herbicide application should be considered.
Norway maple	Occurs along trails in ANSMP and the Fitzgerald Tract.	Outcompetes the less hardy, native sugar maple (Martin 1999).	None.	Should be removed by herbicide application to prevent spreading.

Table 7.1 - Cost-benefit analysis of invasive species

There are two main classes of control mechanisms for invasive species: mechanical and chemical. Mechanical methods include cutting, pulling, smothering, and girdling. They result in manual removal of or physical injury to the plant. Chemical methods refer to the application of herbicides, a class of chemicals which interrupts various biochemical functions in plants. They are chemically unrelated to pesticides—and thus not toxic to wildlife in small doses—as the biochemistry of plants differs in many fundamental ways from that of animals.

In general, manual removal is only effective for small areas of herbaceous annuals. For the effective removal of most invasives, herbicides are usually recommended. Three main strategies for herbicide application pertain to the properties, and usually occur in conjunction with a mechanical method. First, oil-based herbicide can be painted onto the cut stump. Second, a water-based herbicide can be used for foliar application. Third, oil-based herbicide can be painted on to the lower stem of thin barked species, such as burning bush. Application of herbicides should be completed by a licensed professional. Several widely used herbicides are described in Table 7.2. For more information, refer to Appendix 6.



Map 7.1 - Invasive Species Locations

Brand Name	Herbicide	Effective against	Mode of Action	Soil half life (days)	LD50 – Birds* (mg/kg)	Cost (per gallon)
Arsenal®	Imazapyr	Annual and perennial grasses, broadleafs, vines, brambles, brush, and trees	Inhibits acetolactate synthase blocking amino acid synthesis	25-141	> 2,150 [low]	$358
TordonK®	Picloram	Annual and perennial broadleaf weeds, vines, and woody plants	Auxin mimic	90	> 2,510 [low]	$107
Velpar®	Hexazinone	Annuals, biennials, perennials	Blocks Photosystem II	90	2,258 [low]	$83
Round-Up®	Glyphosate	Annual and perennial weeds	Inhibits the shikimac acid pathway depleting aromatic amino acids	47	> 4,640 [low]	$141

**The lethal dose at which 50% of birds die.*

Table 7.2 - Herbicides
Details on herbicide options available for managing invasive species

7.2.1.2 Preserving Meadows in the Properties

The small forest opening in ANSMP is a unique area on the property which fulfills specific habitat requirements for a range of wildlife. 139 species of birds, mammals, and reptiles either prefer or utilize shrubland habitat (Tefft 2006). Although the opening is not large enough for some species' home range requirements, the small shrub meadow may provide habitat for some 58 potential species of scrubland-dependent butterflies, the black rat snake, white-footed mouse, and a variety of songbirds (Tefft 2006). In addition it provides foraging opportunities for wandering species such as turkeys, red foxes, porcupine, and white-tailed deer. Maintaining this area as a shrub meadow is important to the diversity of the property.

In addition, the meadow elucidates the historical context of the area and the role of disturbance in succession. Table 7.2 illustrates possible options for management of the meadow area. We recommend annual disturbance (burning or mowing) plus the planting of native species of shrubs. An emphasis on mast-producing shrubs will maximize the wildlife benefits that this habitat can provide. Some native species to consider planting are: common blackberry (*Rubus fructicosus*), flowering dogwood (*Cornus floridiana*), common elderberry (*Sambucus canadensis*), northern bayberry (*Myrica pensylvanica*), fox grape (*Vitis labrusca*), beach plum (*Prunus maritima*), and northern wild raisin (*Viburnum cassinoides*). Many of these plants are available as inexpensive planting stock from the New Hampshire State Forest Nursery (http://www.dred.state.nh.us/nhnursery/). The seedlings may have to be fenced in to protect them from deer during early development until they reach several feet in height.

To prepare for planting, a controlled spring burn would clear the meadow and encourage regeneration of native, fire-adapted species. This would increase the biodiversity of the area and alter the current species composition. It would also improve soil nutrient levels and remove litter, making regeneration easier. Additionally, it would serve as an educational lesson on fire ecology for the community. Following the initial clearing, mowing should occur on a yearly basis. However, not all of the meadow should be mowed every year: strips of the meadow should be rotated along a 3-5 year schedule so that different portions of the meadow have different levels of woody shrubs versus forbs and grasses. Mowing should occur outside of the nesting and brood rearing season for most species (mid-April to mid-August). Most important is simply fighting the encroachment of the forest into the meadow. Unless the edges are constantly maintained succession into woodland is inevitable. More information on maintaining a small forest opening and on mowing is located in Appendix 7.

	No maintenance	**Mowing**	**Burning**	**Planting**
Ecological result	Succession into mature, forested woodland.	Maintenance as either a grass or shrub meadow, depending on the mowing regime, with similar species as currently occur.	Clears shrubs, grasses, and litter in the meadow, improves soil nutrients and increases the native diversity of regenerating species.	Increases the regeneration of native, mast-producing shrubs which are important food sources for wildlife.
Wildlife habitat	Similar habitat to what currently exists in ANSMP.	Creates habitat for species which prefer or utilize early-successional and edge habitat.	Creates habitat for species which prefer or utilize early-successional and edge habitat.	Enhances availability of forage for wildlife.
Educational benefits	None.	Education about the importance of disturbance in succession.	Education on fire ecology.	An introduction to the native shrubs of Connecticut.
Costs	None.	Fees for annual mowing.	Intensive organization and management for the safe and legal implementation of a burn.	Price of purchasing the shrubs. Limited ongoing management required—possible organization of volunteer help.

Table 7.3 - Benefit-Cost Analysis of Meadow Management Options

The Fitzgerald tract has a large grass meadow central to the property. This services a different range of wildlife than the shrub meadow present in ANSMP. Mowing should continue in the area to preserve the area as grass meadow. In addition, the meadow matrix could be increased by adding meadow patches to Stands 6 or 11 of the Fitzgerald. This could occur as a consequence of a patch selection cut (see recommendation 7.2.2.2), but could also be implemented in isolation. It would require clearing a portion of the forest and maintaining the area similarly to the main meadow. It would increase the amount of meadow and edge habitat on the Fitzgerald and encourage movement between meadow patches. Meadow patches should be located relatively close to the main meadow to create a local metapopulation effect (Harrison et al. 1988). In this manner the main meadow would act as a source population for small meadow inclusions in the forest.

7.2.2 Medium priority recommendations

7.2.2.1 Conservation easement on a portion of the Fitzgerald

We recommend that the town reengage in negotiations with the South Central Connecticut Regional Water Authority regarding the implementation of a conservation easement on a portion of the Fitzgerald tract (Stand 9). A conservation easement mediates the sale of development rights owned by the town of Woodbridge to the Water Authority. The town would still own the land, with use restricted to the terms specified in the agreement. The Water Authority offers between $3,000 and $5,000 per acre depending on the quality of the land and its importance to the watershed (determined after site visitation). The terms of the easement denoting specific activities allowed on the site would be negotiated between Woodbridge and the Water Authority to the mutual satisfaction of both parties. The town first talked with the Water Authority in 2001 about an easement on a possible 111 acres. The possibility of an easement was raised again in 2006. However, negotiations on a possible 22-acre easement fell through on the part of Woodbridge in 2007 (see Appendix 8). We contacted the Regional Water Authority which reported that it is still open to an easement should Woodbridge approach them.

This type of easement offers several benefits for the property. First, the money generated by the watershed easement would set up a small endowment for the continued maintenance of the property. Having an independent source of funding for the park would reduce reliance on town monies for park projects and upkeep. Second, the easement would protect a targeted area of the open space in the Fitzgerald tract (Stand 9). This easement would be a first step in protecting the Fitzgerald. Citizen reactions to this limited easement would enable Woodbridge authorities to gauge the desire for and opposition to protecting a larger portion of the Fitzgerald tract. However, because the restrictions would affect only a small part of the property, the public should not be concerned about the loss of public works development potential. As the area which would be included in the watershed conservation easement is a wetlands area, the area is restricted for development regardless. Thus the opportunity cost of protecting the area is very low. Establishing official protection over a wetlands area sets a precedent for respecting ecologically sensitive areas.

7.2.2.2 Patch selection cut

A patch selection cut should be considered in Stands 6 and 11 of the Fitzgerald tract in order to: 1) significantly enhance wildlife habitat, 2) diversify forest structure, and 3) improve forest resilience. A patch selection cut refers to cutting several relatively small and carefully chosen patches across the stands. Each patch would be about as wide as the height of the canopy, which in these stands averages around 100 ft. A conservative cutting cycle might mean harvesting 1/7 of the total stand area every 15 to 20 years. This means that by the time any single patch would be re-harvested it would be over 100 years in age. This is even older than the current stand age (approximately 80 years). This type of schedule also ensures that the cuts would be relatively unobtrusive and would not disrupt the aesthetic of the forest. Cuts would be carefully located in order to promote the regeneration of certain species and to minimize cutting of the large, old trees (M. Ashton, pers. comm.).

Oaks and hickories are particularly difficult to regenerate due to the large numbers of more shade-tolerant competitors, but they have great value to the forest because of their ability to increase species diversity and provide hard mast for consumption by wildlife. Locating patches around seed trees after masting has occurred would aid in the regeneration of those species (see Appendix 9). Additional methods adopted from the shelterwood method of oak regeneration would help the process. This includes midstory removal prior to the cut to increase diffuse light levels during advance seedling growth, followed by a carefully timed full release treatment once the seedlings are at least 3-4 feet tall (Stringer 2005). Patches not located around seed trees would regenerate tulip poplar, black birch, beech, and ash. To prevent beech regeneration from dominating the patch as a result of its ability to clonally sprout,

herbicide could be applied to the cut stumps. This has been successful in controlling beech regeneration in other areas of New England (see Appendix 10).

In addition to increasing the regeneration of hard mast trees, wildlife would benefit in other ways. Stand 6 currently has relatively poor habitat features including a low level of coarse woody debris and a relatively open understory. First, the cut would increase the amount of woody debris on the forest floor which provides shelter for many species. Second, the cut would create a patchy mosaic structure with different types of habitats in patches at different stages of succession. Cutting at the rate specified mimics the dynamics of natural forest disturbance (Seymour et al. 2002). Forest openings would regenerate as grass and forb meadows. Slowly, they would be invaded by woody shrubs and colonizing tree species. These areas would continue to progress through the different stages of forest development from stand initiation, through stem exclusion and understory reinitiation, and finally to old growth (barring any additional disturbance). Early-successional forest has declined drastically in the northeastern US since 1950. Active intervention is required if it is to be maintained (Brooks 2003). This habitat is important for birds (DeGraaf and Yamasaki 2003) and mammals (Fuller and DeStefano 2003). Even some reptiles prefer this habitat (Greenberg 2001). This patch selection treatment would ensure that a proportion of the Fitzgerald is always early-successional forest. Some patches should also be considered for permanent maintenance as grass or shrub meadows to increase the habitat and resource diversity in the stand. These patches should be annexed relatively near existing meadows to promote habitat connectivity.

The forest is currently uniformly aged. Patch selection would at first generate even-aged inclusions. But over time the forest would become a mosaic of different aged patches. This diversification of the age structure is importance for forest resilience. Old, canopy trees are more likely to blow down than younger, subcanopy trees. A forest with a greater proportion of younger trees is better able to recover from catastrophe.

A professional forester would be employed to manage the cut. The forester would examine the land, mark the trees to be cut, and be responsible for the sale of the timber. The cut would typically either be sent out to bid and given to whomever offers the most money, or offered to a single logging company with whom the value of the stumpage is negotiated. The latter method ensures that a reliable logging company performs a high quality cut. The forester would be paid a percentage commission on the sale of the cut. We estimate that Stands 6 and 11 are worth about $20,000 in stumpage per cut. This money could form an endowment for the parks, and be used to fund some of the other prescriptions. The contact information for reliable foresters is included in Appendix 11.

Implementation of this recommendation would result in several beneficial secondary effects. First, there is the possibility of a community fuelwood program. Following the cut, remaining coarse woody debris could be made available to the citizens of Woodbridge as fuelwood for a fee. This would supplement the park endowment and generate goodwill in the surrounding community. Second, the skid trail that the logging operation would create in order to remove the timber provides an opportunity to add to the existing trail system. It could be looped between patches and used as a hiking or jogging trail in the years between cuts. Third, as previously discussed, the patches allow for increasing the meadow matrix in the stand if so desired. The log landing, in particular, could be maintained as wildflower meadow. This is the area where timber would be collected and loaded onto trucks. In the agreement with the logger, the town ccould stipulate removal of rocks and other waste. Upon leaving, the logger could backblade the area with the skidder (Wilson 2006). This would prepare the area for seeding. A mixture of seeds containing 17 perennial natives of the northeast can be purchased from American Meadows, Inc. (www.americanmeadows.com) for ease of planting. This includes, for example, species such as eastern red columbine (*Aquilegia canadensis*), butterfly weed (*Asclepias tuberosa*), and black-eyed susan (*Rudbeckia hirta*). Other species can also be purchased separately. Picnic tables could be placed here so that park users would have a beautiful place to enjoy lunch in the sunshine. The wildflower meadow would have to be mowed annually in the fall.

Although the public may initially be uncomfortable with the idea of the cut, there is no reason for their apprehension. The trails in these stands are not used extensively by hikers and so operations should not interfere with recreation significantly. In fact, after the cut, recreation opportunities will actually increase. The scale of the cut is quite conservative and will not damage the aesthetic of the stand. Neither should the cut cause any problems for nearby landowners. The first cut can be considered as a trial and future cuts can be considered in light of public reaction. The town of Guilford has been conducting active silvicultural* prescriptions on town land for over twenty years to the benefit of citizens and wildlife alike. This treatment would be a first step towards establishing a tradition of active forest management in Woodbridge.

* *Silviculture is a branch of forestry dealing with the development and care of trees and forests.*

7.2.3 Low priority recommendations

7.2.3.1 Protection of the wetlands

The wetlands are currently passively protected in ANSMP as the area as a whole is protected and trails do not disturb wetland areas. This level of protection should continue. The wetlands in the Fitzgerald tract, on the other hand, are not entirely protected. Pursuing a watershed easement would protect the majority of the Fitzgerald wetlands. Additionally, some of the trails in the Fitzgerald pass through swampy areas. These trails might be re-routed to avoid the wettest areas. Protection of wetlands habitat is intimately linked to protection of the entire parcel of forest. Many species rely on dry woodlands for parts of their lifecycle and require buffer zones of up to 300 meters (Semlitsch and Bodie 2003). However, buffers up to 1000 meters can continue to positively influence species richness (Herrmann et al. 2005). Thus, all protected area helps to preserve intact wetland communities.

7.2.3.2 Maintaining a forest resilient to catastrophe

The 1938 hurricane devastated Connecticut forests. As the region is due for another catastrophic weather event, the town of Woodbridge should have an idea of how its open space will respond to the situation. The biggest impact of a hurricane is blowdown of canopy trees in a forest, leaving timber and detritus on the ground and a greatly thinned canopy. The subcanopy, receiving full light, rapidly grows into the canopy. In the properties examined, this would likely accelerate the conversion of the forest into a beech and sugar maple mosaic. The patch selection cut recommended in the Fitzgerald would increase the diversity of age structure in the forest improving its resilience to such a catastrophe. Beyond this there is little to be actively done. The town should simply be aware of the possibility of such a disaster and know about the ecological and economic costs and benefits of salvage (Lindenmayer et al. 2004).

7.3 User group prescriptions

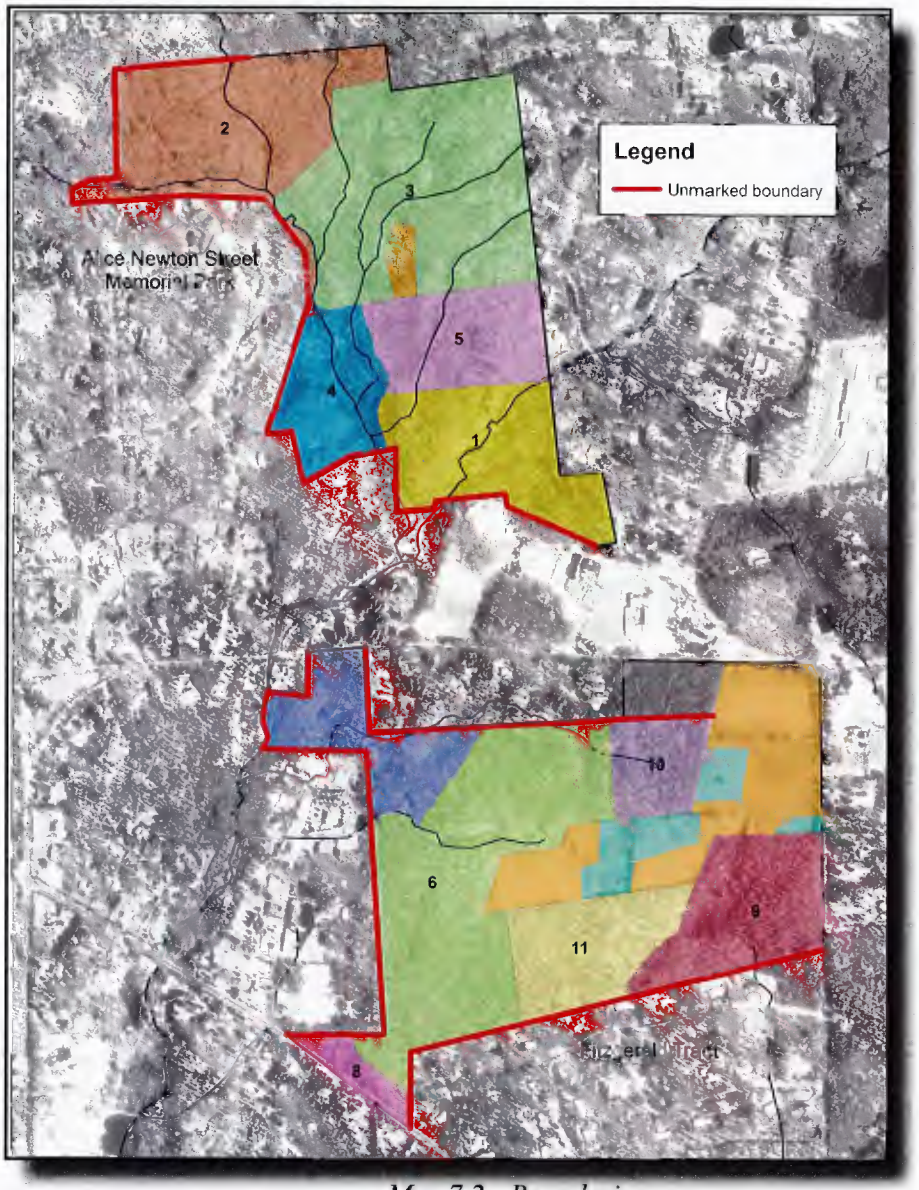
7.3.1 High priority recommendations

7.3.1.1 Maintenance of the forest trails

Although the forest trails are largely in good condition, some of the trails require improvements to ensure a safe experience for users. First, washed-out trails along drainage routes need to be filled and modified to direct runoff away from the trails. This may include adding water bars to divert the flow of water off of the trail, where soil is compacted, and into the loose soils of the forest which have greater capacity for water absorption. Boardwalks may be necessary in wetter areas to prevent soil compaction and improve recreation for users. Second, hazardous snags should be removed along trail edges. Trails which are not safely maintained should be eliminated from the trail map. Map 7.3 denotes which portions of the trails need immediate maintenance.

7.3.1.2 Blazing of the property boundaries

The boundaries of ANSMP and the Fitzgerald are currently very poorly marked. In order to delineate town property and prevent encroachment such as dumping by residential neighbors the boundaries should be clearly blazed. This has important legal implications. Blazes should be professionally marked by a surveyor. Map 7.2 denotes unmarked boundaries.



Map 7.2 - Boundaries
Red lines denote boundaries which should be marked to prevent encroachment onto the properties

7.3.1.3 Establishing a policy on dog use

Currently, policy in both of the parks states that dogs must be leashed at all times. Along the Fitzgerald Fit Trail, this policy is largely adhered to, but the majority of forest trail users do not leash their dogs. This creates two problems: First, unleashed dogs, if not properly trained and obedient to voice control, may pose a threat to other park users (Bernardo et al. 2000). Second, unleashed dogs which stray off of the trails disturb wildlife. This includes chasing the animals, causing physical injury, flushing birds, disturbing nesting sites, altering behavior to increase vigilance and reduce foraging opportunities, and introducing disease (Burger 1986, Sime 1999, Fernandez-Juricic and Telleria 2000, and Shine and Koenig 2000). Table 7.4 outlines possible ways to address this problem:

	Enforcement of leash laws	**No leash laws**	**Seasonal leash laws (leashed May – August)**	**Dog park**
Risk to park users	Low risk.	High risk.	High risk during off-leash season, least risk during on-leash season.	Low risk to other park users, some risk to dog walkers inside of the dog park.
Risk to wildlife	Low risk.	High risk to ground-nesting birds and mammals, and breeding amphibians.	Minimal risk to breeding wildlife, but disturbance to populations during less sensitive times of the year.	Low risk.
Cost of enforcement	High costs of implementation (no mechanisms currently exist).	None.	High costs of implementation (no mechanisms currently exist), but fewer months per year where enforcement is required.	High installation cost but low long-term maintenance.
Cost to dog walkers	No legal way to exercise dogs off-leash.	None.	No legal way to exercise dogs off-leash during a few months of the year, no cost during the remainder of the year.	None.

Table 7.4 - Benefit-Cost Analysis of Dog Use Policies

We suggest creating a dog park in Woodbridge. The Fitzgerald tract, with its unused meadows below the community gardens and established status as an outdoor social hub, is one possible location. However, other properties in town may be equally or better suited for this project. We predict that a dog park would be used extensively as a large number of dog walkers currently use the properties. Currently, citizens of Woodbridge travel to dog parks in nearby towns to use their facilities. We feel that this clear demand justifies the initial investment to build the park. Two of our recommendations generate money for the park. These funds could be used to pay for the construction of the dog park.

Proper education of the public as to the importance of leash laws is another means of mediating the situation. Often park users do not have a clear understanding as to why they are being told to leash their pets. A simple but focused sign explaining the impacts of dogs on wildlife could be posted next to all the signs which stipulate leash use. If dog walkers have a legal option for exercising their dogs off-leash, and they are informed as to the motivation behind leash laws (protecting wildlife and park users), then leash laws on the properties are more likely to be obeyed voluntarily. This decreases the need for the strict enforcement of leash laws while still garnering most of the benefits.

7.3.2 Medium priority recommendations

7.3.2.1 Educational signage along forest trails

Currently, there is very little educational material in the properties. Signage is limited to a few species labels attached to trees in ANSMP—and these labels are not correct in some instances. Several initiatives could be taken to improve the educational opportunities in the properties (for more information, refer to Appendix 10).

1. Signage educating the public about the main invasive species present in the properties. These signs can present the historical context of invasive species introduction and their current value to the property. These signs should challenge popular perceptions of invasive species as foreign intruders requiring eradication. For example, a sign could inform the public that Japanese barberry was planted around homesteads at the turn of the century for ornamental purposes and today provides thick cover for ground nesting birds and small mammals. In fact, its berries are an excellent food source. Invasive species signs could be clustered along a single themed trail.

2. Signage educating the public about ticks located at the forest entrances. Potential park users expressed concern about using the forest trails because of the presence of ticks. Signs informing the public about the myths and realities of ticks in Connecticut would alleviate undue fear of the forest and encourage more people to utilize the forest trails.

3. Correcting the labels on the trees and adding more species. A single, heavily-used trail would be a good location for concentrating species identification.

4. Adding a sign to the front of the experimental chestnut orchard. The experimental orchard is an interesting research project; however, its purpose is not readily visible to the public and thus may be perceived as a blight on the landscape or a misuse of space. A sign informing the public as to the purpose and goals of the orchard would help the orchard gain acceptance. The sign could be designed by the students at Beecher Road School who have been involved in activities at the orchard in the past.

5. Signage explaining succession and the historical context of old-field meadows. The old-field meadow in ANSMP is a prime candidate for a sign explaining succession and the role of disturbance in some habitat types. Currently, some members of the public are confused as to why mowing is occurring in a "natural" ecosystem.

6. Maintenance of old field cedars and explanation. The old-field cedar glades present on the Fitzgerald Tract and ANSMP are a unique feature of the properties which elucidate the historical context of the site and increase site diversity. Although old-field cedar cannot regenerate in forested areas, the currently overtopped cedars present on the property can be encouraged to grow by girdling nearby trees, thereby allowing the cedars to receive sunlight. Signage can explain the interest of eastern red cedar to park users. In particular, a trail from the rear of the firehouse connecting east to the fit trail would pass through and highlight the cedar glade while also providing direct access to the firehouse. The trail could also be extended westward into a larger loop through stands 10 and 6 if citizens are interested in additional trails.

7. Signage explaining the purpose of the patch selection cut, if implemented. If the purpose and ecological value of the patch selection cut is not explained to the public, people will likely be confused and angry. Proper public relations will ensure that citizens do not react negatively to the cut.

7.3.2.2 Infrastructure improvements to the Fit Trail and forest trails

There are several infrastructure improvements to the trails which could enhance the user experience. While none are strictly necessary, they each have benefits for park users. These could be implemented as funding allows. First, the Fit Trail could benefit from resurfacing, the addition of small lampposts around the perimeter, and the elimination of cars. These options are presented in table 7.5:

	Status quo (Mostly gravel)	**Mulching the Fit Trail**	**Paving the Fit Trail**	**Adding small lights to the Fit Trail**	**Prohibiting cars from driving on the Fit Trail**
Benefits	Compromise substrate for avoiding impact injuries. Improved drainage.	Best substrate for avoiding impact injuries.	ADA accessible; even surface for senior citizens; least expensive long-term maintenance.	Allows park users to continue using the trail during the fall and the winter months.	Prevents degradation of the trail due to motor vehicles and makes the trail safer for walkers.
Costs	Ongoing maintenance cost of top-dressing every two years. Damage to environment caused by gravel erosion.	Annual top-dressing required; cheaper per square foot than gravel.	High initial investment; worst substrate for runners in terms of impact injuries.	Initial installation cost and long-term maintenance fees. Minimal light pollution, although any lights installed must be sensitive to the rural surroundings.	Gardeners will have to use wheelbarrows to transport materials from their car to their plot.

Table 7.5 - Benefit-Cost Analysis of Infrastructure Improvements

Along the forest trails, increased signage at major trail intersections, including a map of the park and trail distances, would improve the experience for those unfamiliar with trails. Runners indicated a desire to know the length of their workout and thus avoid working out on the forest trails where there is no way to monitor distance travelled. Presenting distances is a simple way to increase use of the properties. A second potential improvement is to construct an extension of the Fit Trail into the forest to introduce Fit Trail users to the forest trails in an easy and non-threatening manner. This trail would be contiguous with the current fit trail, well-maintained, and marked. Additionally, it would be designed to meet standards for accessible recreation trails such that disabled or older members of the community would be able to enjoy the forested areas of the park (see Appendix 13).

7.3.3 Low priority recommendations

7.3.3.1 Planting in the firehouse buffer

The firehouse buffer was extensively cut during the construction of the firehouse. To reduce the visual impact of the fire house and improve the aesthetics of the Fit Trail the buffer should be replanted. A coniferous species such as Norway spruce or white pine should be used to ensure a visual buffer year round.

7.3.3.2 Removing the ice hockey rink

The ice hockey rink is unused for recreation and currently serves no purpose. Pools of water which may collect during the summer months serve as breeding grounds for mosquitoes. The rink can be removed for aesthetic purposes, and the area potentially can be converted into additional parking for the Fitzgerald tract. The current lot often fills during periods of high demand. Expansion should not, however, encroach on the adjacent wetland area. Nevertheless, the rink is not actively detracting from the Fitzgerald tract, and money should not be spent on this project until, at a minimum, all the improvements relevant to user safety have been completed.

7.4 Checklist of Property Improvements

7.4.1. Invasive Checklist

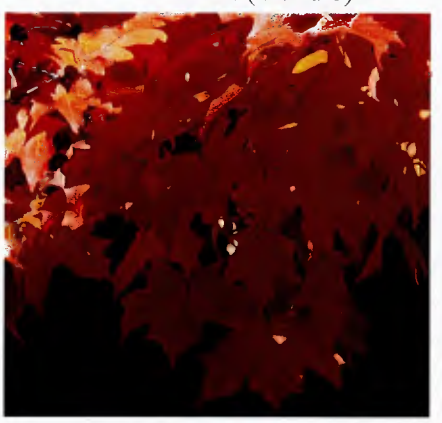
• Invasive burning bush, barberry and/or privet is found in disturbed areas along trails. While invasives may not currently be a major problem in the interior of this stand, invasives may spread if not controlled. Removal is highly recommended. (Stands 1, 2, 3)

• Invasive Norway maples are present, especially along trails and will spread if not removed. Cut and apply herbicide to the stumps for most effective removal. (Stands 1, 7, 10)

• Along boundaries with private residences multiple garden species such as *pachysandra* form large creeping invasive mats on the forest floor. Removal should be considered. (Stands 3, 5, 6)

• Invasives are abundant in this stand. Barberry, burning bush and/or privet dominate the understory. Barberry provides valuable habitat and need not be removed. However, burning bush does not provide the same ground cover benefits. Removal should be considered, weighing both the costs and benefits of clearing such a large area. Containment in these areas is probably the best compromise. (Stand 7, 10)

• Removal of invasive multiflora rose and poison ivy should be considered, weighing both the costs and benefits of removal. (Stand 8)



7.4.2. Trail Maintenance Checklist

• There are no trails providing access to this area. In one region, blazes may indicate an abandoned trail. However, opening access to the area may not be advisable. The area is high quality wildlife habitat, and trails along the steep slope will be difficult to maintain due to erosion and washout. This area may be better left untouched. (Stand 2)

• Improve property access in the southwest corner of the property. (Stands 6, 8)

• There is significant erosion along the trail leading up the hill toward the meadow. Improved drainage options should be considered to reduce trail erosion. (Stand 6)

• Trails have extremely wet and muddy patches. In some of these patches, remains of boardwalks are present but have sunken into the swampy areas. Rocks now serve as stepping stones. However, they are wet, slippery and covered in moss, making it easy to slip and be injured. Boardwalk repairs, new boardwalks or improved drainage should be considered along these trail segments to reduce safety hazards along the trail. (Stand 6)

• If looking for a place to expand the trail network, this stand has a very open understory, making it ideal for trail placement. (Stand 6)

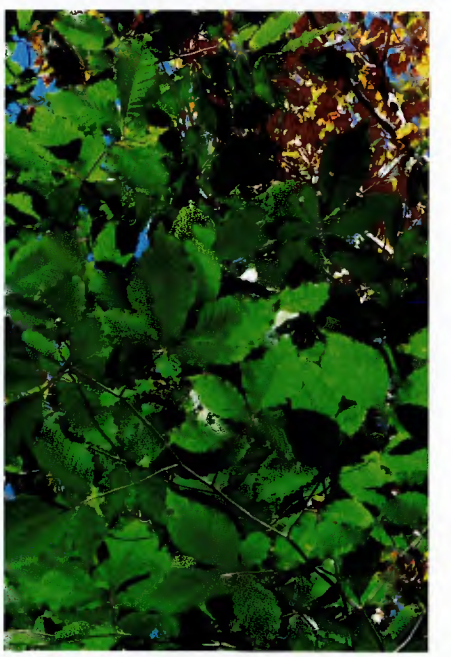
• Northern access from the main road should be publicized and more noticeably marked to increase awareness about the forest trails. Many people do not use the trails because they believe there is a lack of convenient access locations. Where these locations already exist they should be better advertised to increase awareness in the Woodbridge population. (Stand 7)

• Trail access should be improved. (Stand 8)

7.4.3. Boundaries Checklist

• Part/all of the stand boundaries are currently poorly marked. They should be clearly delineated. (Stands 2, 4, 6, 7, 8, 9, 11)

• Encroachment from neighboring houses such as debris and lawn infringement should be addressed when boundaries have been clearly marked. (Stand 2, 4, 6, 7, 11)



7.4.4. Important Ecosystem Checklist

• This stand contains wetlands which should be protected. (Stands 7, 8, 9, 11)

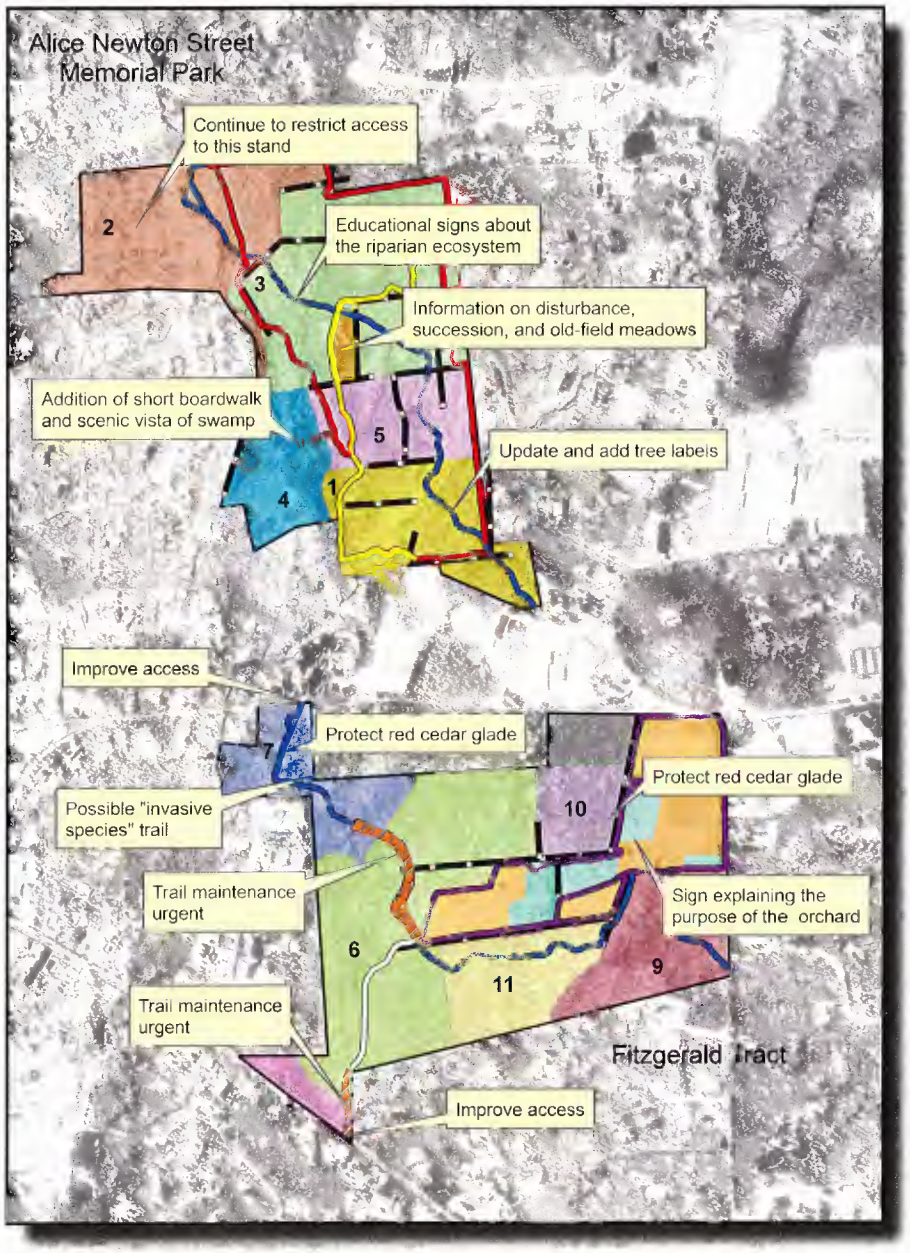
• This stand contains riparian corridors with high species diversity and should be protected. (Stands 3, 6, 7, 11)

• This stand contains vernal pools which should be protected. (Stands 7, 9)

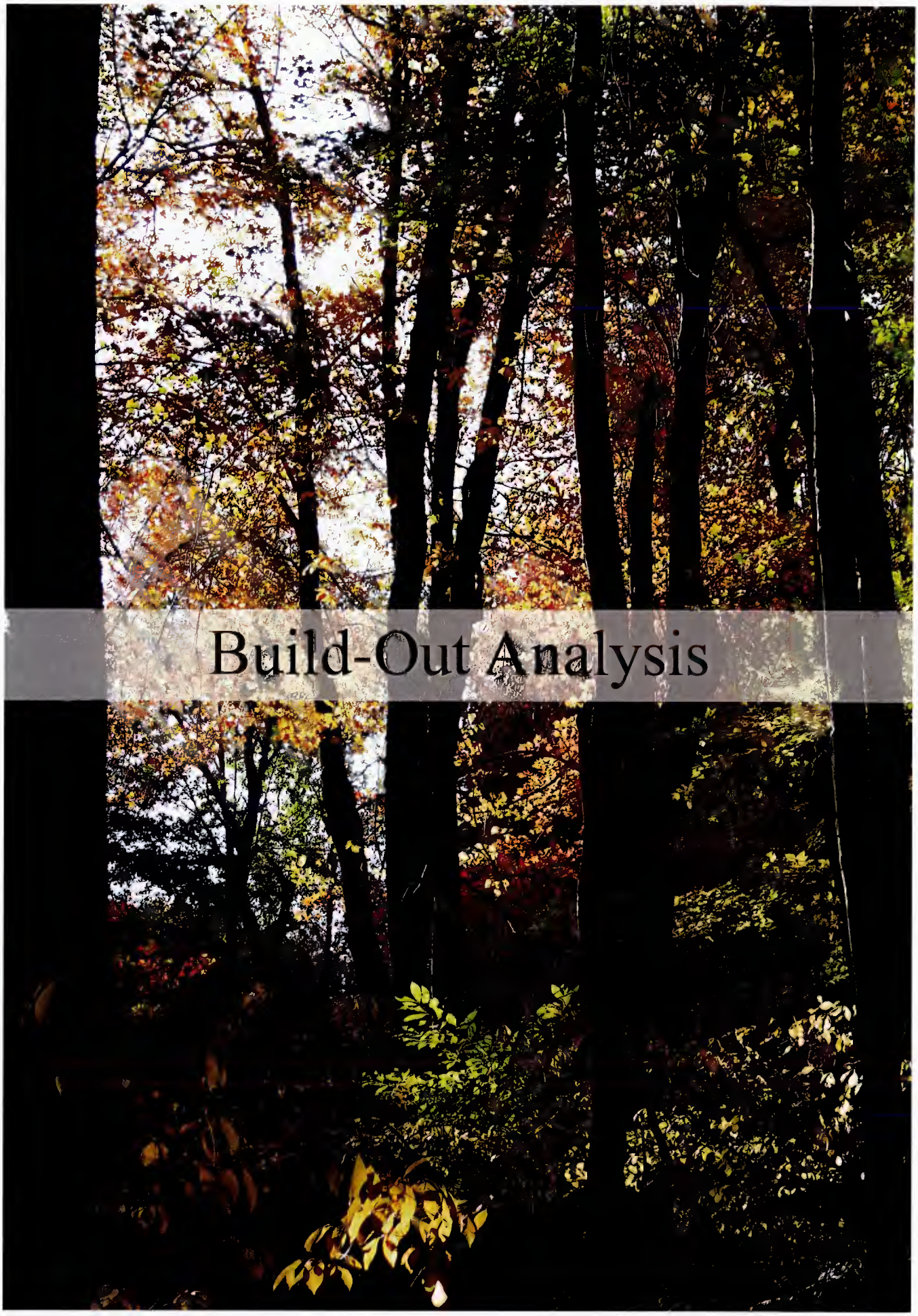
• This stand has very few snags. Fallen trees should be left in place as wildlife habitat and should not be removed as fuelwood by neighbors. (Stand 3)

• In the central eastern part of the stand, there are many old field red cedars which are dying or dead. These are not a hazard to hikers and should be left in place as wildlife habitat. Many stumps provide significant evidence of cutting the cedar wood, though this might have been more of a problem in the past. Wood extraction on town property is not allowed and needs to be stopped. If the community has a high demand for wood, a community fuelwood program could be started. (Stand 10)

• A patch selection cut would significantly improve forest structure and wildlife habitat (Stands 6, 11)



Map 7.3 - Trail Recommendations
This map highlights important maintenance and education suggestions



Build-Out Analysis

8.1. Rationale

The purpose of this section is to place the Alice Newton Street Memorial Park and Fitzgerald tract properties in the larger context of the town of Woodbridge. It will superficially assess the natural resources present in Woodbridge and examine the town's open space network. This chapter is divided into two main sections, a map atlas and an analysis of the town's greenway.

8.2. Open Space Analysis

8.2.1. Background and Status Quo

One of the biggest threats facing wildlife today is the fragmentation of the landscape at the hands of suburban sprawl. As development creeps across the landscape habitat is parsed into increasingly small pieces. Isolation of an area and changes in microclimate (such as radiation, wind, and the hydrological cycle) drastically alter the biological communities which a fragment can support (Saunders et al. 1991). One way to combat fragmentation is by implementing a town greenway system.

One inclusive definition of a greenway is, "networks of land containing linear elements that are planned, designed and managed for multiple purposes including ecological, recreational, cultural, aesthetic, or other purposes compatible with the concept of sustainable land use" (Ahern 1995). This definition points to two key factors in the success of a greenway: 1) improving connectivity with a network of corridors and nodes, and 2) promoting sustainable land use in a variety of contexts.

Corridors have long been debated as a solution to the problem of connectivity. While individual parcels of land may not be able to sustain a population indefinitely, several connected parcels may be able to support a viable and lasting population. Ideally, corridors allow species to migrate between patches, facilitating optimal dispersal and increasing available resources. The benefits of connectivity are deeply rooted in island biogeography theory and metapopulation theory. Critics attack the efficacy of corridors, maintaining that the species they are intended for may not use them, while invasive species, fires, and disease may spread more quickly (Simberloff and Cox 1987). However, the bulk of the evidence lies in support for corridors as a conservation tool (Beier and Noss 1998).

As Ahern's definition suggests, deciding which parcels of land to include in the greenway can be based on several criteria, including both biological and social factors. In order to maximize the impact of the greenway, however, the parcels included should ideally reflect sensitive areas, either in terms of their ecology (biodiversity and water resources) or historic and cultural values.

Woodbridge has already adopted a town Open Space Plan, which aims to preserve and extend the state-recognized Woodbridge Greenway. Indeed, the objectives of the plan include protecting water resources, creating corridors to provide linkage, protecting critical and threatened species and habitats, and preserving historic sites and sites with recreational opportunity (Woodbridge 2005). These goals align closely with the objectives inherent in Ahern's definition and are to be commended. The properties forming the existing Greenway are illustrated in Map 8.1. Main Greenway nodes include the Elderslie Preserve, Alice Newton Street Memorial Park, the Fitzgerald Tract, and Water Authority land. The beginning of network corridors can also be observed. Currently, the Open Space Plan lists a number of properties "worthy of preservation" but without any type of prioritization. The list of these properties is included in Appendix 14.

8.2.2. Recommendations

Our aim is to provide more structure to the strategy for land acquisition by endorsing certain priorities. Thus we used three criteria to evaluate the greenway system.

1. The largest nodes should be connected. This is the most efficient way to generate more contiguous habitat for wildlife.

2. Riparian corridors are highly valuable. Corridors along rivers and streams are attractive to wildlife for travel because of the resources they provide. In addition, they provide important buffering effects for water resources such as erosion prevention and filtration.

3. Large parcels are better than small parcels. In general, purchasing large parcels will be more efficient that purchasing small parcels.

Ultimately, an ideal Greenway network should appear approximately like Map 8.2. In reality, many of the properties needed to complete these connections may not be for sale, now or ever. In these instances, Woodbridge can consider purchasing conservation easements on privately owned lands, especially along riparian corridors. This allows Woodbridge to buy the development rights on a property without acquiring the land itself. Also, the town should consider enforcing existing wetlands regulations to protect riparian edges (Inlands Wetlands and Watercourse Regulations, located in the Town Hall). Enforcing the current regulations may enhance riparian corridors at a reduced cost.

Fully connecting the existing wildlife and riparian corridors delineated in the ideal Greenway network should be a long term goal for Woodbridge. As the town moves in this direction, it will need to prioritize the acquisition of properties and easements. Below are recommendations for systematic expansion of the Woodbridge Greenway network.

8.2.2.1 High Priority

Woodridge should focus on increasing connectivity in Corridor 1 (Map 8.2). Corridor 1 has the potential to fully connect many large nodes, uniting Water Authority lands, the Elderslie Preserve, Alice Newton Street Memorial Park and the Fitzgerald tract. Additionally, the axis linking these properties aligns with an important riparian corridor bisecting Woodbridge. Existing connectivity along this corridor is high. Thus, cementing connections within Corridor 1 should be a priority. For example, fully uniting Alice Newton Street Memorial Park and the Elderslie Preserve would have enormous benefits for wildlife, allowing unrestricted passage along the riparian corridor joining these two large open space areas. Additionally, there is high potential to expand Corridor 1 north of the Elderslie Preserve into the Bladens River watershed. This northern area is largely forested, with many wetlands and watercourses, lending the area high conservation value. The adjacency of this area to waterways and other protected lands would allow this area to serve as a meaningful extension to Corridor 1. Strengthening existing connections between the Elderslie Preserve and Alice Newton Street Memorial Park, and extending the corridor northward will add high conservation value while requiring the acquisition of relatively few properties. For this reason Corridor 1 is highest priority.

8.2.2.2 Medium Priority

A network of streams connects Water Authority land in the northeast to Alice Newton Street Memorial Park and the Fitzgerald Tract in central Woodbridge. Further south, waterways lead to Water Authority land in southwest Woodbridge. Along this riparian corridor are many wetlands ecosystems such as swamps and marshes, which offer attractive habitat for many species. Currently, there is very little protected or public open space land along this critical riparian corridor (Corridor 2, Map 8.2). The Town of Woodbridge should have the long term goal of fully connecting Corridor 2 with protected open spaces. Although fully uniting Corridor 2 will be a difficult task due to its current fragmented state, when complete, this corridor will serve as the heart of the Woodbridge Greenway. Various strategies for increasing connectivity along Corridor 2 are listed below.

1. Purchase of Properties – Large undeveloped properties within or adjacent to Corridor 2 should be considered for purchase. Various properties currently under consideration by the town lie within this corridor. These properties include 424 Amity Road, 902 Baldwin Road, 145 Beecher Road, 1156 Racebrook Road, 1130 Racebrook Road, and 25 Northrop Road, and are shaded in yellow on Map 8.2.

2. Purchase of Conservation Easements – The majority of properties along Corridor 2 are privately owned, and many of these landowners may be unwilling to sell their property to the town. Or, in the case of residential lots, properties may not be appropriate for purchase as protected open space. While residential properties may be partially developed and not suitable for purchase, land directly adjacent to the waterway still has very high conservation value. In such situations, the town of Woodbridge should consider the purchase of conservation easements to ensure ecosystem protection and maintain the connectivity of Corridor 2 throughout residential areas.

3. Encourage Voluntary Participation in the Greenway Program – In addition to the purchase of critical properties and conservation easements, the town of Woodbridge should pursue other means of protecting land along Corridor 2 waterways. The town could run a campaign to encourage citizens to voluntarily protect land along streams. For example, land owners could voluntarily pledge to leave a buffer zone undeveloped. Unlike the purchase of an easement, this agreement would not be legally binding. However, it would still have both important conservation and social value. If landowners recognize the ecological importance of riparian corridors, they will be more likely to participate in the Greenway Program and to take responsibility for protecting ecosystems on their own properties. Promotion of such ecological stewardship is a long term investment in the health of Woodbridge's natural resources. Properly implemented, such programs could allow citizens to create their own personal "easements." This is a cost effective conservation model that encourages citizen participation, education and community pride.

4. Enforcement of Existing Regulations – Many regulations are already in place to protect swamp and wetlands areas. To maximize the area protected in Corridor 2, the town of Woodbridge should take steps to ensure that inland wetland regulations are enforced on both private and public properties. Many towns have weak enforcement of such regulations. Placing increased emphasis on existing land use codes (Inlands Wetlands and Watercourse Regulations, available in Town Hall) may be a way to increase the protected area in Corridor 2.

8.2.2.3 Low Priority

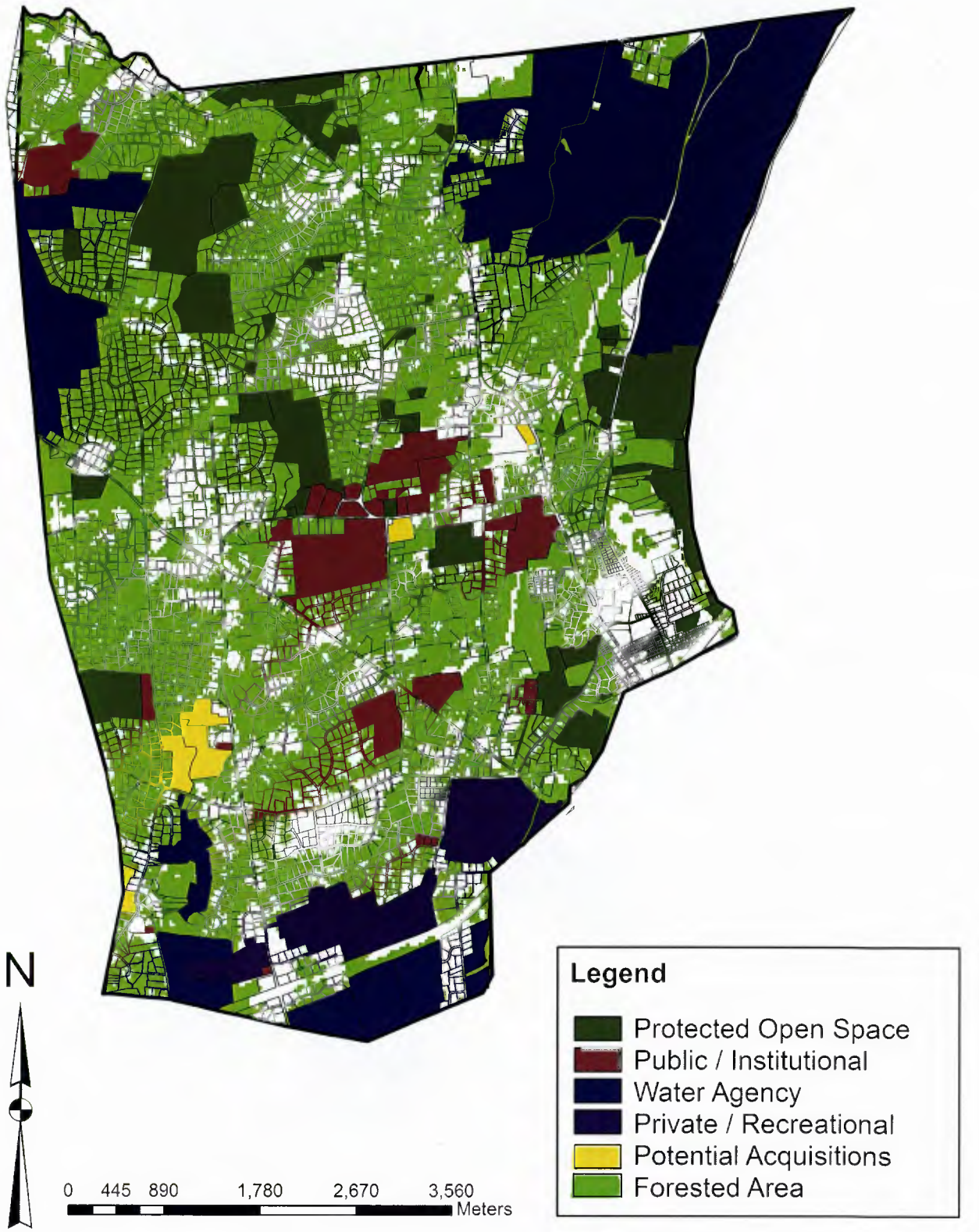
In general, Woodbridge should aim to increase connectivity between open space properties wherever possible. Ideally, these connections will be formed along streams and waterways, such as Corridors 1 and 2. However, increasing connectivity among other open spaces also has significant conservation value. Where connectivity does not follow natural waterways, emphasis should instead be placed on linking large nodes and purchasing larger, rather than smaller parcels. Following this framework, two suggested connective corridors are outlined in Map 8.2, labeled Corridors 3. These would provide valuable wildlife movement corridors between large areas of open space land. Where possible, properties and easements should be purchased in order to increase connectivity along these corridors.

8.2.3 Conclusion

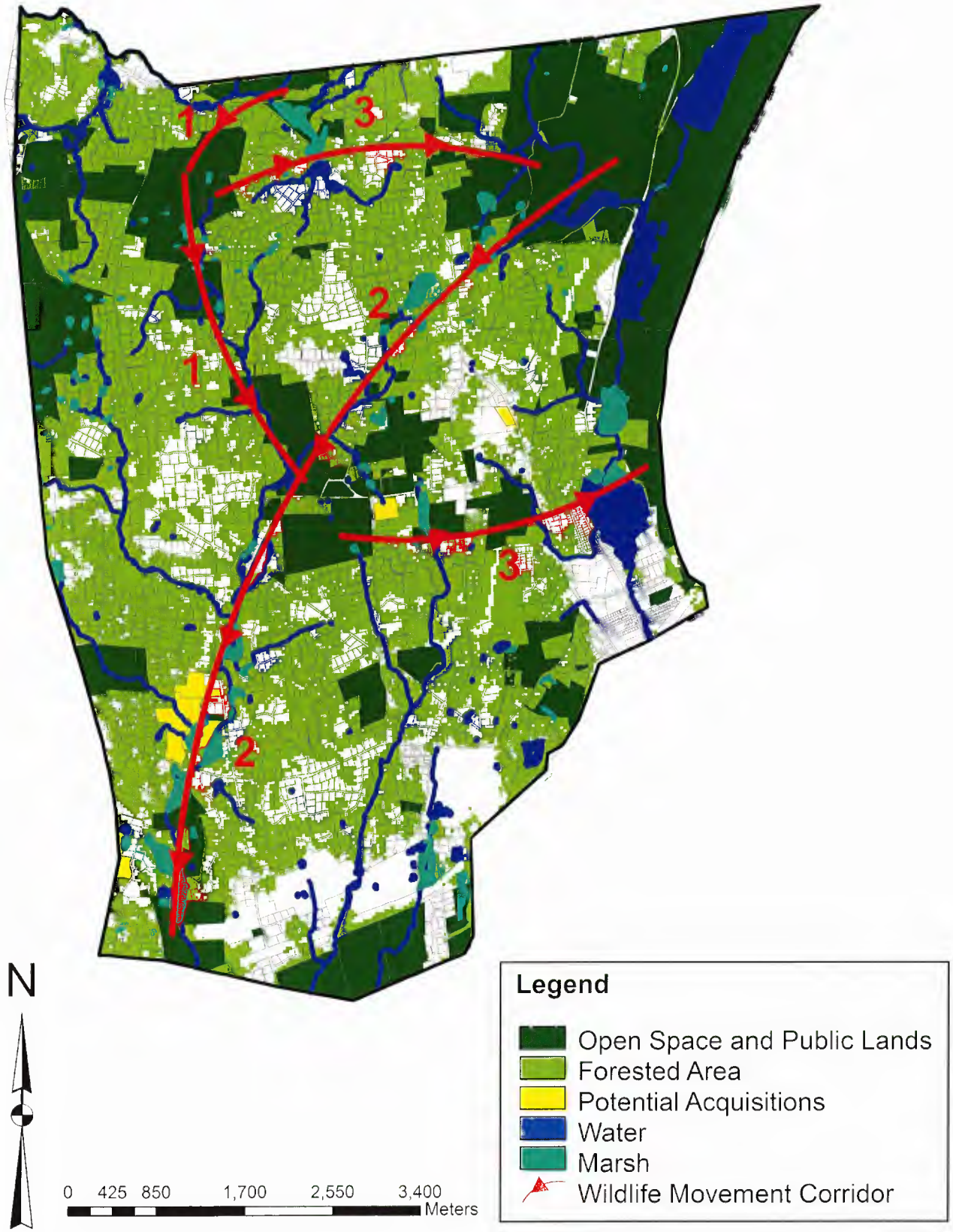
The existing greenway provides an excellent framework from which to strengthen the connectivity of the town's open space network. Over time, individual properties will coalesce into robust corridors allowing the free movement of wildlife across the landscape. The Woodbridge Greenway will combat the fragmentation of the landscape inevitably associated with development.

8.3. Map Atlas

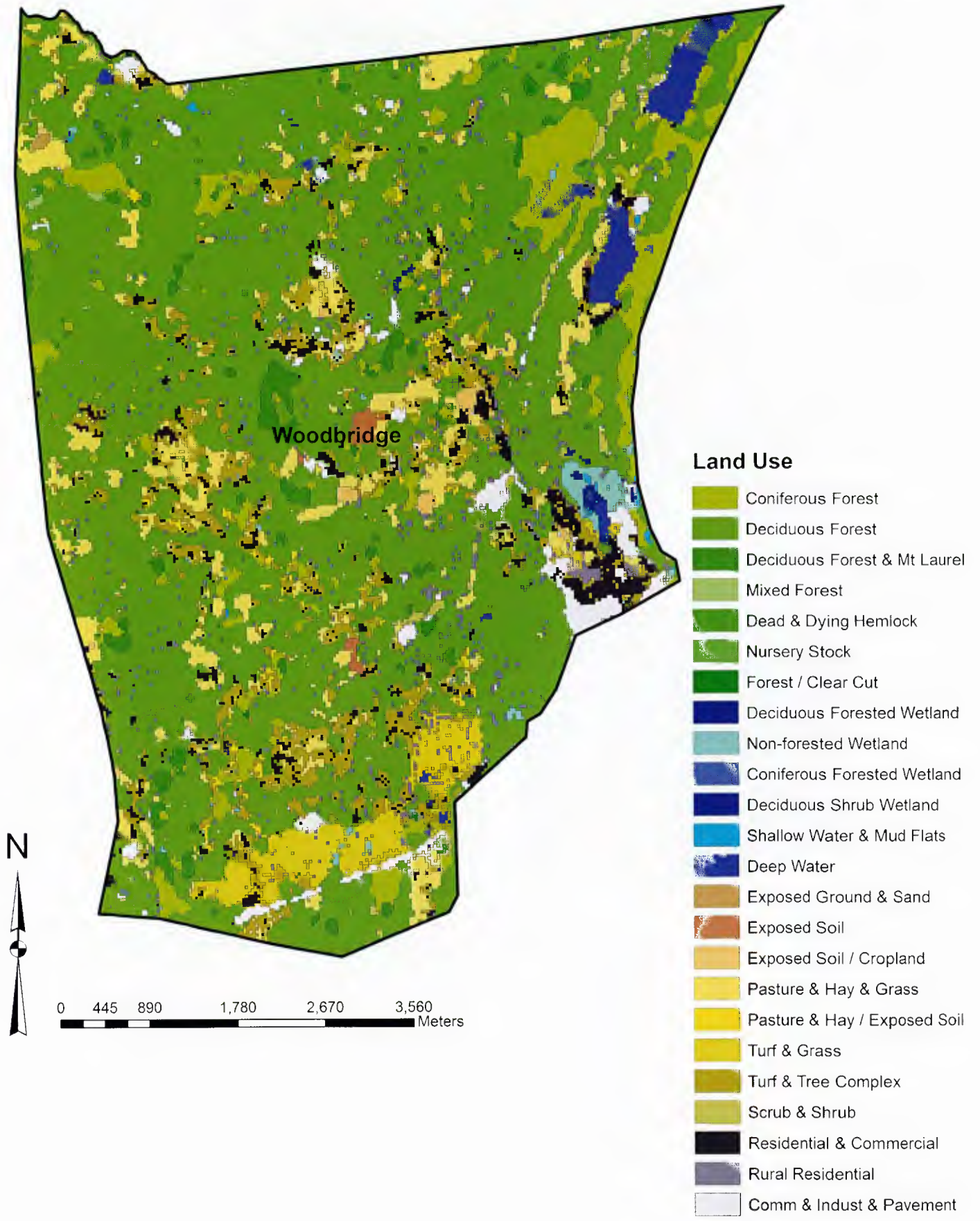
We have provided a collection of maps denoting the location and presence of various natural resources in Woodbridge. This includes open space, soils, geology, hydrology, land use, drainage basins, and topography. Together, these maps characterize in brief the biophysical endowment of the town.



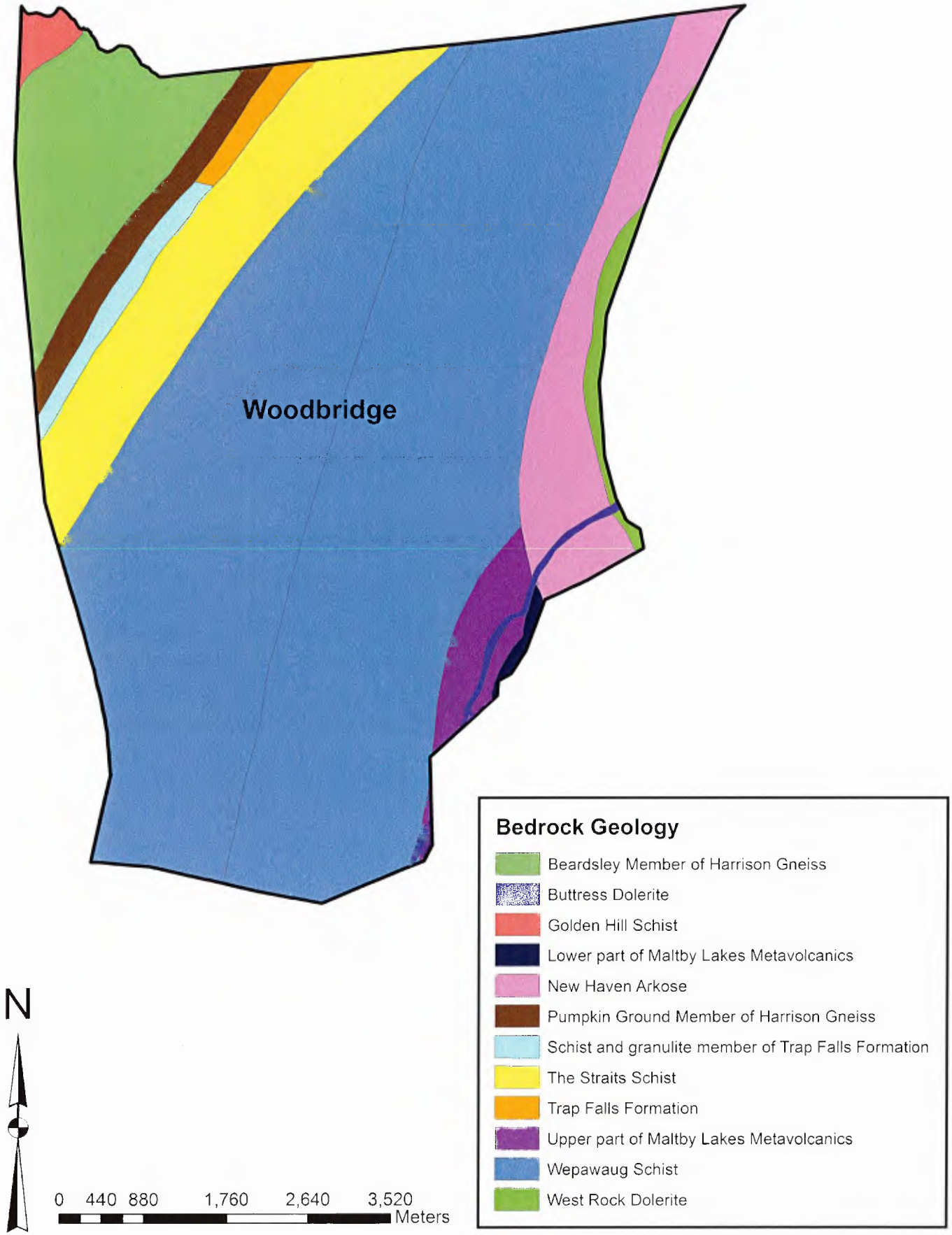
Map 8.1 - Existing open space in Woodbridge



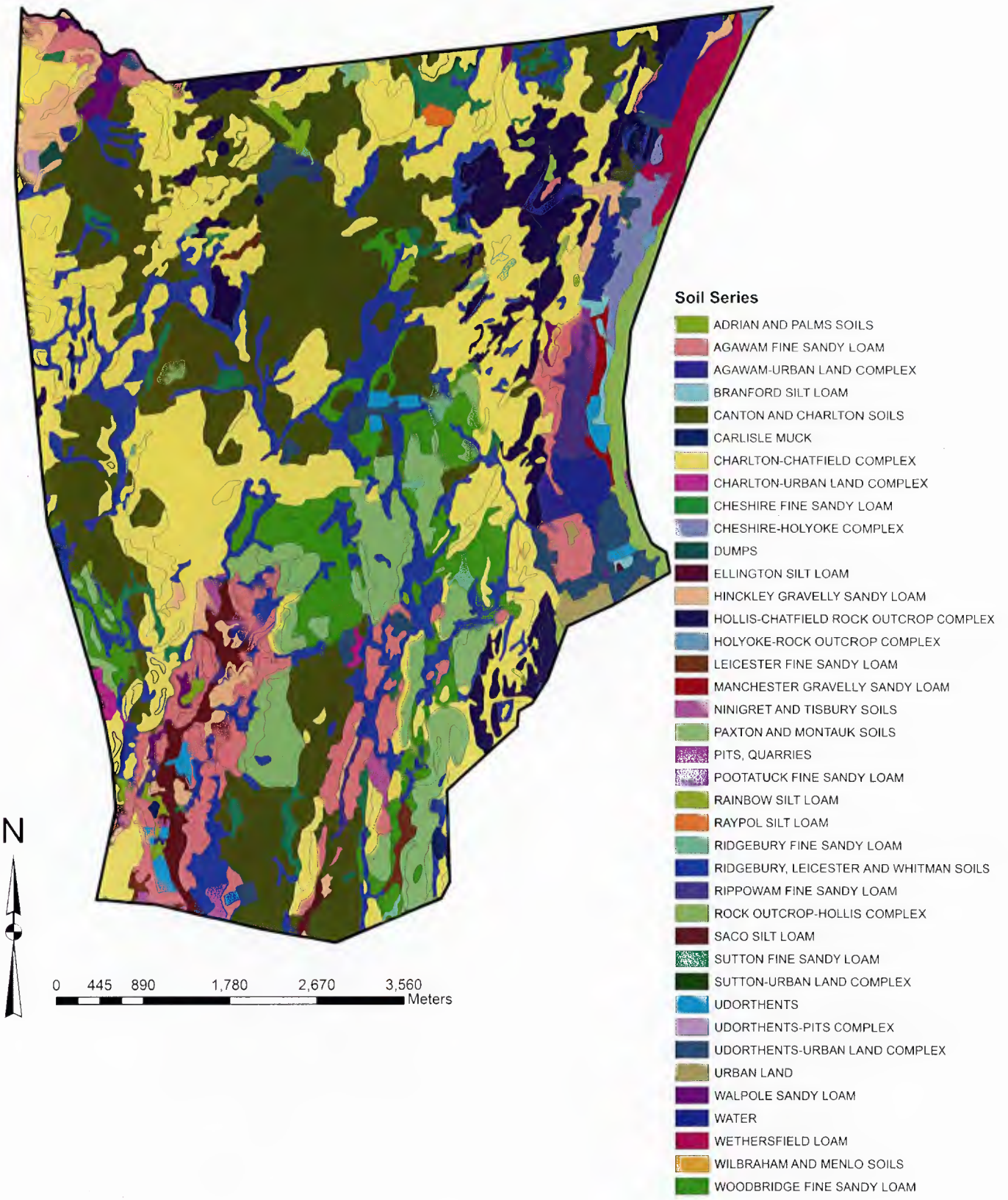
Map 8.2 - Wildlife Corridors and the Woodbridge Greenway



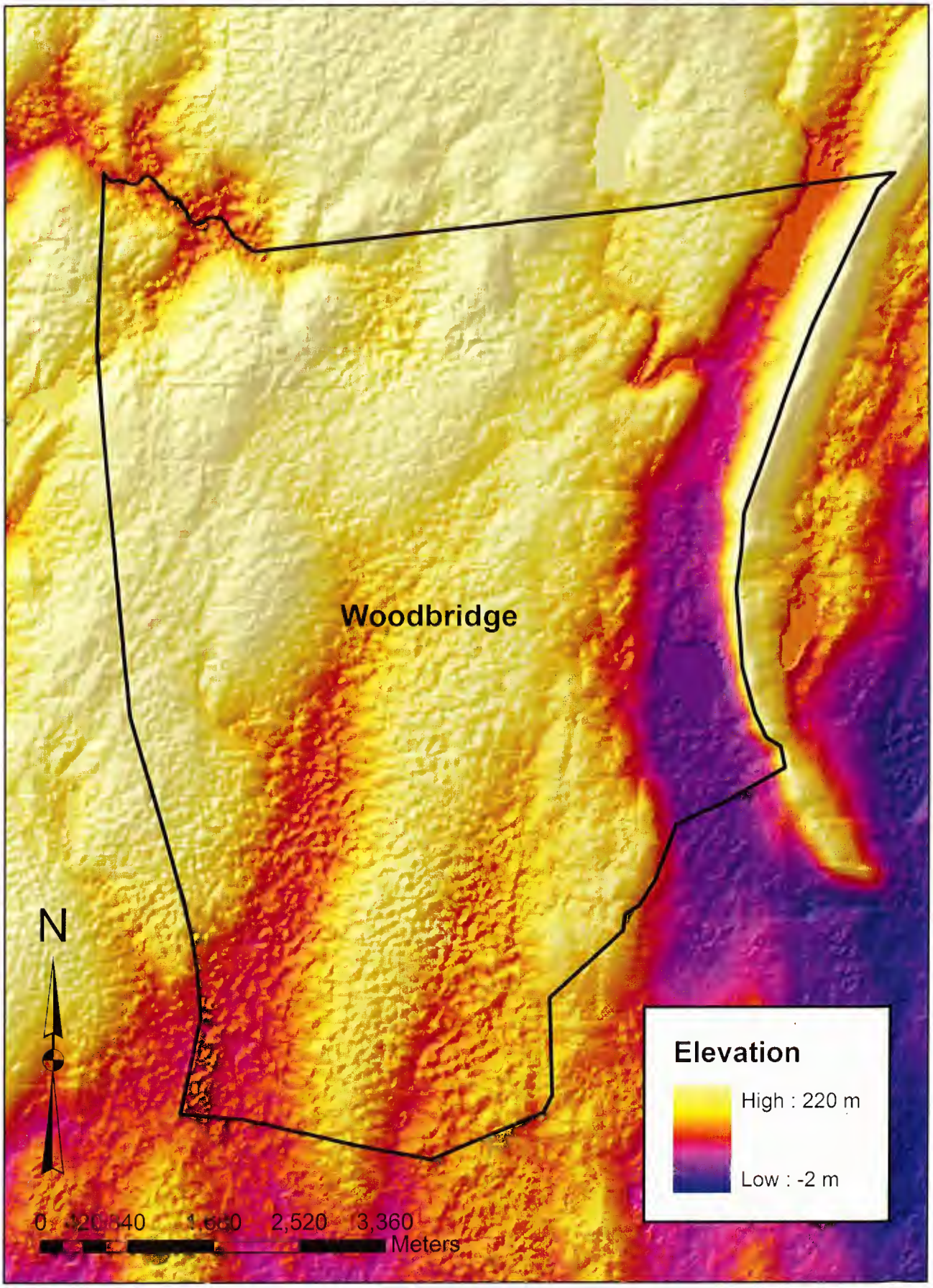
Map 8.3 - Land use in the town of Woodbridge



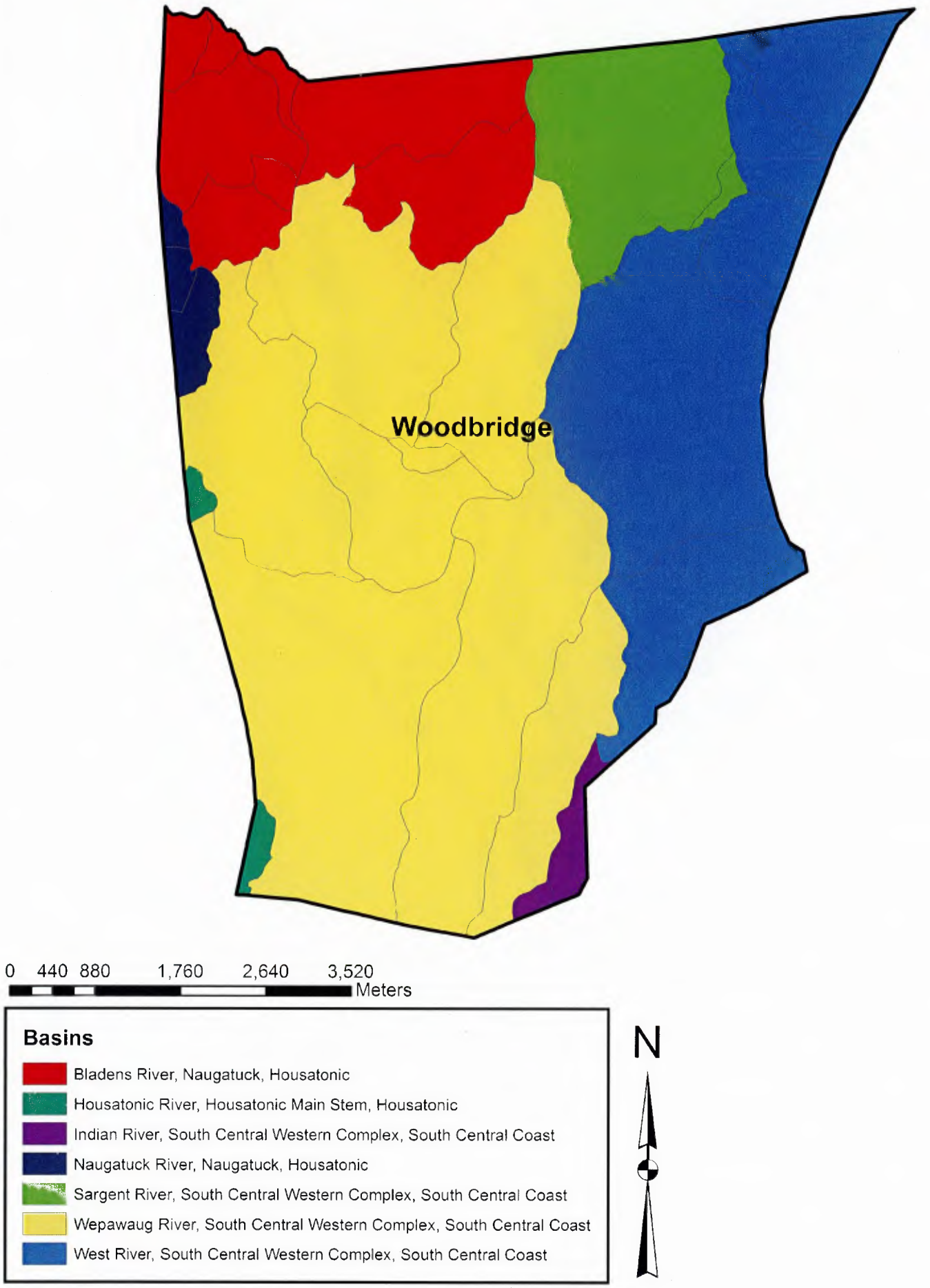
Map 8.4 - Bedrock Geology of Woodbridge



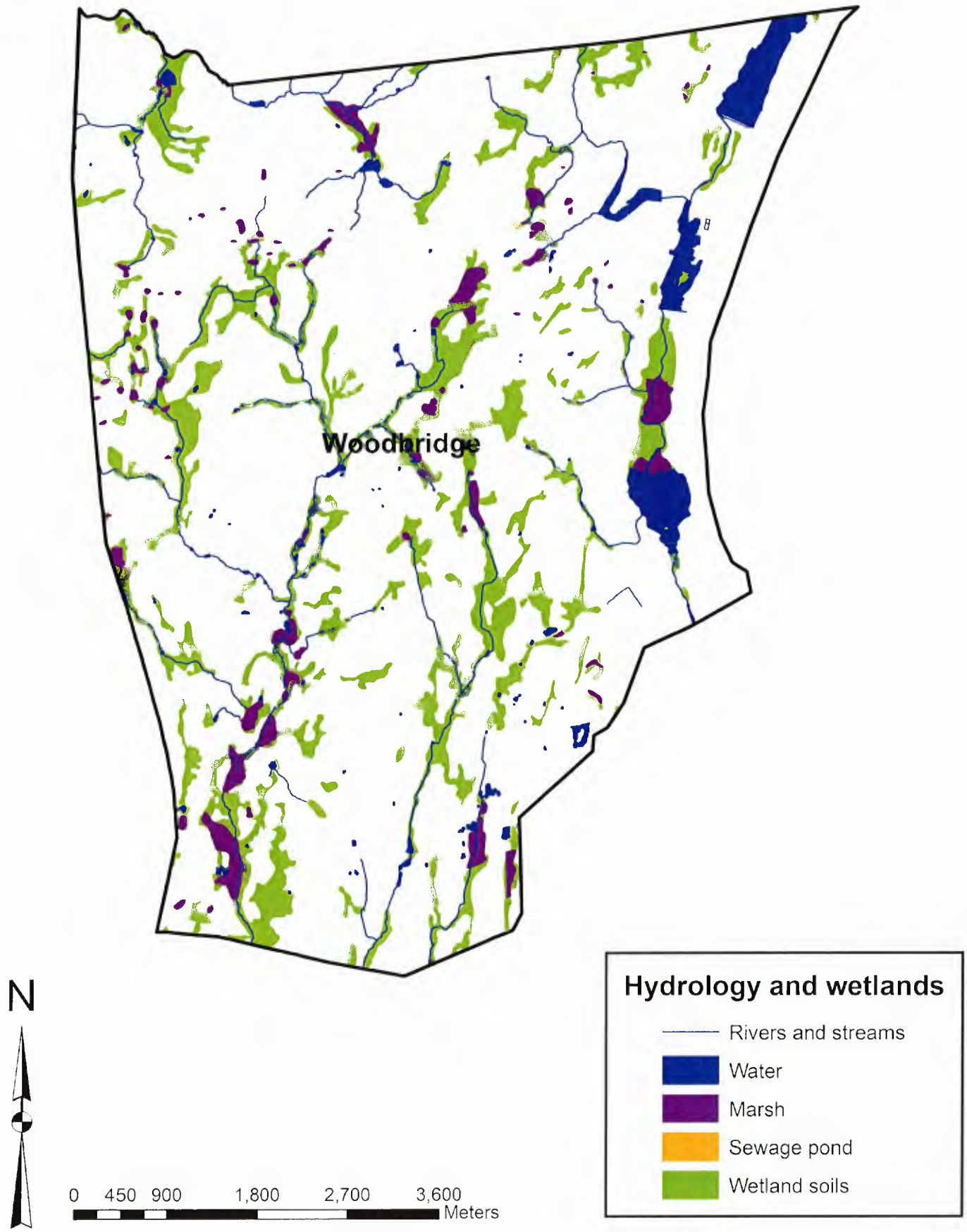
Map 8.5 - Soils of Woodbridge



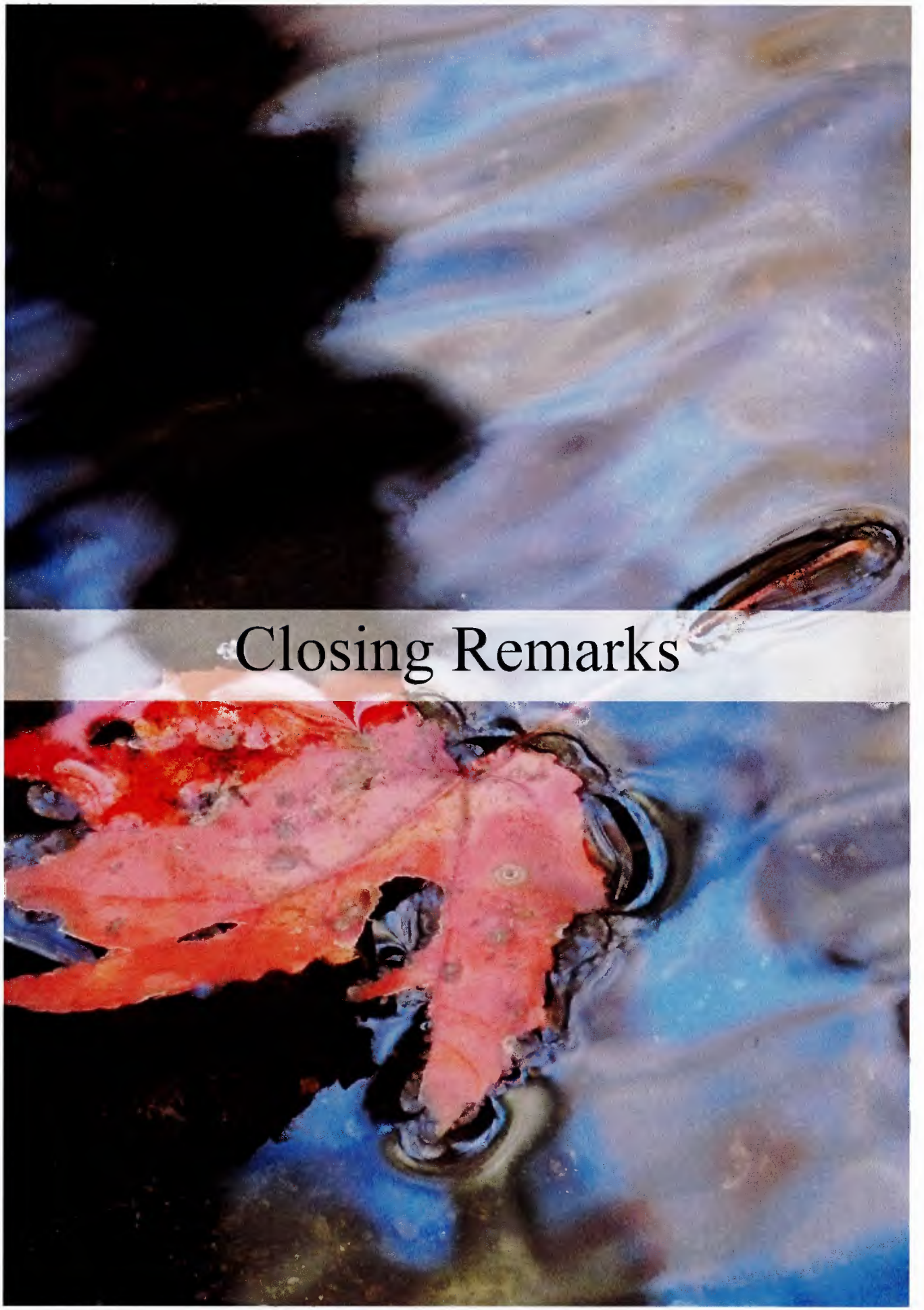
Map 8.6 - Topography of Woodbridge



Map 8.7 - Hydrological Basins of Woodbridge



Map 8.8 - Hydrological features of Woodbridge



Closing Remarks

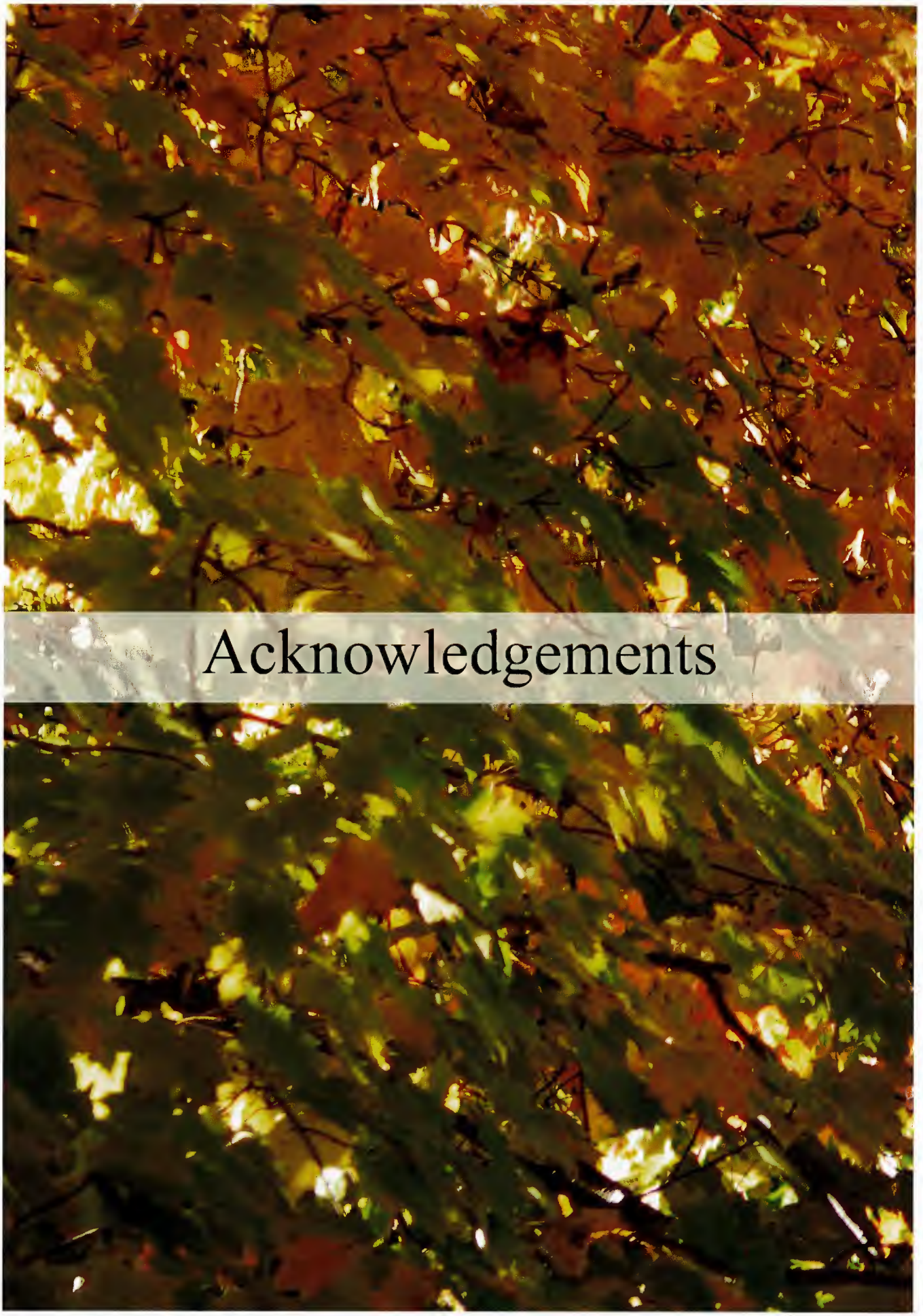
9. Closing Remarks

Alice Newton Street Memorial Park and the Fitzgerald tract are valuable resources for the citizens of Woodbridge. People are attracted to the properties for a multiplicity of reasons: they may come for the natural beauty of the landscape, or perhaps to exercise in the fresh air. Or maybe they just like running into acquaintances at the gardens and catching up on town gossip. Whatever their motivation for visiting, everyone agrees that these properties greatly enhance town life. Equally important is the wildlife that makes Alice Newton Street Memorial Park and the Fitzgerald tract its home. These residents of Woodbridge value the shelter and forage that the forest, wetlands, and meadows provide.

The town's appreciation of the properties' recreational resources combined with the Conservation Commission's desire to better understand and protect the properties' natural resources drove the request of this document. These two motivations served as a guide during the production of our management plan. Recommendations are designed to fully include park users and to protect the ecology of the area. As a result, we anticipate that everyone involved will find this management plan both relevant and effective.

One priority is maintaining the diversity of wildlife habitats by preserving vulnerable areas such as the meadows and wetlands, and improving forest habitat by performing a patch selection cut on an area of the Fitzgerald. A second priority is preserving the integrity of the forest by controlling invasive species. Hikers will be happy to see—and walk on—the results of improved trail maintenance. Children and grandparents alike will be able to learn from educational signs erected around the properties.

It is our hope that this management plan will guide the conservation ethic of Woodbridge in a direction that is both meaningful to users and soundly grounded in the science of biological protection. This document is the first step in a more extensive assessment of the town's natural resources. The initial assessment established here will set the tone for future conservation initiatives. Continued collaboration with the Yale School of Forestry and Environmental Studies can help the town of Woodbridge move forward in this direction.



Acknowledgements

10. Acknowledgements

We would like to thank the following people for their help, guidance, patience and knowledge. Without their support we would not have been able to produce this management plan.

Mark Ashton

Tom Siccama

Francis Eaton

Patrick Furtado

Woodbridge Conservation Commission

Richard Campbell

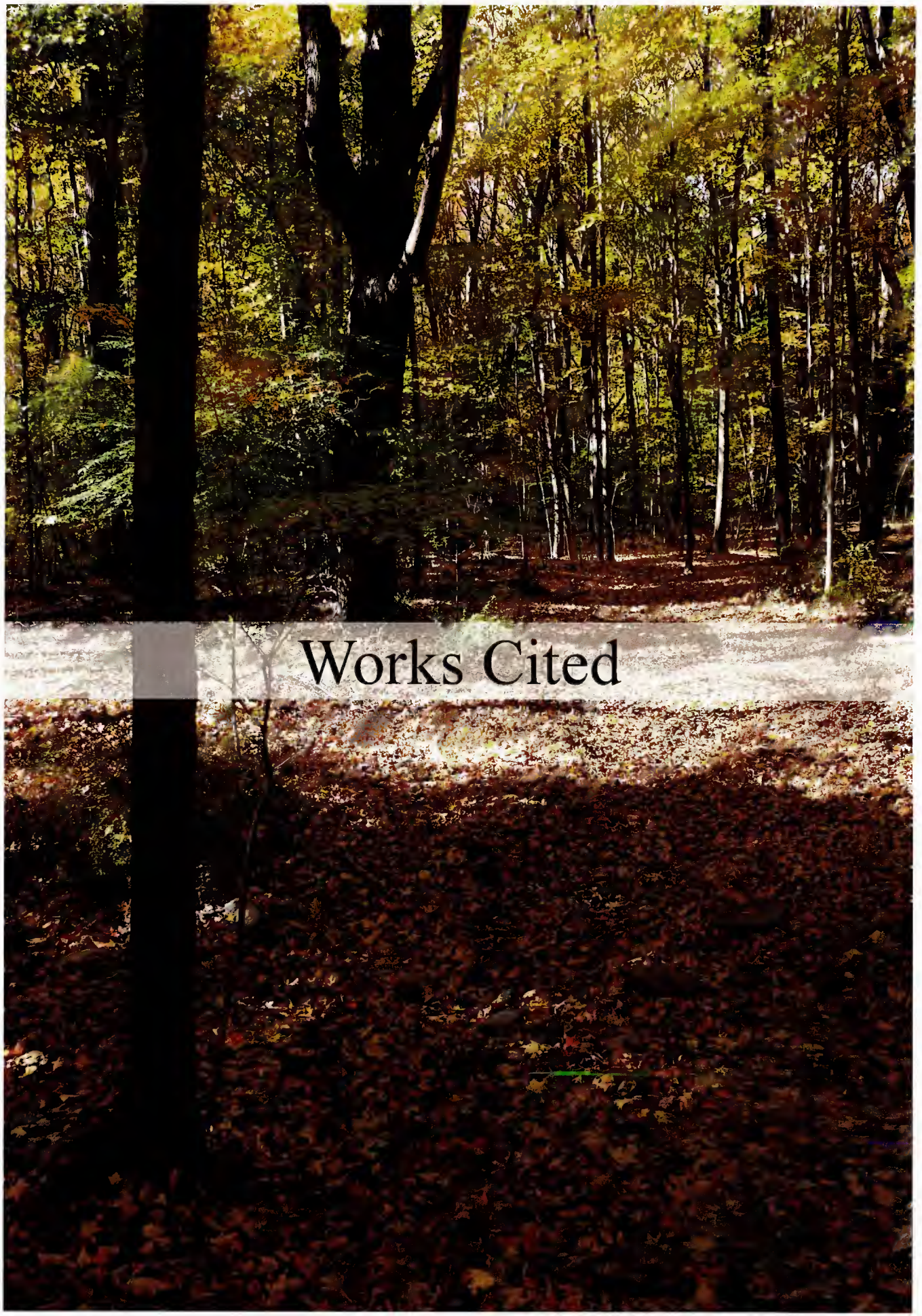
Philip Marshall

Timothy Gregoire

Stacey Maples

Colleen Murphy-Dunning

The Citizens of Woodbridge



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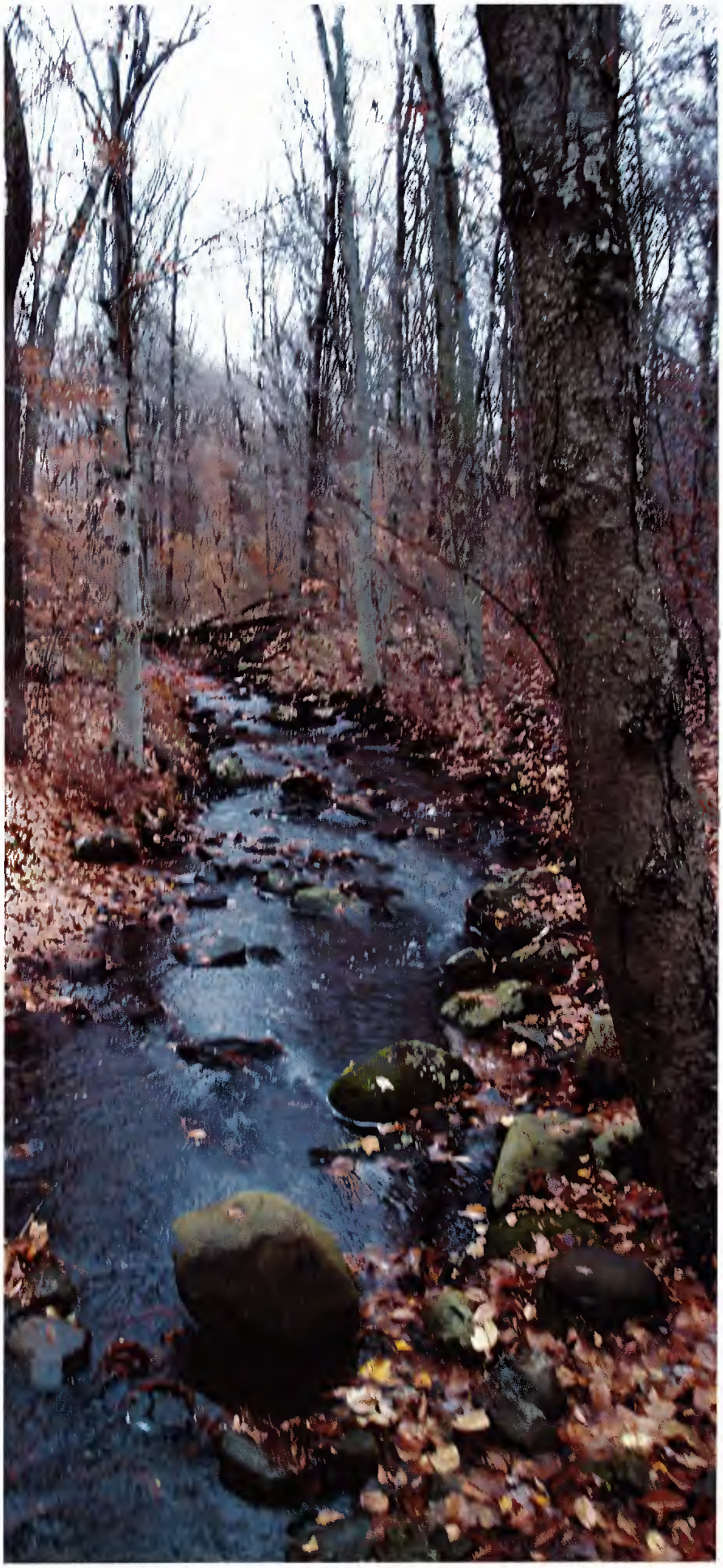
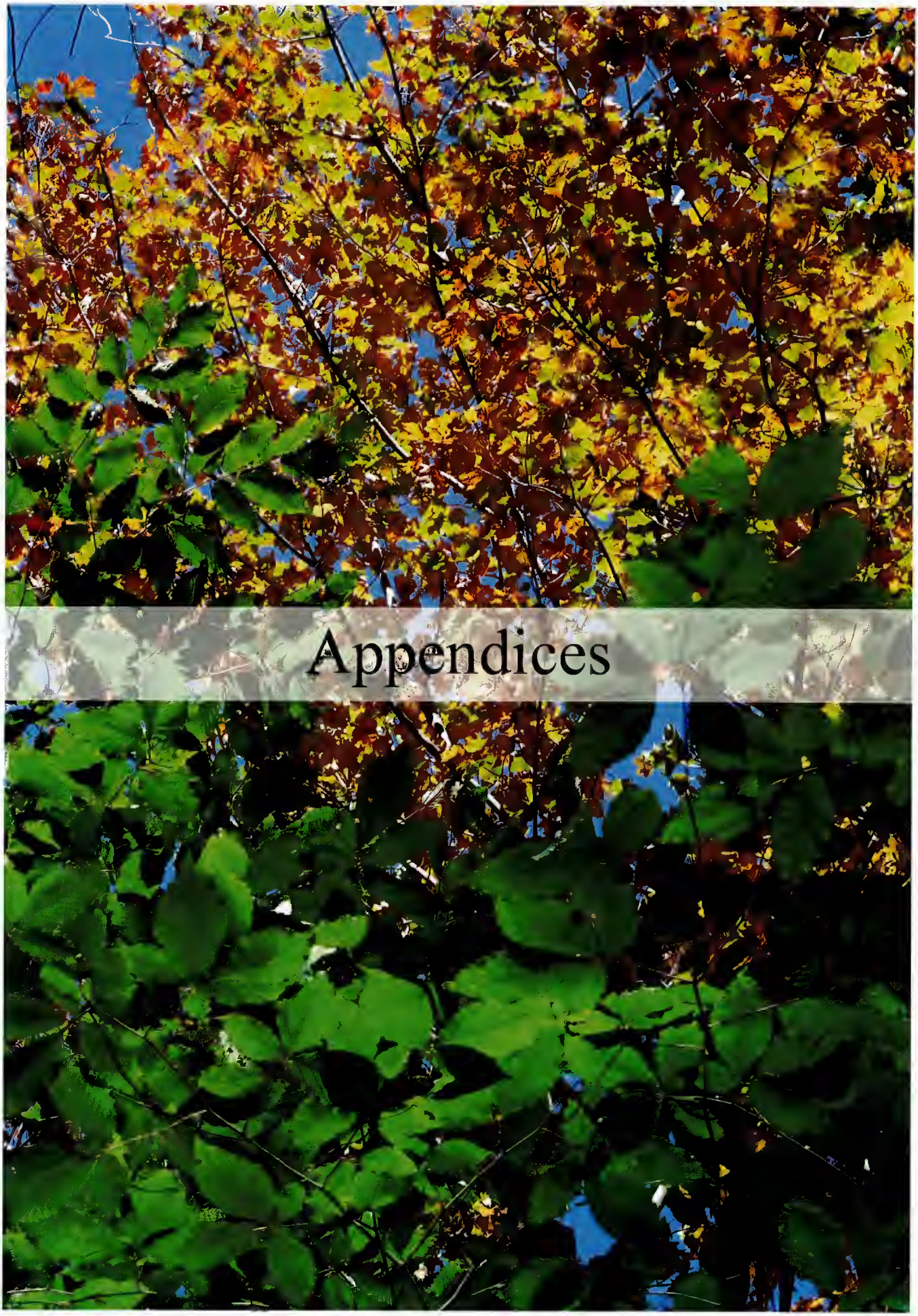




Appendices

APPENDIX 1

EXECUTOR'S DEED

TO ALL PEOPLE TO WHOM THESE PRESENTS SHALL COME--Greeting:

WHEREAS, At a Probate Court holden at New Haven, within and for the District of New Haven, in the State of Connecticut, on the 19th day of January, 1973, upon written application of The Connecticut Bank and Trust Company, Executor of the will of David E. FitzGerald, Jr., late of Woodbridge, in said District, deceased, an order was made authorizing and directing such Executor to sell at private sale, the real estate of said deceased, hereinafter described, all of which will more fully appear by the records of said Court, reference thereto being had;

AND WHEREAS, Pursuant to said order said corporation sold at private sale the real estate hereinafter described, for the sum of Six hundred and fifty-five thousand Dollars, to Town of Woodbridge, a body politic and corporate, located in the County of New Haven and State of Connecticut, whose mailing address is Town Hall, Woodbridge, Connecticut.

NOW THEREFORE, KNOW YE THAT It, the said Executor, in pursuance of the authority and direction given as aforesaid, and in consideration of said sum received to its full satisfaction of the said Town of Woodbridge, does give, grant, bargain, sell and confirm unto the said Town of Woodbridge, and unto its successors and assigns forever, all the right, title, interest, claim and demand which the said David E. FitzGerald, Jr., had at the time of his death, or which It, as such Executor, has or ought to have in and to all those two certain pieces or parcels of land, with all the improvements thereon, situated in the Town of Woodbridge, in the County of New Haven and State of Connecticut, bounded and described as follows:

THE FIRST PIECE is bounded:

North by Center Road;
East by Beecher Road;
South by land now or formerly of Newton J. Peck;

"No Conveyance Tax collected

Mabel K. Hayes Asst.
Town Clerk of Woodbridge"

1.

West by land now or formerly of Henry E. Baldwin;
South again by land now or formerly of said Henry E. Baldwin;
West again by land now or formerly of said Henry E. Baldwin;
North again by land now or formerly of said Henry E. Baldwin;
West again by land now or formerly of said Henry E. Baldwin.

Said First Piece is subject to a certain grant to American Telephone & Telegraph Company, recorded in Volume 22 on Page 580 of the Woodbridge Land Records; and a grant to the Racebrook Game Club, Incorporated, recorded in Volume 42 on Page 82 of said Land Records.

THE SECOND PIECE is bounded:

Southwest by Rimmon Road, 620 feet, more or less;
East by land now or formerly of the heirs of Alfred Cowel, 320 feet, more or less;
South in part by land now or formerly of the heirs of Alfred Cowel, in part by land now or formerly of Newton J. Peck and Franklin A. Beecher, and in part by land now or formerly of Lewis Smith, in all, 1835 feet, more or less;
East again by land now or formerly of Christian Marcusen and Martin Marcusen, 695 feet, more or less, by a bent line;
North by land now or formerly of Christian Marcusen and Martin Marcusen, 1625 feet, more or less;
East again by land now or formerly of Christian Marcusen and Martin Marcusen, 700 feet, more or less;
South again by land now or formerly of Christian Marcusen and Martin Marcusen, 1025 feet, more or less;
East again by land now or formerly of Christian Marcusen and Martin Marcusen, 520 feet, more or less;
North again by land now or formerly of Charles H. Koffinke, 1570 feet, more or less;
East again by land now or formerly of Charles H. Koffinke, 520 feet, more or less;
North again by Center Road, 405 feet;
West by land now or formerly of David R. Schmied and Matilda J. Schmied, 210 feet, more or less;
North again by land now or formerly of David R. Schmied and Matilda J. Schmied, 190 feet, more or less;
West again by Wepawaug River, 400 feet, more or less;
South again by land now or formerly of Alfred L. Beecher, 700 feet, more or less;
West again by land now or formerly of Alfred L. Beecher, 1720 feet, more or less;
North again by land now or formerly of Alfred L. Beecher, 475 feet, more or less;
Northwest by land now or formerly of Alfred L. Beecher, 70 feet, more or less.

Said Second Piece is subject to a grant in favor of American Telephone and Telegraph Company, dated March 14, 1902 and recorded in Volume 22 on Page 581 of the Woodbridge Land Records; and a grant in favor of Racebrook Game Club, Inc., dated September 27, 1934 and recorded in Volume 42 on Page 79 of said Land Records.

Said premises are subject to building lines if established, all laws, ordinances or governmental regulations, including building and zoning ordinances, affecting said premises, and taxes on the list of 1972, which taxes said grantee hereby assumes and agrees to pay as part of the consideration for this deed.

Being the premises described in said application and order.

TO HAVE AND TO HOLD the above granted and bargained premises, with the appurtenances thereof, unto the said Grantee, and unto its successors and assigns forever, to its and their proper use and behoof. And It, the said grantor, does for itself and its successors, covenant with the said grantee, its successors and assigns, that it has full power and authority as Executor aforesaid to bargain and sell the same in manner and form as above written.

AND FURTHERMORE, It, the said grantor, does by these presents bind itself and its successors forever to Warrant and defend the above granted and bargained premises to it, the said grantee, its successors and assigns, against all claims and demands of any person or persons claiming by, from or under it, as Executor aforesaid, except as above written.

IN WITNESS WHEREOF, On this 9th day of March, A.D. 1973, said corporation, The Connecticut Bank and Trust Company, as such Executor, has caused this deed to be executed and delivered and its corporate seal to be hereto affixed in its behalf by H. V. Pelton, its Assistant Vice President, who is duly authorized and empowered.

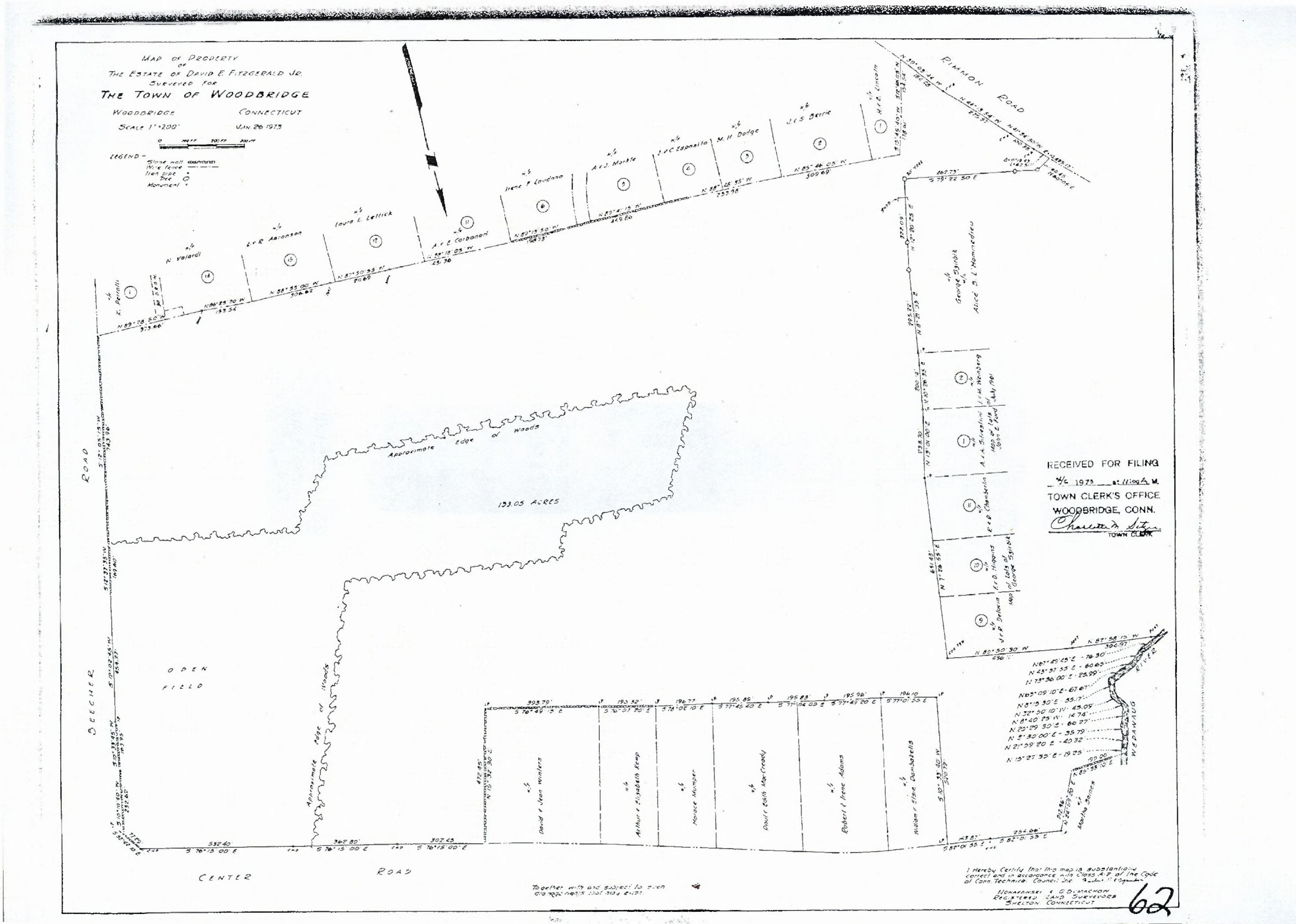
Signed, sealed and delivered
in presence of:

Ronald J. Fracasse

William J. Cousins

THE CONNECTICUT BANK AND TRUST COMPANY
Executor as aforesaid

by H. V. Pelton
Its Assistant Vice President.


Map of Property
of
The Estate of David E Fitzgerald Jr.
Surveyed for
The Town of Woodbridge
Woodbridge
Connecticut
Scale 1" = 200'
Jan 26 1973
Legend -
Stone wall
Wire fence
Iron pipe
Tree
Monument
Rimmon Road
Beecher Road
Center Road
Wepawaug River
Approximate Edge of Woods
Approximate Edge of Woods
193.05 Acres
Open Field
David & Jean Winters
Arthur & Elizabeth Kemp
Horace Mumper
Doris Edith MacCready
Robert & Irene Adams
William & Elsie Dombakelis
Irene F Loudano
J & C Esposito
M. H. Dodge
J & S Berrie
Laura L. Leftick
George Szpirke
Alice S L Hommerdieu
RECEIVED FOR FILING
4/c 1973 at 11:00 A M.
TOWN CLERK'S OFFICE
WOODBRIDGE, CONN.
TOWN CLERK
Together with and subject to such
Honakowski & O'Donahon
Registered Land Surveyors
Shelton Connecticut
62

440

...satisfied or released; and

Whereas said grantor in consideration thereof has this day executed and delivered to said grantee this mortgage deed and his -5- promissory notes of the face value of two hundred dollars each his – 16- promissory notes of the face value fo Five Hundred dollars each, his -5- promissory notes of the face value of One Thousand dollars each, and his -2- promissory notes of the face value of Two Thousand dollars each, together aggregating said total sum of Eighteen Thousand dollars, of even date herewith, payable to bearer, or if registered to the registered holder thereof, at the Office of The Charles T. Lincoln Company in New Haven, Connecticut, with interest at the rate of six percent – (6%) per annum, payable semi-annually until said principal sum is fully paid, together with all taxes assessed upon said sum against said payees or the holders of any of said notes and all cost of collection including reasonable attorney fees; provided however, that if any payment of interest shall remain in arrears and unpaid after the same shall become due as aforesaid, or if the whole or any part of the principal of any of said notes shall remain unpaid at maturity, the principal of all of said notes shall immediately thereupon at the option solely of the then acting trustee of this mortgage become due and payable: each of which notes bears the certification of the New Haven Bank N.B.A., that it is one of the notes herein described, and all of which notes are payable on or before five years after date.

Now therefore, if each and all of said notes together with the interest thereon shall be pain in all respects according to their tenor, and all taxes assessments costs and expenses herein agreed to be paid by said grantor shall be well and truly paid, and if all agreements and provisions herein contained are fully kept and performed by said grantor his heirs, executors, administrators, successors and assigns, then this deed shall be void, otherwise to remain in full force and effect.

In Witness Whereof, I have hereunto set my hand and seal this 18th day of December 1928 signed, sealed and delivered in presence of:

Prentice T. Chase

Arthur B. Darling [L.S.]

Elba R. Anderson

State of Connecticut} ss New Haven, December 18th, 1928.

New Haven County Personally appeared Arthur B. Darling signer and sealer of the foregoing instrument and acknowledge the same to be his free act and deed before me.

Prentice T. Chase,

Notary Public

Received for record Dec.19, 1928 at 12h 30m P.M. and recorded by

Henry E. Baldwin,

Town Clerk.

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Power of Attorney

Know all men by these presents, that I, Newton H. Street of the Town of Woodbridge, State of Connecticut, do hereby constitute and appoint The New Haven Bank N.B. A., A national banking corporation located at New Haven, in said state, My lawful Attorney, for me and in my name and stead, and at any time prior to the 1st day of January, 1929, to sign, seal, acknowledge and deliver a warranty deed of the lands hereinafter described, either to a corporation without capital stock hereafter to be formed under the name of The Woodbridge Park Association, Incorporated, or under some similar name, to be organized for the purpose of holding lands in the Town of Woodbridge to be used for park forest and kindred purposes only, or to a Board of Trustees, (as may be hereafter determined), to hold said lands for like purposes. Said land is located in the Town of Woodbridge westerly of Newton road and Northerly of Center Street, and contains 82 acres, more or less, and is bounded and described as follows; Beginning at a point on the Northerly line of land of the Woodbridge Church Society at the Southwesterly corner of land of Mildred G. Hatch; thence running Northerly 283 feet, more or less, along a line between my land and that of said Hatch and in part upon my own land; thence Westerly on a line parallel to the line between my land and that of Chester Hitchcock, and distant 100 feet therefrom a distance of 320 feet more or les, upon my own land; thence running northerly 2747 feet more or less, along the line of the division line between my land and that of W. P. Harrington, extended both Northerly and Southerly, in part upon my own land, in part upon said division line, and in part along the division line between my land and that of Ruby E. Street, Bertha s. Ferguson and Mildred S. Hatch to the land of Jacob Stengel; thence Westerly 749 feet, more or less, along the division line between my property and that of said Stengel; thence Northerly 315 feet, more or less, along the line between my land and that of said Stengel; thence Westerly 750 feet, more or less, between my land and that of Brinie Zeides and Clifford S. Stoddard; thence Southeasterly 825 feet, more or less, along the line between my land and that of said Stoddard; thence Southeasterly in the same line 725 feet, more or less, along the line between my land and that of the State of Elizabeth R. Clark; thence Westerly 144 feet, more or less, along the line between my land and that of said Estate; thence Southerly 600 feet, more or less, along the line between my land and that of said Estate to the land of Henry E. Baldwin; thence Easterly 550 feet, more or less, along the line between my land and that of said Baldwin; thence Southerly 771 feet, more or less, along the line between my land and

that of said Baldwin to land formerly of Isaac Smith, thence Easterly 200 feet, more or less, along the line between my land and that of formerly said Smith; thence Northerly 60 feet, more or less, along the line between my land and that of Chester Hitchcock;

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thence Easterly 681 feet, more or less, along the line between my land and that of said Hitchcock; thence Southerly 183 feet, more or less, to land of said Church Society; thence Easterly 85 feet, more or less, to the point of beginning.

Said land shall be conveyed substantially upon the following terms and conditions:

1. Said land shall be used for park, forest and kindred purposes only, and the grantee may transfer to the State of Connecticut the right to establish a preserve therein for the protection of fish, game and wild life, in accordance with the statutes laws of the state of Connecticut.

2. The track to be conveyed shall be named "the Alice Newton Street Memorial Park", and a suitable sign or marker bearing that name shall be erected and maintained at any entrance to this land, which is regularly used by the Public.

3. No buildings shall be erected on said land except those used for park or community purposes.

4. No hunting, fishing, trapping and picking of wild flowers or removal of plants or trees, shall be permitted, except that which may be necessary for the proper development and maintenance of the park.

5. If at any time any of these restrictions are violated, the title in the above described land shall immediately revert to me or to my heirs.

I also empower said Bank to execute and deliver under seal a contract in my name with the corporation or Board of Trustees to which or to whom the land hereinbefore described shall be conveyed giving o said corporation, or to said Bank, an option to purchase, for the sum of Seven Hundred Dollar ($700) the track of land adjoining the land hereinbefore described on the east, and containing 6.87 acres, more or les, bounded and described as follows:

Beginning at a point 283 feet Northerly of the Northerly line of the Woodbridge Church Society along the line between my land and that of Mildred S. Hatch, extended Northerly; thence running Northerly 549feet, more or less, on my own land to the land of W. P. Harrington; thence Northerly 282 feet, more or less, thence Westerly 57 feet, more or less; thence Northerly 126 feet, more or less, thence Westerly 210 feet, more ore less, all along the division line between my land and that of said Harrington to a point in the line forming a part of the Easterly line of the land to be conveyed by my said attorney; thence running Southerly 957 feet, more or less, along said line; thence Easterly 320 feet, more or less, to the point of beginning along the line between my land and the land to be conveyed as aforesaid.

Provided the same shall be paid within one year from the date hereof; which contract shall be binding upon my heirs, executors and administrators.

In Witness Whereof, I have hereunto set my hand and seal, at New Haven Connecticut, this 4th day of October, A. D. 1928.

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Signed, Sealed and delivered
in the presence of
Newton H. Street L.B.
Veronica Hart
George D. Watsons
State of Connecticut
County of New Haven

New Haven, the 4th day of October, 1928.

Personally appeared Newton H. Street, signed and sealed of the foregoing instrument, and acknowledged the same to be his free act and deed, before me,

George D. Watsons,
Notary Public,

Received for record December 21, 1928, at 12h 30m P.M. and recorded by

Henry E. Baldwin,
Town Clerk.

To all people to whom these Presents shall come – Greeting:

Know yes that I, Newton H. Street, of the Town of Woodbridge, State of Connecticut, acting herein by the New Haven Bank, N.B.A., a national banking

Corporation, located at New Haven, Connecticut my attorney hereunto authorized and empowered by Power of Attorney dated the 4th day o of October, 1928, duly executed, and recorded in the Land Records of said Town of Woodbridge, for the consideration of one dollar and other valuable considerations, received to my full satisfaction of the Woodbridge Park Association, Incorporated, a corporation organized under the general laws of the State of Connecticut, and located in said Town of Woodbridge, do give, grant, bargain, sell and confirm unto the said The Woodbridge Park Association, Incorporated, a piece of land in said Town of Woodbridge Westerly of Newton Road and Northerly of Center street, containing eighty two (82) acres, more or less, and bounded and described as follows:

Beginning at a point on the Northerly line of land of the Woodbridge Church Society at the Southwesterly corner of land of Mildred S. Hatch; thence running northerly 283 feet, more or less, along a line between my land and that of said Hatch and in part upon my own land, thence running Northerly 2747 feet, more or less, along the line of the division line between my land and that of W. P. Harrington, extended both Northerly and Southerly, in part upon my own land, in part upon said division

line, and in part along the division line between my land and that of Ruby E. Street, Bertha S. Ferguson and Mildred S. Hatch to the land of Jacob Stengel; thence Westerly 749 feet, more or less, along the division line between my property and that of said Stengel, thence Northerly 315 feet, more or less, along the line between my land and that of said Stengel; thence Westerly 750 feet, more or less, between my land and that of Bunie Zeider and Clifford I. Stoddard; thence Southeasterly 825 feet, more or less, along the line between my land and that of said Stoddard; thence Southeasterly in the same line 725 feet, more or less, along the line between my land and that of the Estate of Elizabeth R. Clark; thence Westerly 144 feet, more or less, along the line between my land and that of said Estate; thence Southerly 600 feet, more or less, along the line between my land and that of said State to the land of Henry E. Baldwin; thence Easterly 550 feet, more or less, along the line between my land and that of said Baldwin; thence Southerly 771 feet, more or less, along the line between my land and that of said Baldwin to land formerly of Isaac Smith; thence Easterly 200 feet, more or less, along the line between my land and that formerly of said Smith; thence Northerly 60 feet, more or less, along the line between my land and that of Chester Hitchcock; thence Easterly 681 feet more or less, along the line between my land and that of said Hitchcock; thence Southerly 183 feet, more or less, to land of said Church Society; thence Easterly 85 feet, more or less, to the point of beginning.

Said land is conveyed for the uses and purposes of the Woodbridge Park Association, Incorporated, as set forth in its Articles of Association, and upon the following terms and conditions:

1. Said land shall be used for park, forest and kindred purposes only, and the grantee may transfer to the State of Connecticut the right to establish a preserve therein for the protection of fish, game and wild life, in accordance with the statutes laws of the state of Connecticut.

2. The track to be conveyed shall be named "the Alice Newton Street Memorial Park", and a suitable sign or marker bearing that name shall be erected and maintained at any entrance to this land, which is regularly used by the Public.

3. No buildings shall be erected on said land except those used for park or community purposes.

4. No hunting, fishing, trapping and picking of wild flowers or removal of plants or trees, shall be permitted, except that which may be necessary for the proper development and maintenance of the park.

5. If at any time any of these restrictions are violated, the title in the above described land shall immediately revert to me or to my heirs.

To have and to hold the above granted and bargained premises, with the appurtenances thereof, unto the said Grantee, its successors and assigns forever, for the uses and purposes, and subject to the terms and conditions hereinbefore set forth. And also, the said Grantor, do for myself, my heirs, executors, and administrators, covenant with the said grantee, its

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successors and assigns, that at and until the unsealing of these presents, I am well seized of the premises as a good indefeasible estate in Fee Simple; and have good right to bargain and sell the same in manner and form as is above written; and that the same is free from all encumbrances whatsoever, except taxes on the list of 1928.

And furthermore, the said grantor does by these presents bind himself and his heirs forever, to warrant and defend the above granted and bargained premises to the said grantee, its successors and assigns, against all claims and demands whatsoever.

In Witness Whereof, I have hereunto set my hand and seal; acting herein by the New Haven Bank N.B. A., my attorney in fact, hereunto duly authorized this 21st day of December, A.D. 1928.

Signed, sealed and delivered
in the presence of
Newton H. Street
L.S.
Chas. H. Raymond

By the New Haven Bank N.B.A., Attorney
Chas E. Cornwall

By William G. Redfield, President.

State of Connecticut
New Haven, December 21st, 1928
County of New Haven

Personally appeared William G. Redfield, President of the New Haven Bank, N.B.A., the attorney in fact of Newton H. Street, signer and sealer of the foregoing instrument, and acknowledged the same to be the free act and deed of said Newton H. Street, before me.

Charles E. Cornwall- Notary Public

Received for record December 26, 1928 (Seal of notary) at 8h 30m P.M and recorded by

Helen I. Baldwin

Assistant Town Clerk

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To all People to whom these Presents shall come, GREETING:

Know Ye, that I, Chester C. Hitchcock, of the town of Woodbridge, County of New Haven and State of Connecticut,

For the consideration of One Dollar and other valuable considerations received to my full satisfaction of the Woodbridge Park Association, Incorporated, a corporation legally existing under the Statute laws of

Connecticut do give, grant, bargain, sell and confirm unto the said The Woodbridge Park Association, Incorporated, and unto its successor and assigns forever, all that certain piece or parcel of land, with all the improvements thereon, containing two and one-half acres, more or less, and bounded and described as follows: Beginning at a point at the North East corner of land of said Woodbridge, which said land is known as Town Hall Lot; thence Westerly following the division line between said Town Hall Lot and land herein described and conveyed, to the North West corner of said Town Hall Lot, three hundred five (305) feet, more or less; thence Northerly in a straight line with the Westerly boundary line of said Town Hall Lot, to the center of a stone wall running Easterly and Westerly, three hundred forty seven (347) feet, more or less; thence Easterly following the center of said stone wall; three hundred nineteen (319) feet, more or less, to the center of a fence running Northerly and Southerly; thence Southerly following said last mentioned fence, three hundred thirty four (334) feet, more or less, to a corner, thence Easterly again, twenty two (22) feet, more or less following stone wall to land of The Woodbridge Ecclesiastical Society; thence Southerly, again bounded Easterly, by land of said Woodbridge Ecclesiastical Society, forty (40) feet, more or less to point or place of beginning. Said described land is bounded:
Southerly by Town Hall Lot herein mentioned; Westerly by land of Grantor herein; Northerly by land of said Park Association, Easterly by land of said Park Association; Northerly again by land of said Park Association, Easterly again by land of the Woodbridge Ecclesiastical Society.
The division fence on the Westerly boundary line of said land herein described and conveyed shall be built and maintained by said Woodbridge Park Association.

To have and to hold the above granted and bargained premises, with the appurtenance thereof, unto the said grantee its successors and assigns forever, to its and their proper use and behoof. AND ALSO, I the said grantor do for myself my heirs, executor and administrators, covenant with the said grantee heirs and assigns, that at, and until the ensealing of these presents, I am well seized of the premises, as a good indefeasible estate in Fee Simple, and have good right to bargain and sell the same in manner and form as is above written; and that the same is free from all incumbrances whatsoever.
And Furthermore, I the said grantor do by these presents, bind myself and my heirs forever, to WARRANT and defend the above granted and bargained premises to it the said grantee its successors and assigns against all claims and demands whatsoever.
IN WITNEWSS WHEREOF, I have hereunto set my hand and seal this 20th day of January A.D. 1930.
Signed, sealed and delivered in presence of
Helen I. Baldwin
Henry E. Baldwin
Chester C. Hitchcock

STATE OF CONNECTICUT
Woodbridge, January 20 1930
NEW HAVEN COUNTY,

Personally appeared Chester C. Hitchcock
Signer and Sealer of the foregoing Instrument, and acknowledge the same to be this free act and deed, before me.

Henry E. Baldwin
Notary Public

Received for Record, January 20 1930, at 9 h 30 m P. M., and recorded by me.

Ethel M. Street Asst. Town Clerk

Notary Public.

Received for Record December 21st, 1935 at 12h. 32m. P.M. and recorded by
Newton H. Street, Town Clerk.

Alice Newton
v 42, 107-08

QUIT CLAIM DEED

TO ALL PEOPLE TO WHOM THESE PRESENTS SHALL COME--GREETING:
KNOW YE, THAT, The First Ecclesiastical Society of the Town of Woodbridge, an ecclesiastical corporation organized under the laws of the State of Connecticut and located in the Town of Woodbridge, in the County of New Haven and State of Connecticut For the consideration of one dollar ($1.00) and other valuable considerations but of an amount of less than the sum of one hundred ($100) dollars received to its full satisfaction of The Woodbridge Park Association, Incorporated, a corporation organized under the general laws of the State of Connecticut, and located in said Town of Woodbridge, in said County and State, do remise, release and forever Quit-Claim unto the said The Woodbridge Park Association, Inc. and unto its successors and assigns forever, all the right, title, interest, claim and demand whatsoever as it the said releasor has or ought to have in or to All that certain piece or parcel of land, with all the improvements thereon, situated in the said Town of Woodbridge, in the County of New Haven and State of Connecticut and bounded and described as follows: Beginning at an iron pipe, or other marker which is located at the North-east corner of land of the grantee herein; thence southerly, bounded Easterly by land of the grantor herein, in a straight line, three hundred (300) feet, more or less, to a point in the northerly boundary line of the highway known as Meeting House Lane, said easterly boundary line of land herein described if extended southerly in a straight line would pass through the Northwest corner of the building known as Center School; thence westerly in a curved line, bounded Southerly by the said northerly boundary line of said highway known as Meeting House Lane, to land of the said Town of Woodbridge; thence Northerly, bounded Westerly by said land of said Town of Woodbridge, and by land of the grantee herein, each in part, to a point which said point is distant westerly ninety-nine (99) feet, more or less, from the point or place of beginning; thence easterly bounded Northerly by land of the said grantee herein, ninety-nine (99) feet, more or less, to the point or place of beginning.

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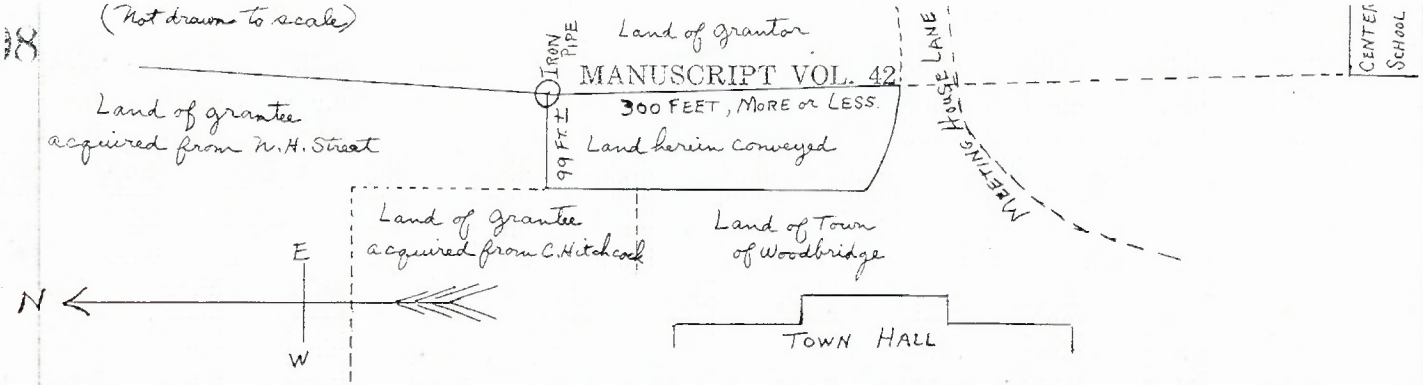


TO HAVE AND TO HOLD the premises, with all the appurtenances, unto the said Releasee and unto its successors and assigns forever, so that neither it the Releasor nor its successors nor any other person under it or them shall hereafter have any claim, right or title in or to the premises or any part thereof, but therefrom it is and they are by these presents, forever barred and secluded.

IN WITNESS WHEREOF, on this 23rd day of December A.D. 1935, said grantor having no corporate seal has caused a common seal to be hereto affixed and has adopted the same as and for its corporate seal and has caused this instrument to be signed, executed and delivered in its behalf by LeRoy C. Beecher, Frederick W. Rice, Howard W. Haggard, Henry A. Sperry, Marjorie Kilborn and Ivy E. Peck, a committee of this corporation and its agents, hereunto duly authorized.

Signed, sealed and delivered) THE FIRST ECCLESIASTICAL SOCIETY OF THE TOWN OF
in presence of) WOODBRIDGE By

Suzette A. Junglas (as to L.C.B.) Leroy C. Beecher (L.S.) Henry A. Sperry (L.S.)
Silas J. Peck (as to F.W.R. H.W.H. Frederick W. Rice (L.S.) Marjorie Kilborn (L.S.)
H.A.S M.K. & I.E.P.) Howard W. Haggard (L.S.) Ivy E. Peck (L.S.)
Newton H. Street (As to all)

Corp. Seal of First Eccl. Society of the Town of Woodbridge

State of Connecticut
New Haven County ss. Woodbridge, December 23, 1935

Personally appeared Leroy C. Beecher, Frederick W. Rice, Howard W. Haggard, Henry A. Sperry, Marjorie Kilborn, and Ivy E. Peck-A Committee of this corporation and its Agents, of the First Ecclesiastical Society of the Town of Woodbridge, signers and sealers of the foregoing instrument and acknowledged the same to be their free act and deed as such Committee and Agents, and the free act and deed of said The First Ecclesiastical Society of the Town of Woodbridge, before me,

Newton H. Street,
(Notarial Seal) Notary Public.

Received for Record December 24th, 1935 at 9h. 20m. A.M. and recorded by
Newton H. Street, Town Clerk.

WARRANTY

To all People to whom these Presents shall come, GREETING:

Know Ye, That I, Dorothy B. Heise, wife of Arthur R. Heise, to whom I was married after April 20th, 1877, both of the Town of Woodbridge, County of New Haven and State of Connecticut, for the consideration of One Dollar and other valuable considerations, in all less than One Hundred Dollars, received to my full satisfaction of The Woodbridge Park Association, Incorporated, a corporation legally existing under the statute laws of Connecticut, do give, grant, bargain, sell and confirm unto the said The Woodbridge Park Association, Incorporated, and unto its successors and assigns forever, a certain piece or parcel of land with all the improvements thereon, situated in said Town of Woodbridge, County of New Haven and State of Connecticut, as shown on a map entitled, "Amity Hills, Woodbridge, Conn., Developed by A.R.Heise, Inc., Scale 1 in. - 100 ft., May 15, 1953", Frederick C. Hahn, Civil Engineer and Surveyor, on file in the Woodbridge Town Clerk's Office, and bounded as follows:

EASTERLY by a Private Right of Way or Old Mill Road, as shown on said map, 20 feet;

SOUTHERLY by land of Aaron B. Lerner, et ux, 166.25 feet;

WESTERLY by land of The Woodbridge Park Association, Inc. 20 feet, more or less, and

NORTHERLY by land of the grantor herein, 168 feet, more or less, by a line drawn parallel with the said Southerly boundary.

As part consideration for this deed it is agreed that in the event that the private right of way or Old Mill Road as shown on said map is relocated in an easterly direction, then and in that event the grantor herein or her heirs or assigns will execute and deliver to said The Woodbridge Park Association, Inc., a good and sufficient Warranty Deed conveying a strip of land twenty (20) feet in width from the easterly end of the piece or parcel of land herein described and extending to the new private right of way or Old Mill Road as relocated.

Said premises are subject to a grant in favor of the Southern New England Telephone Company by deed from Dorothy B. Heise and Arthur R. Heise, dated April 30, 1956 and recorded in Vol. 58 on Page 403 of the Woodbridge Land Records, and to any other encumbrances as of record may appear, including a right of way to Newton H. Street and Ethel M. Street.

Said premises are also subject to building lines if established, all laws, ordinances or governmental regulations, including building and zoning ordinances, affecting said premises; and to taxes assessed against the same on the List of 1956, which will become due July 1, 1957.

To Have and to Hold the above granted and bargained premises, with the appurtenances thereof, unto the said grantee its successors and assigns forever, to its and their proper use and behoof. And Also, I the said grantor do for myself and my heirs, executors and administrators, covenant with the said grantee, its successors and assigns, that at, and until the ensealing of these presents, I am well seized of the premises, as a good indefeasible estate in Fee Simple, and have good right to bargain and sell the same in manner and form as is above written; and that the same is free from all incumbrances whatsoever, except as above written.

And Furthermore, I the said grantor do by these presents, bind myself and my heirs forever, to Warrant and defend the above granted and bargained premises to it the said grantee, its successors and assigns against all claims and demands whatsoever, except as above written.

In Witness Whereof, I have hereunto set my hand and seal this 9th day of November, A.D. 1956.

Signed, Sealed and Delivered in the presence of

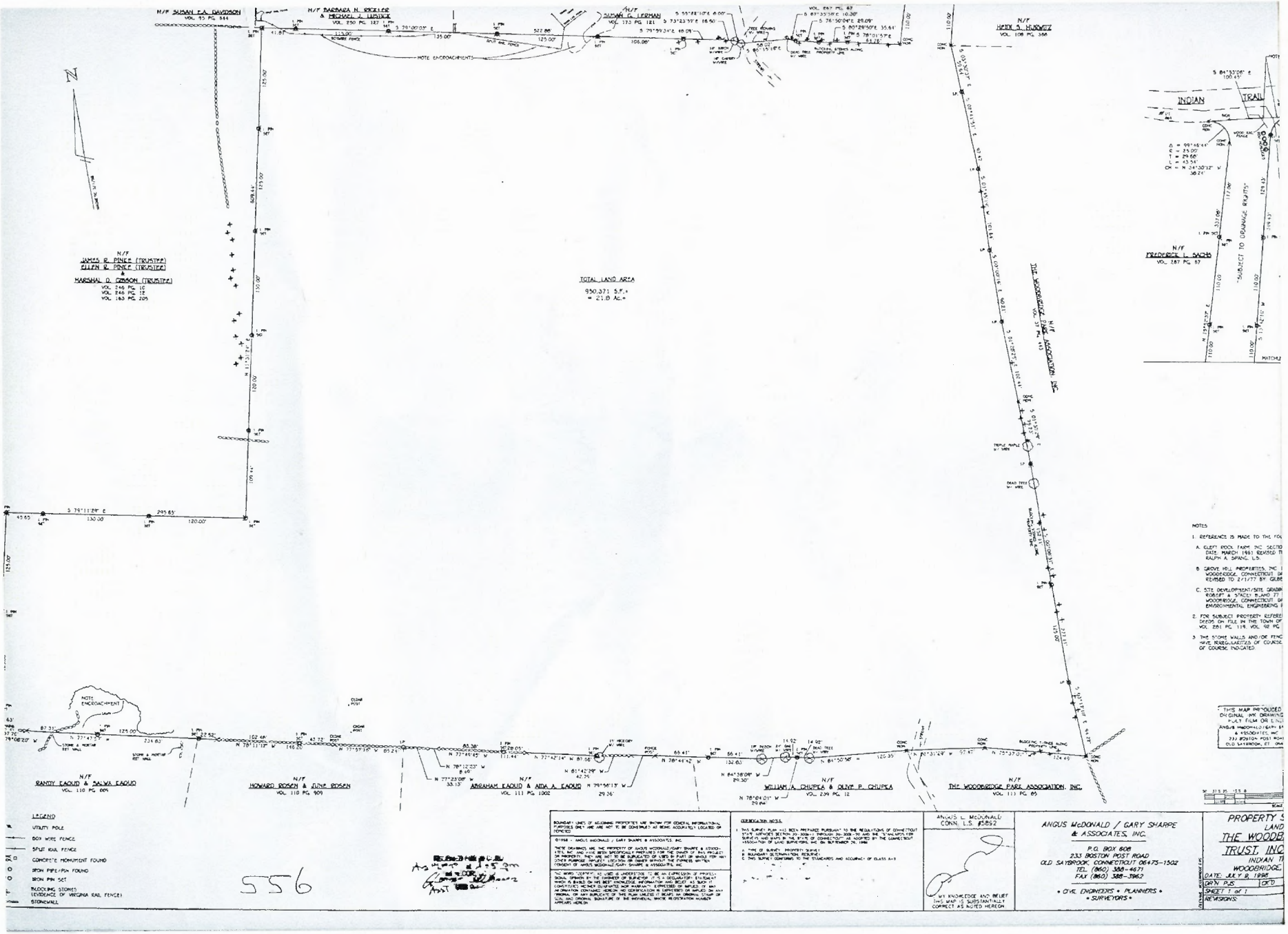
Dorothy B Heise (L.S.)

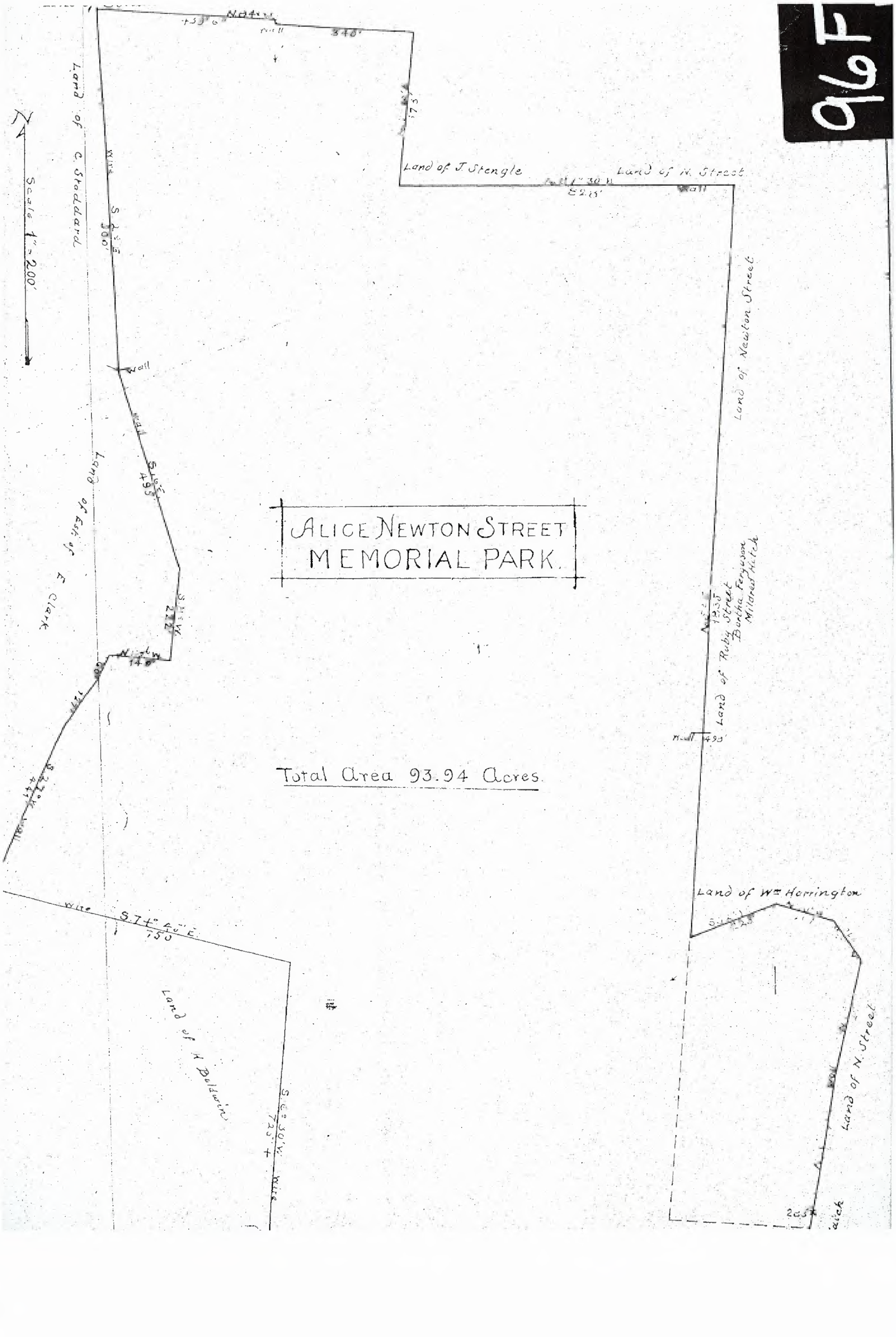
Victor Bacque

Grace P. Mansfield

STATE OF CONNECTICUT)
COUNTY OF NEW HAVEN) ss. Woodbridge, November 9th, A.D. 1956

Personally appeared Dorothy B. Heise, Signer and Sealer of the foregoing instrument, and acknowledged the same to be her free act and deed, before me,


N/F SUSAN P.A. DAVIDSON
VOL. 93 PG. 844
N/F BARBARA N. RICKLER & MICHAEL J. LEVINE
VOL. 250 PG. 127
N/F SUSAN G. LERMAN
VOL. 173 PG. 181
N/F HEIDI S. HOROWITZ
VOL. 108 PG. 366
N/F JAMES R. PINKE (TRUSTEE) ELLEN R. PINKE (TRUSTEE) & MARSHAL D. OSMON (TRUSTEE)
VOL. 246 PG. 10
VOL. 246 PG. 12
VOL. 183 PG. 205
TOTAL LAND AREA
950,371 S.F.±
= 21.8 Ac.±
N/F FREDERICK L. SACHS
VOL. 287 PG. 67
INDIAN TRAIL
SUBJECT TO DRAINAGE RIGHTS
THE WOODBRIDGE PARK ASSOCIATION, INC.
N/F RANDY EAQUID & SALWA EAQUID
VOL. 110 PG. 609
N/F HOWARD ROSEN & JUNE ROSEN
VOL. 110 PG. 909
N/F ABRAHAM EAQUID & AIDA A. EAQUID
VOL. 111 PG. 1002
N/F WILLIAM A. CHUPKA & OLIVE P. CHUPKA
VOL. 239 PG. 12
N/F THE WOODBRIDGE PARK ASSOCIATION, INC.
VOL. 133 PG. 65
NOTE ENCROACHMENT
NOTES
1. REFERENCE IS MADE TO THE FOL
A. CLIFFT ROCK FARM INC. SECTIO DATE MARCH 1981 REVISED T RALPH A. SPANG, L.S.
B. GROVE HILL PROPERTIES, INC. WOODBRIDGE, CONNECTICUT SH REVISED TO 2/1/77 BY GILBE
C. SITE DEVELOPMENT/SITE GRADIN ROBERT A. STACEY, PLAND 77 WOODBRIDGE, CONNECTICUT SH ENVIRONMENTAL ENGINEERING
2. FOR SUBJECT PROPERTY REFERE DEEDS ON FILE IN THE TOWN OF VOL. 221 PG. 118, VOL. 92 PG.
3. THE STONE WALLS AND/OR FENC HAVE IRREGULARITIES OF COURSE OF COURSE INDICATED
THIS MAP INCLUDED ORIGINAL INK DRAWING FULLY FILM OR E.N.I. ANGUS McDONALD / GARY SHARPE & ASSOCIATES, INC. 233 BOSTON POST ROAD OLD SAYBROOK, CT
LEGEND
UTILITY POLE
BOX WIRE FENCE
SPLIT RAIL FENCE
CONCRETE MONUMENT FOUND
IRON PIPE/PIN FOUND
IRON PIN SET
BLOCKING STONES (EVIDENCE OF VIRGINIA RAIL FENCE)
STONEWALL
556
ANGUS L. McDONALD CONN. L.S. #5852
ANGUS McDONALD / GARY SHARPE & ASSOCIATES, INC.
P.O. BOX 608
233 BOSTON POST ROAD
OLD SAYBROOK, CONNECTICUT 06475-1502
TEL. (860) 388-4671
FAX (860) 388-3962
• CIVIL ENGINEERS • PLANNERS • • SURVEYORS •
PROPERTY S
LAND
THE WOODBR
TRUST, INC
INDIAN TR
WOODBRIDGE,
DATE: JULY 8, 1998
DRN PJS
CKD
SHEET 1 of 1
REVISIONS


96F
ALICE NEWTON STREET
MEMORIAL PARK.
Total Area 93.94 Acres.
Land of J. Strengle
Land of N. Street
Land of Newton Street
Land of Ruby Street
Bertha Ferguson
Mildred Hitch
Land of Wm Harrington
Land of N. Street
Land of C. Stoddard
Land of Est. of E. Clark
Land of H. Baldwin
Scale 1" = 200'
340'
173'
528'
1255'
493'
S. 6° 30' W.
725' +
S. 74° 40' E.
750
495
222
441

VL0553[illegible]038

TO ALL PEOPLE TO WHOM THESE PRESENTS SHALL COME, GREETING:

KNOW YE, THAT I, ELAINE GLASS, of the Town of New Haven, County of New Haven and State of Connecticut, for the consideration of One Dollar and other valuable consideration, received to my full satisfaction of THE WOODBRIDGE PARK ASSOCIATION, INC., having a mailing address of PO Box 3883, Woodbridge, Connecticut 06525, grant to THE WOODBRIDGE PARK ASSOCIATION, INC., with **QUITCLAIM COVENANTS** all that certain piece or parcel of land, with all the improvements thereon, situated in the Town of Woodbridge, County of New Haven and State of Connecticut, known as Parcel 2B (undeveloped land) on the map referenced in Schedule A which piece or parcel is more particularly described in Schedule A attached hereto.

IN WITNESS WHEREOF, I have hereunto set my hand and seal this 12 day of July, 2006.

Signed, Sealed and Delivered
in the presence of:

Susan A. DeSilvis

Elaine Glass

Frank W. Pietrosimone

STATE OF CONNECTICUT)
) ss: Hamden July 12, 2006
COUNTY OF NEW HAVEN)

Personally appeared Elaine Glass, signer and sealer of the foregoing instrument, and acknowledged the same to be her free act and deed before me.

Frank W. Pietrosimone, Jr.
Commissioner of the Superior Court

$ 0 Conveyance Tax received

Eleanor A Leehy
Asst. Town Clerk of Woodbridge

Land Records Vol 553, p. 39-40
Alice Newton
Acquired 9.4 Acres from 163 Center Road, 2004

VL 0553PG039

ACCEPTANCE ON BEHALF OF THE WOODBRIDGE PARK ASSOCIATION, INC.

Pursuant to Connecticut General Statutes Section 47-6b, the undersigned, Christopher R. Dickerson, President of THE WOODBRIDGE PARK ASSOCIATION, INC., and duly authorized officer of THE WOODBRIDGE PARK ASSOCIATION, INC., by his signature endorsed hereon indicates the acceptance of this grant of the land herein by THE WOODBRIDGE PARK ASSOCIATION, INC.

IN WITNESS WHEREOF, The Woodbridge Park Association, Inc., through its President, Christopher R. Dickerson, has hereunto set its hand and seal this 26th day of July, 2006.

Signed, Sealed and Delivered
in the presence of:

THE WOODBRIDGE PARK
ASSOCIATION, INC.

Joseph F. Riccio

By: Christopher R. Dickerson
President, duly authorized

David W. Schaefer

STATE OF CONNECTICUT)
) ss: Woodbridge July 26, 2006
COUNTY OF NEW HAVEN)

Personally appeared Christopher R. Dickerson, President of THE WOODBRIDGE PARK ASSOCIATION, INC., signer and sealer of the foregoing instrument, and acknowledged the same to be his free act and deed and the free act of THE WOODBRIDGE PARK ASSOCIATION, INC., before me.

Commissioner of the Superior Court
~~Notary Public~~
~~My Commission Expires~~:

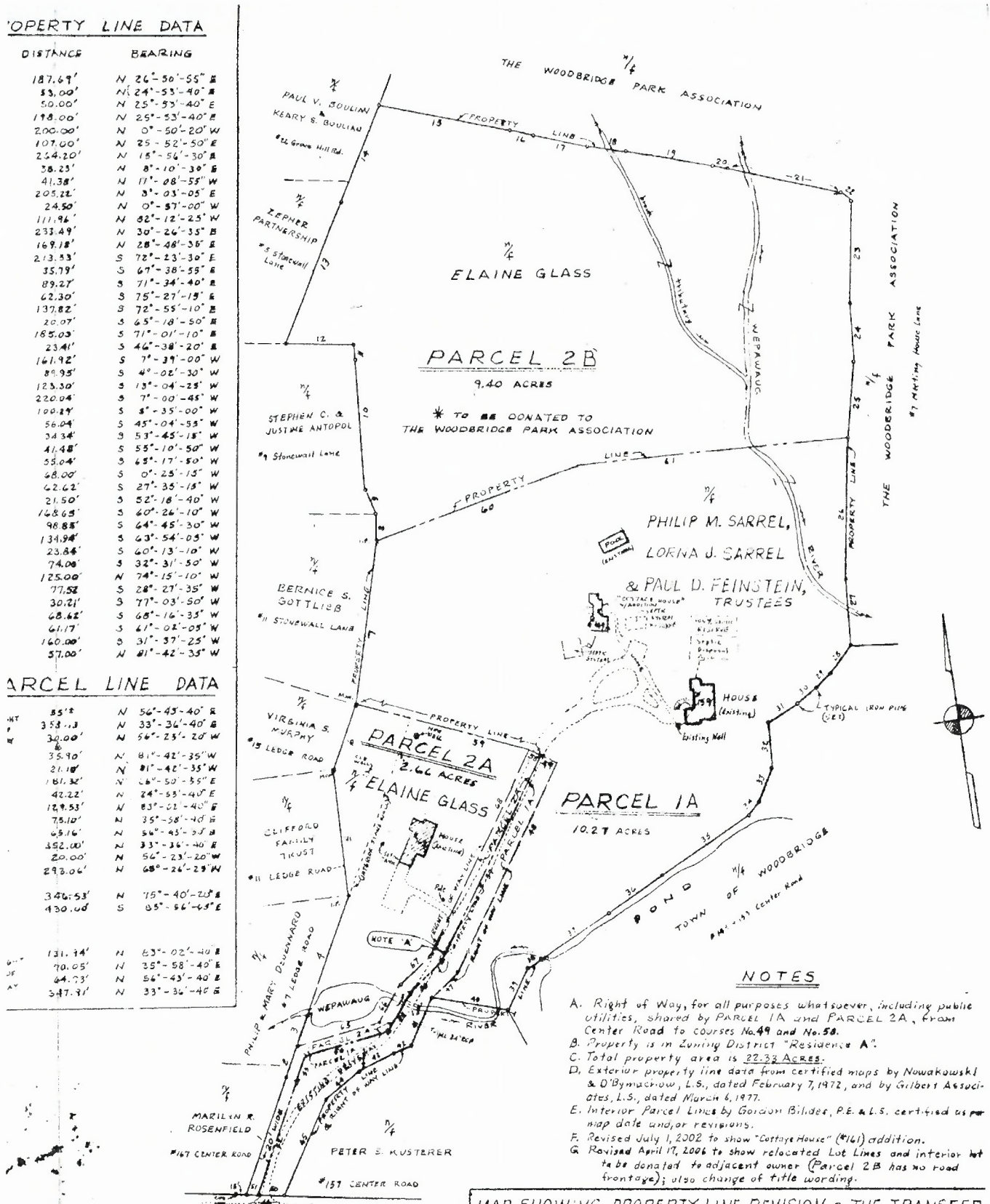
Land Records Vol 553, p. 39-40
Alice Newton
Acquired 9.4 Acres from Center Road, 2004

SCHEDULE A

All that certain piece and parcel of land with all the buildings and improvements thereon situated in the Town of Woodbridge, County of New Haven and State of Connecticut, being approximately 9.40 Acres and shown as Parcel 2B, "To Be Donated To The Woodbridge Park Association, on a map entitled: Map Showing Property Line Transfer & The Transfer of Land to the Woodbridge Park Association by Elaine Glass and Philip M. & Lorna Sarrel 159 and 163 Center Road Woodbridge, Connecticut" dated August 6, 1998, Revised July 1, 2002, Revised April 17, 2006, Scale 1"=100', prepared Gordon Bilides, PE Civil Engineer & Land Surveyor, Hamden, Connecticut, said map is on file in the Woodbridge Town Clerk's Office as map number 673.

Said piece and parcel of land is further subject to:
1. Notes and conditions shown on said map.
2. Riparian rights of others in and to the brooks and ponds on or crossing said parcel.
3. Building lines, if established, all laws, ordinances or governmental regulations, including building and zoning ordinances, affecting said parcel.
4. Said Parcel is not a building lot.

RECEIVED FOR RECORD
2006 JUL 31 A 9:12
001298
Asst. Eleann Ashelby
WOODBRIDGE TOWN CLERK



PROPERTY LINE DATA

DISTANCE	BEARING
187.69'	N 26°-50'-55" E
53.00'	N 24°-53'-40" E
50.00'	N 25°-53'-40" E
198.00'	N 25°-53'-40" E
200.00'	N 0°-50'-20" W
107.00'	N 25-52'-50" E
264.20'	N 15°-56'-30" E
38.23'	N 8°-10'-30" E
41.38'	N 17°-08'-55" W
205.22'	N 3°-03'-05" E
24.50'	N 0°-57'-00" W
111.96'	N 82°-12'-25" W
233.49'	N 30°-26'-35" E
169.18'	N 28°-48'-35" E
213.53'	S 72°-23'-30" E
35.79'	S 67°-38'-55" E
89.27'	S 71°-34'-40" E
62.30'	S 75°-27'-19" E
137.82'	S 72°-55'-10" E
20.07'	S 65°-18'-50" E
185.03'	S 71°-01'-10" E
23.41'	S 46°-38'-20" E
161.92'	S 7°-39'-00" W
89.95'	S 4°-02'-30" W
123.30'	S 13°-04'-25" W
220.04'	S 7°-00'-45" W
100.29'	S 8°-35'-00" W
56.04'	S 45°-04'-55" W
34.34'	S 53°-45'-15" W
41.48'	S 55°-10'-50" W
55.04'	S 65°-17'-50" W
68.00'	S 0°-25'-15" W
42.62'	S 27°-35'-15" W
21.50'	S 52°-18'-40" W
168.65'	S 60°-26'-10" W
98.85'	S 64°-45'-30" W
134.94'	S 63°-54'-05" W
23.84'	S 60°-13'-10" W
74.00'	S 32°-31'-50" W
125.00'	N 74°-15'-10" W
77.52	S 28°-27'-35" W
30.21'	S 77°-03'-50" W
68.62'	S 68°-16'-35" W
61.17'	S 61°-02'-05" W
160.00'	S 31°-37'-25" W
57.00'	N 81°-42'-35" W

PARCEL LINE DATA

HT	85'±	N 56°-43'-40" E
	358.13	N 33°-36'-40" E
W	30.00'	N 56°-23'-20" W
	35.90'	N 81°-42'-35" W
	21.18'	N 81°-42'-35" W
	181.32'	N 66°-50'-55" E
	42.22'	N 24°-53'-40" E
	129.53'	N 83°-02'-40" E
	75.10'	N 35°-58'-40" E
	65.16'	N 56°-43'-30" E
	352.00'	N 33°-36'-40" E
	20.00'	N 56°-23'-20" W
	293.06'	N 68°-26'-29" W
	346.53'	N 75°-40'-28" E
	430.00'	S 85°-56'-45" E
	131.74'	N 63°-02'-40" E
	90.05'	N 35°-58'-40" E
	64.73'	N 56°-43'-40" E
	347.31'	N 33°-36'-40" E

NOTES

A. Right of Way, for all purposes whatsoever, including public utilities, shared by PARCEL 1A and PARCEL 2A, from Center Road to courses No. 49 and No. 58.
B. Property is in Zoning District "Residence A".
C. Total property area is 22.32 ACRES.
D. Exterior property line data from certified maps by Nowakowski & O'Bymachow, L.S., dated February 7, 1972, and by Gilbert Associates, L.S., dated March 6, 1977.
E. Interior Parcel Lines by Gordon Bilides, P.E. & L.S. certified as per map date and/or revisions.
F. Revised July 1, 2002 to show "Cottage House" (#161) addition.
G. Revised April 17, 2006 to show relocated Lot Lines and interior lot to be donated to adjacent owner (Parcel 2B has no road frontage); also change of title wording.

MAP WAS MADE PREPARED IN ACCORDANCE WITH THING 20-300b-20 OF THE REGULATIONS OF MERCIES - "MINIMUM STANDARDS FOR SURVEYS TATE OF CONNECTICUT". IT IS A PROPERTY RESURVEY CONFORMING TO HORIZONTAL ACCURA- INTENDED TO BE USED IN THE OMBR.

ID BELIEF, THIS MAP IS SUBSTANTIALLY COR- M.

Gordon Bilides
DON BILIDES, P. E. & L. S.
nnecticut License No. 4400

STATE OF CONNECTICUT
GORDON BILIDES
LICENSED
PROFESSIONAL ENGINEER & LAND SURVEYOR

RECEIVED FOR RECORD
July 10, 2006
[illegible]

MAP SHOWING PROPERTY LINE REVISION & THE TRANSFER OF LAND TO THE WOODBRIDGE PARK ASSOCIATION BY

ELAINE GLASS

AND

PHILIP M. & LORNA SARREL

159 AND 163 CENTER ROAD

WOODBRIDGE, CONNECTICUT

Appendix 3

Wildlife Species List

1. Marbled Salamander
2. Spotted Salamander
3. Red-spotted Newt
4. Redback Salamander
5. Eastern American Toad
6. Northern Spring Peeper
7. Gray Treefrog
8. Bullfrog
9. Green Frog
10. Wood Frog
11. Pickerel Frog
12. Eastern Box Turtle
13. Eastern Painted Turtle
14. Northern Water Snake
15. Northern Brown Snake
16. Northern Redbelly Snake
17. Eastern Garter Snake
18. Black Rat Snake
19. Eastern Milk Snake
20. Great Blue Heron
21. Wood Duck
22. Turkey Vulture
23. Sharp-shinned Hawk
24. Cooper's Hawk
25. Red-shouldered Hawk
26. Broad-winged Hawk
27. Red-tailed hawk
28. Ruffed Grouse
29. Wild Turkey
30. American Woodcock
31. Mourning Dove
32. Black-billed Cuckoo
33. Yellow-billed Cuckoo
34. Barred Owl
35. Ruby-throated Hummingbird
36. Red-bellied Woodpecker
37. Yellow-bellied Sapsucker
38. Downy Woodpecker
39. Hairy Woodpecker
40. Northern Flicker
41. Pileated Woodpecker
42. Olive-sided Flycatcher
43. Eastern Wood-Pewee
44. Least Flycatcher
45. Eastern Phoebe
46. Tree Swallow
47. Blue Jay
48. American Crow
49. Black-capped Chickadee
50. Tufted Titmouse
51. Red-breasted Nuthatch
52. White-breasted Nuthatch
53. Brown Creeper
54. Carolina Wren
55. House Wren
56. Golden-crowned Kinglet
57. Ruby-crowned Kinglet
58. Veery
59. Swainson's Thrush
60. Hermit Thrush
61. Wood Thrush
62. American Robin
63. Gray Catbird
64. Northern Mockingbird
65. Cedar Waxwing
66. European Starling
67. Solitary Vireo
68. Red-eyed Vireo
69. Yellow Warbler
70. Chestnut-sided Warbler
71. Black-and-white Warbler
72. American Redstart
73. Ovenbird
74. Louisiana waterthrush
75. Common yellowthroat
76. Scarlet Tanager
77. Northern Cardinal
78. Rose-breasted Grosbeak
79. Rufous-sided Towhee
80. Chipping Sparrow
81. White-throated Sparrow
82. Dark-eyed Junco
83. Red-winged Blackbird
84. Common Grackle
85. Brown-headed Cowbird
86. Northern Oriole
87. Purple finch
88. American Goldfinch
89. Virginia Opossum
90. Masked Shrew
91. Pygmy Shrew
92. Eastern Pipistrelle
93. Big Brown Bat
94. Eastern Chipmunk
95. Woodchuck
96. Gray Squirrel
97. Red Squirrel
98. Southern Flying Squirrel
99. Beaver
100. Deer Mouse
101. White-footed Mouse
102. Southern Red-backed Vole
103. Porcupine
104. Coyote
105. Red Fox
106. Black Bear
107. Raccoon
108. Fisher
109. Striped Skunk
110. Bobcat
111. White-tailed Deer

Weed of the Week

Border Privet *Ligustrum obtusifolium* Sieb. & Zucc.

Common Names: border privet, blunt-leaved privet, regal privet

Native Origin: East Asia, Japan; introduced to North America as a common hedge in landscaping.

Description: Deciduous semi-evergreen, or evergreen shrub in the olive family (Oleaceae) that grows to 10 to 12 feet in height with spreading or arching stems. . Border privet is distinguished by its minutely pubescent twigs, by its pubescent leaf midrib, and by its flowering panicles which are about 1 to 2 inches in length. The deep green leaves are oblong-ovate in shape, opposite, and 1-2 inches long. Leaves turn red to purple in fall. Small white fragrant flowers, appearing in June, are grouped in panicles at the end of branch lets. The developing fruits (berry-like drupes) are green during the summer and turn blue-black when mature in the fall. The fruits persist long into the winter. This perennial shrub grows readily from seed or from root or stump sprouts

Habitat: It can be found in edge habitats, along roadsides, in open woods in old fields, in other disturbed habitats and in a variety of undisturbed natural areas.

Distribution: Connecticut, District of Columbia, Illinois, Indiana, Kentucky, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Tennessee, Utah, Vermont, and Virginia.

Ecological Impacts: This plant is capable of escaping to form dense thickets that can crowd out native species. It escapes from cultivation when the fruits are consumed by wildlife, particularly birds, which often excrete the seeds unharmed at distant locations where they may germinate and become established.

Control and Management:

- **Manual**- Mowing and cutting are appropriate for small populations or environmentally sensitive areas where herbicides cannot be used. Stems should be cut at least once per growing season as close to ground level as possible. Repeated mowing or cutting will control the spread.

- **Chemical**- Thoroughly wet all leaves with one of the following herbicides in water with a surfactant:
  August to September- imazapyr as a 1-percent solution or glyphosate as a 3-percent solution
  March to June- a glyphosate herbicide as a 3-percent solution.

  For stems too tall for foliar sprays, apply triclpyr as a 20-percent solution in commercially available basal oil, diesel fuel, or kerosene as a basal spray or thinline application October through February. Follow label and state requirements.

References:
http://plants.usda.gov, www.invasive.org/eastern/srs/control.html,
http://horticulture.psu.edu/courses/hort138/up-open/print_images.htm
Nature Conservancy Element Stewardship Abstract-
http://tncweeds.ucdavis.edu/esadocs/documnts/ligu_sp.html,
www.hort.uconn.edu/plants/l/ligobt/ligobt1.html,
http://webapps.lib.uconn.edu/ipane/browsing.cfm?descriptionid=61

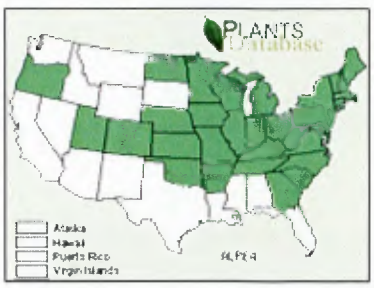
Produced by the USDA Forest Service, Forest Health Staff, Newtown Square, PA. WOW 09-28-05
Invasive Plants website: http://www.na.fs.fed.us/fhp/invasive_plants

Garlic Mustard *Alliaria petiolata* [Bieb] Cavara & Grande

Native Origin: Europe

Description: Garlic mustard is a cool season biennial herb in the mustard family (Brassicaceae) with stalked, triangular to heart-shaped, coarsely toothed leaves that give off an odor of garlic when crushed. First-year plants appear as a rosette of green leaves close to the ground. Rosettes remain green through the winter and develop into mature flowering plants the following spring. Flowering plants of garlic mustard reach from 2 to 3-1/2 feet in height and produce buttonlike clusters of small white flowers, each with four petals in the shape of a cross. Beginning in May (in the mid-Atlantic Coast Plain region), seeds are produced in erect, slender pods and become shiny black when mature. By late June, when most garlic mustard plants have died, they can be recognized only by the erect stalks of dry, pale brown seedpods that remain, and may hold viable seed, through the summer.

Habitat: Garlic mustard frequently occurs in moist, shaded soil of river floodplains, forests, and roadsides, edges of woods and trails edges and forest openings. Disturbed areas are most susceptible to rapid invasion and dominance. Though invasive under a wide range of light and soil conditions, garlic mustard is associated with calcareous soils and does not tolerate high acidity. Growing season inundation may limit invasion of garlic mustard to some extent.



Distribution: Garlic mustard is located from eastern Canada, south to Virginia and as far west as Kansas and Nebraska. See shaded areas on the distribution map.

Ecological Impacts: Garlic mustard poses a severe threat to native plants and animals in forest communities. Once introduced to an area, garlic mustard out-competes native plants by aggressively monopolizing light, moisture, nutrients, soil and space.

Control and Management:

Mechanical- Hand removal of entire root system of plant is practical for light infestations. For larger infestations cut stems at ground level or within several inches of the ground, to prevent seed production.
Chemical- Herbicide (e.g., Roundup) may be applied for very heavy infestations. Fire can be used but can encourage germination of stored seeds and promote growth of emerging garlic mustard seedlings.
Biocontrol- Five weevils and one flea beetle feed on garlic mustard

References: http://plants.usda.gov, www.nps.gov/plants/alien/fact/alpe1.htm
Biological Control of Invasive Plants in the Eastern United States p. 365-369

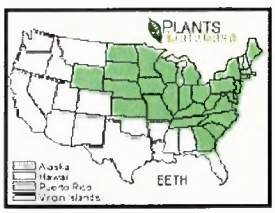
Produced by the USDA Forest Service, Forest Health Staff, Newtown Square, PA. WOW 08-01-05
Invasive Plants website: http://www.na.fs.fed.us/fhp/invasive_plants

Japanese Barberry *Berberis thunbergii* DC.

Native Range: Japan

Description: Japanese barberry is a compact, spiny, deciduous shrub in the barberry family (*Berberidaceae*) that commonly grows from 2 to 3 feet tall (although it can grow up to six feet in height). Roots are shallow but tough. The smooth-edged leaves range from oval to spoon-shaped and are clustered in tight bunches close to the branches. The single spines bear small leaves in their axils. Yellow flowers bloom in May, are about one third of an inch wide, and are solitary or in small clusters of 2-4 blossoms. The bright-red fruits mature in mid-summer and hang from the bush during autumn and into winter. The berries are small, oblong, and found singly or in clusters. The plant regenerates by seed and creeping roots. Birds and rabbits are known to eat the seeds and distribute the species. Branches root freely when they touch the ground; thus allowing single plants to become quite large.

Habitat: Japanese barberry prefers well-drained soils, although it has been found in wet, calcareous situations, (specifically in a black ash swamp). It is typically found in locations of partial sunlight such as woodland's edge; it can survive well under the shade of an oak canopy. It is also found along roadsides, fences, old fields, forest edges, and open woods. Japanese barberry can be found invading oak woodlands and oak savannas; it is widespread in Wisconsin woodlands south of the tension zone. A related non-native species, *B. vulgaris*, was widely planted for similar purposes, but has been exterminated because it is the alternate host of black rust, a disease that affects wheat crops. Japanese barberry competes poorly with grasses and may succumb to drought conditions.



Distribution: This species is reported from states shaded on the Plants Database map. It is reported invasive in CT, DC, DE, IN, KY, MA, MD, ME, MO, NC, NH, NJ, NY, OH, PA, RI, TN, VA, VT, WI, and WV.

Environmental Impact: It often escapes cultivation. Plants shade out other understory species. Recent research studies in New Jersey indicted that Japanese barberry changes the soil chemistry in environment it inhabits.

Control and Management:

- **Manual-** Mechanical removal of the plant is recommended in early spring because barberry is one of the first shrubs to leaf out, thereby making identification easier. Cutting, pulling or digging are effective in areas where there are only a few plants. A hoe, weed wrench, or mattock should be used to uproot the bush and all connected roots. Thick gloves are recommended for protection from the shrub's spines. Japanese barberry may be relatively easy to control in fire-adapted communities. Fire is thought to kill these plants and prevent future establishment.
- **Chemical-** Triclopyr has been used as a cut-stump treatment with success. Other herbicides labeled for brush control, such as glyphosate, may prove to be effective. Care in application is essential because glyphosate is a non-selective herbicide that can kill native species as well. Herbicides are suggested only for plants that are difficult to remove mechanically.

Reference: http://www.dnr.state.wi.us/org/land/er/invasive/factsheets/b..., http://plants.usda.gov/ http://webapps.lib.uconn.edu/ipane/browsing.cfm?descriptionid=26, www.forestryimages.org/ www.nps.gov/plants/alien, Czarapata, Elizabeth J. Invasive Plants of the Upper, *an Illustrated Guide to their Identification and Control,* 2005, p. 88-89

Produced by the USDA Forest Service, Forest Health Staff, Newtown Square, PA. WOW 06-13-05
Invasive Plants website: http://www.na.fs.fed.us/fhp/invasive_plants

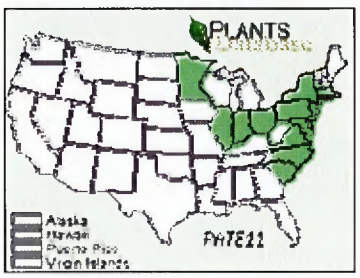
Japanese Pachysandra

Pachysandra terminalis Sieb. & Zucc.

Common Names: Japanese pachysandra, Japanese spurge

Native Origin: Asia- Japan

Description: An evergreen perennial herb groundcover in the Boxwood family (*Buxaceae*) that can reach twelve inches in height and spread to form dense mats. Small oval-shaped leaves, generally two to four inches in length, alternate about the stem. Flowers are white and appear between March and April. Fruits are on terminal branches and are extremely small. Reproduces vegetatively through underground stems and roots.



Habitat: It is prominent along forest and meadow edges.

Distribution: This species is reported from states shaded on Plants Database map. It is reported invasive in VA and DC.

Ecological Impacts: Japanese spurge grows very quickly, spreading by underground stems and forming a very dense groundcover that can displace other vegetation.

Control and Management:

- **Manual**- Hand pulling and controlled burning have been used successfully on appropriate areas.
- **Chemical**- It can be effectively controlled using any of several readily available general use herbicides such as glyphosate. Follow label and state requirements.

References: www.forestimages.org, http://plants.usda.gov, www.nps.gov/plants/alien, http://oncampus.richmond.edu, www.invasive.org, http://hortweb.cas.psu.edu, http://pubs.caes.uga.edu

Produced by the USDA Forest Service, Forest Health Staff, Newtown Square, PA. WOW 02-15-05
Invasive Plants website: http://www.na.fs.fed.us/fhp/invasive_plants

Japanese Honeysuckle *Lonicera japonica* Thunb

Native Origin: Japan and Korea; introduced to the U.S. in the early to mid-1800's as an ornamental plant, for erosion control, and wildlife

Description: Japanese honeysuckle, a member of the honeysuckle family (Caprifoliaceae), is a perennial vine that climbs by twisting its stems around vertical structures, including limbs and trunks of shrubs and small trees. The semi-evergreen to evergreen woody vine climbs and trails to 80 feet (24m) long, branching and often forming arbors in forest canopies. Leaves are opposite, oblong to oval, sometimes lobed, have short stalks, and occur in pairs along the stem. Flowers are tubular, with five fused petals, white to pink, turning yellow with age, very fragrant, and occur in pairs along the stem at leaf junctures (April to August). Stems and leaves are sometimes covered with fine, soft hairs. Small black fruits are produced in autumn, each containing 2-3 oval to oblong berry. The nearly spherical, green ripening to black, glossy berry is about 0.2 inch across on 0.4 to 1.2 inch stalks. It reproduces and spreads through vegetative (plant growth) and sexual (seed) means.

Habitat: It thrives in a wide variety of habitats including fields, forests, wetlands, barrens, and all types of disturbed lands. Occurs as dense infestations in forest margins, right-of-ways, and forest canopies. It is shade tolerant.

Distribution: Japanese honeysuckle occurs across the southern U.S. from California to New England and the Great Lakes region. Escaped populations also occur in Hawaii. Severe winter temperatures and low precipitation may limit its distribution in northern latitudes and in the West, respectively.

Ecological Impacts: It spreads and out-competes native plant species. Its evergreen to semi-evergreen nature gives it an added advantage over native species in many areas. Shrubs and young trees can be killed by girdling when vines twist tightly around stems and trunks, cutting off the flow of water through the plant. Dense growths of honeysuckle covering vegetation can gradually kill plants by blocking sunlight from reaching their leaves. Vigorous root competition helps it spread and displace neighboring native vegetation.

Control and Management:

Manual and mechanical- For small patches, hand-pull seedlings and young plants when the soil is moist, holding low on the stem to remove the whole plant along with its roots. Monitor frequently and remove any new plants. For large patches, repeated mowing combined with herbicide application is effective. Burning removes above ground vegetation but does not kill the underground rhizomes, which will continue to sprout.

Chemical- For effective control with herbicides, healthy green leaves must be present at application time and temperatures must be sufficient for plant activity. Several systemic herbicides (e.g., glyphosate and triclopyr) move through the plant to the roots when applied to the leaves or stems and have been effective on Japanese honeysuckle. Treatment in the fall, when many non-target plants are going dormant, is best. Repeat applications may be needed. Follow label guidelines.

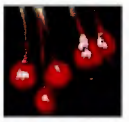
Other: In certain situations, tethered goats have been used to remove honeysuckle growth, but must be monitored to prevent their escape to the wild where they would become an added ecological threat.

References: http://plants.usda.gov, www.nps.gov/plants/alien, Nonnative Invasive Plants of the Southern Forest, p. 38-39

Produced by the USDA Forest Service, Forest Health Staff, Newtown Square, PA. WOW 01-05-05
Invasive Plants website: http://www.na.fs.fed.us/fhp/invasive_plants

Multiflora Rose

Rosa multiflora Thunb. ex Murr.



Common Names: multiflora rose, rambler rose

Native Origin: Eastern Asia (Japan, Korea and eastern China) introduced for ornamental purposed in the mid to late 1800's

Description: Multiflora rose is a thorny, perennial shrub in the rose family (*Rosaceae*) growing 10–15 feet in height and 9-13 feet in width. Stems are wide arching canes covered with hard thorns. Leaves are alternate, pinnately compound, and have five to eleven sharply toothed oval leaflets. Clusters of showy, fragrant, white to pink flowers begin blooming in May or June. Flowers are 0.5-1 inch wide and have 5 petals. Small bright red fruits, or rose hips, develop during the summer, becoming leathery, and remain on the plant through the winter. It reproduces by seed and by forming new plants that root from the tips of arching canes that contact the ground. Fruits are readily sought after by birds which are the primary dispersers of its seed. It has been estimated that an average plant may produce a million seeds per year, which may remain viable in the soil for up to twenty years.

Habitat: It grows in old fields, pastures, prairies, roadsides, and open woods. It thrives in full and partial sun with well-drained soils. It cannot tolerate winter temperatures below -28^0 F.

Distribution: This species is reported from states shaded on Plants Database map. It is reported invasive in AR, CA, CO, CT, DC, DE, GA, IL, IN, KY, LA, MA, MD, ME, MI, MO, MS, NC, NH, NJ, NY, OH, OR, PA, RI, SC, TN, VA, VT, WI, and WV.

Ecological Impacts: Multiflora rose is extremely prolific and can form impenetrable thickets that exclude native plant species. It invades a large number of habitats such as hillside pastures, fence rows, right-of-ways, roadsides, forest edges, margins of swamps and marshes.

Control and Management:

- **Manual**- cutting or mowing at the rate of three to six times per growing season, for two to four years is effective
- **Chemical**- It can be effectively controlled using any of several readily available general use herbicides such as glyphosate or triclopyr. Because of the long-lived stores of seed in the soil, follow-up treatments may be necessary. Follow label and state requirements.
- **Biological Control-** Four agents show potential for biological control in the US. Multiflora rose is vulnerable to defoliation by Japanese beetles. It also suffers from rose rosette disease, a virus like disease that causes plants to turn a deep red color, sprout broom-like growth, and produce more thorns than usual.

Roadside infestation

References: www.forestimages.org, http://plants.usda.gov, www.nps.gov/plants/alien, http://tncweeds.ucdavis.edu/esadocs/rosamult.html, Czarapata, Elizabeth J. Invasive Plants of the Upper Midwest, An Illustrated Guide to their Identification and Control, 2005 p. 43-45, Biological Control of Invasive Plants in the Eastern United States p. 280

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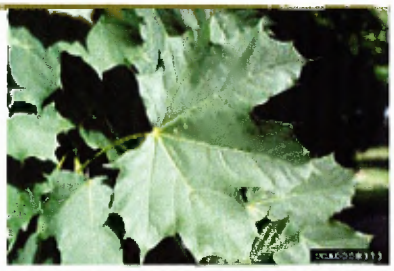
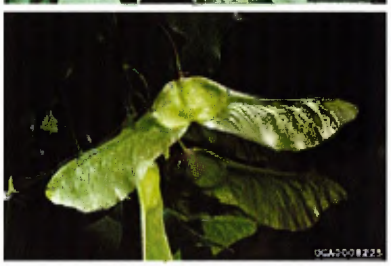
Invasive Plants website: http://www.na.fs.fed.us/fhp/invasive_plants

Norway maple *Acer platanoides* L.



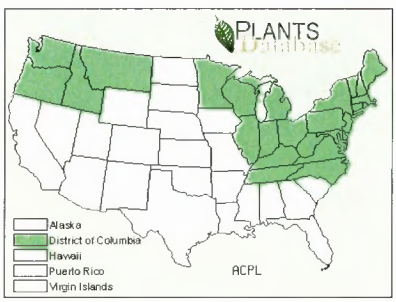


Native Origin: Europe and Western Asia

Description: A deciduous tree in the maple family (*Aceraceae*) growing 40-60 feet in height, but can reach heights of 100 feet with dense foliage, broad-rounded crown, and stout stems. The bark of the tree is grayish and shallowly grooved or furrowed. Palmate leaves are opposite, simple, and 10-18 cm across with 5 to 7 sharply pointed lobes. The glossy dark green leaves develop into yellow fall foliage. Leaves often have hairs in axils of veins and a milky sap can be observed when petiole is removed. In spring (April and May), showy clusters of flowers develop before leaves open. The yellow or greenish-yellow flowers are approximately 8 mm in diameter. Fruits mature during summer into wide-spreading wings that look like helicopter blades which split down the middle, releasing each half to the wind. Norway maple can be confused with many maple species, especially sugar maple (*Acer saccharum*). Milky white sap that oozes out of leaf veins and stalks when broken can help distinguish them from native maples. Also bud tips of sugar maple are pointy and sharp to the touch, while those of Norway maple are more rounded and not sharp to the touch.

Habitat: Norway maple prefers full sun, withstands hot dry conditions and tolerates ozone and sulfur dioxide air pollution. It is adapted to extremes in soils (sand, clay, acid, calcareous) and hardy to USDA Zone 4. It can be found in early and late succession forest, forested wetlands, open disturbed areas, roadsides, vacant lots, yards and gardens.

Distribution: This species is reported from states shaded on Plants Database map. It is reported invasive in CT, DC, DE, IL, IN, MA, MD, ME, MI, NH, NJ, NY, OR, PA, TN, VA, VT, WI, and WV.



Ecological Impacts: Trees produce a large quantity of seeds that can germinate rapidly and crowd out native species. Norway maples have been found in woodlands near cities, especially in the northeastern U.S. It has escaped cultivation and invades forests, fields, and other natural habitats. The species can be locally dominant in forest stands, create dense shade, and displace native trees, shrubs and herbs. Its dense canopy also can shade out native wildflowers.

Control and Management: Don't plant Norway maple.

- **Manual**- Pull seedlings when soil is moist. Dig out larger plants, including the root systems. Cut down large tree. Grind out the stump, or clip off re-growth. Girdle tree by cutting through the bark and growing layer (cambium) all around the trunk. Girdling is most effective in spring.

- **Chemical**- It can be effectively controlled using any of several readily available general use herbicides such as glyphosate or triclopyr. Follow label and state requirements.

References: www.forestimages.org, http://plants.usda.gov, www.nps.gov/plants/alien, www.invasive.org, http://oregonstate.edu, Invasive Plant Atlas of New England http://webapps.lib.uconn.edu/ipane, www.mdflora.org/publications/invasives, www.hort.uconn.edu/cipwg/art_pubs/docs/norway_maple.pdf, Plant Invaders of Mid-Atlantic Natural Areas, NPS & USFWS, p. 52-53

Produced by the USDA Forest Service, Forest Health Staff, Newtown Square, PA. WOW 11-15-04
Invasive Plants website: http://www.na.fs.fed.us/fhp/invasive_plants

Oriental Bittersweet *Celastrus orbiculatus* Thumb.

Common Names: Oriental, round-leaved and Asiatic bittersweet

Native Origin: Eastern Asia, Korea, China and Japan

Description: It is a deciduous, woody, perennial vine or trailing shrub. Light brown stems may reach 2 – 4 inches in diameter and up to 59 feet in length. Leaves (2-5 inch) are glossy, rounded, finely toothed and arranged alternately along the stem. Clusters of small whitish- greenish flowers emerge, May – June, from leaf axils, allowing each plant to produce large numbers of seeds. At maturity, globular, green to yellow fruits split open to reveal three red-orange, fleshy arils that contain the seeds. These showy fruits have made oriental bittersweet popular for use in floral arrangements. They reproduce by seed and vegetatively by root suckering.

Habitat: Oriental bittersweet infests forest edges, woodlands, early succession fields, hedgerows, coastal areas and salt marsh edges, particularly those suffering some form of land disturbance. While often found in more open, sunny sites, its tolerance for shade allows oriental bittersweet to invade forested areas.

Distribution: Oriental bittersweet currently occurs from New York to North Carolina, and westward to Illinois.

Ecological Impacts: Oriental bittersweet is an aggressive invader that threatens all vegetation levels of forested and open areas. It grows over other vegetation, completely covering it, and kills other plants by preventing photosynthesis, girdling, and uprooting by force of its massive weight. In the northeastern U.S., exotic Oriental bittersweet appears to be displacing the native climbing bittersweet, *Celastrus scandens*, which occurs in similar habitats, through competition and hybridization.

Control and Management:

Mechanical- hand pull by the roots and removed from the site, preferably before fruiting; if fruits are present, vines should be bagged and disposed of in a landfill, or left in the bags and allowed to bake in the sun long enough to kill the seeds.

Chemical- Herbicides, such as glyphosate (e.g., Roundup) or triclopyr (e.g., Garlon) are successful\. These herbicides are taken into the roots and kill the entire plant.

References: http://plants.usda.gov, http://www.nps.gov/plants/alien/
Invasive Plants Field and Reference Guide: An Ecological Perspective of Plant Invaders of Forests and Woodlands

Produced by the USDA Forest Service, Forest Health Staff, Newtown Square, PA. WOW 07-14-05
Invasive Plants website: http://www.na.fs.fed.us/fhp/invasive_plants

Winged Burning Bush

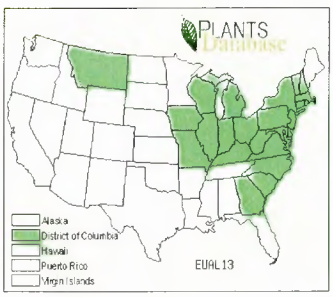
Euonymus alatus (Thunb.) Sieb.

Common Names: winged burning bush, winged euonymus, burning bush, burning bush euonymus, wahoo, winged spindle-tree

Native Origin: Asia to central China; introduced into U.S. around 1860 as an ornamental shrub

Description: A deciduous bushy shrub in the bittersweet family (*Celastraceae*) that grows to 15 to 20 feet tall and equally as wide. It is multi-stemmed with a broad closed crown. The green to brown stems have two to four prominent corky wings. The elliptic leaves are simple, opposite or sub-opposite, 1 to 3 inches long and 1/2 to 1 1/4 inches wide and have fine toothed margins. The leaves turn a bright red in the fall before dropping. Small green inconspicuous flowers have 4-petals and occur from May to early June. Small smooth red-orange fruits appear as stemmed pairs in leaf axils and turn purple in fall.

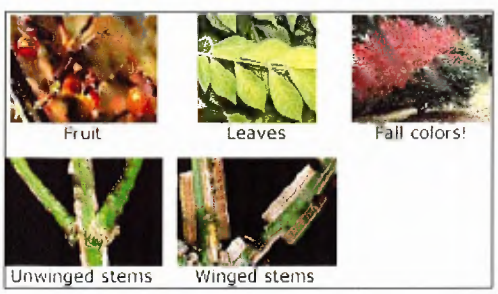
Habitat: It can be found in open woods, forests, pastures, prairies, and roadsides. It is very adaptable to a variety of soils, including being pH adaptable, performing best in well drained soils and poorest in waterlogged soils. It grows well in full shade and full sun but shows stress in soils subject to drought.



Distribution: This species is reported from states shaded on Plants Database map. It is reported invasive in CT, DE, IN, KY, MA, MD, MO, NH, NJ, OH, PA, RI, TN, VA, WI, and WV.

Ecological Impacts: It has been widely planted as an ornamental shrub for its spectacular red autumn foliage and along roadsides for its tolerance to salt. It may spread by seed from where it is used as an ornamental shrub. It colonizes by root suckers and spreads by animal-dispersed seeds. It shades out native herbs and crowds out native shrubs. The shrub may become a troublesome plant because of the ease with which seeds are spread, the readiness of germination, the adaptability to various soils, and tolerance of full shade.

Control and Management:



- **Manual**- Hand-pull seedlings up to 2 feet tall; cut or dig out larger plants; root systems can be removed with a spading fork or pull with a weed wrench; ground out stump and paint with glyphosate immediately after cutting
- **Chemical**- It can be effectively controlled using any of several readily available general use herbicides such as glyphosate, imazapyr, or triclopyr. Cut stumps can be sprayed or painted with glyphosate. Follow label and state requirements.

References: www.forestimages.org, http://plants.usda.gov, www.nps.gov/plants/alien, Czarapata, Elizabeth J. Invasive Plants of the Upper Midwest, An Illustrated Guide to their Identification and Control, 2005 p. 90-91, www.vnps.org/invasive/invfseual.htm, www.invasive.org

Produced by the USDA Forest Service, Forest Health Staff, Newtown Square, PA. WOW 01-16-05
Invasive Plants website: http://www.na.fs.fed.us/fhp/invasive_plants

APPENDIX 5

Woodbridge Inventory

Date:_____Observer Initials:_____GIS (UTM) Coordinates:_____Plot #_____

1. Stand Development Stage: SI SE UR OG Cover Type:_____
2. Is area near plot abundant in invasives? Y / N
3. Circle if present: Scat Tracks Nests Browse
4. Animal Sighting? Y / N
5. Any ledges? Wildlife habitat potential? Y / N
6. If near a boundary, is it marked? Y / N
7. Any sign / sighting /contact with neighbors / property users ? Y / N
8. Does this area seem suitable for trail placement / nature walk ? Y / N / Maybe
9. Does this area seem suitable for a conservation area? Y / N / Maybe

Additional Notes: Indicate question number followed by special considerations.

	Overstory					*Understory*				*Regeneration*	
	Spp	**DBH (in)**	**Heig ht (ft)**	**W, D, S**		**Spp**	**% Bin**	**D, V, U**		**Seedling (1 – 4.5 ft)**	**Sapling (> 4.5 ft)**
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

Snags			*Coarse Woody Debris*		
Quad	Distance (ft)		2-4”	4-10”	>10”
Q1					
Q2					
Q3					
Q4					

The Nature Conservancy

SAVING THE LAST GREAT PLACES ON EARTH

Weed Control Methods Handbook: Tools & Techniques for Use in Natural Areas

Wildland Invasive Species Team

Mandy Tu, Callie Hurd & John M. Randall
The Nature Conservancy
Wildland Invasive Species Team
version April 2001

Weed Control Methods Handbook:
Tools and Techniques for Use in Natural Areas

Mandy Tu, Callie Hurd, and John M. Randall

Note: This manual is periodically revised, expanded, and improved. If you have any comments or questions please contact TNC's Wildland Invasive Species Team:

Barry Rice bamrice@ucdavis.edu or 530-754-8891

Mandy Tu imtu@tnc.org or 503-230-1221

Tu, M., Hurd, C. & J.M. Randall. 2001. Weed Control Methods Handbook, The Nature Conservancy, http://tncweeds.ucdavis.edu, version: April 2001

INTRODUCTION

Invasive non-native plants are a serious threat to native species, communities, and ecosystems in many areas around the world. They can compete with and displace native plants, animals, and other organisms that depend on them, alter ecosystem functions and cycles significantly, hybridize with native species, and promote other invaders. The good news is that many plant invasions can be reversed, halted or slowed, and in certain situations, even badly infested areas can be restored to healthy systems dominated by native species. In most instances this requires taking action to control and manage those invasive plants. This handbook provides you with detailed information about the tools and techniques available for controlling invasive plants, or weeds, in natural areas. Whenever possible, language familiar to natural area managers is used, and unfamiliar terms and jargon borrowed from other fields are defined.

Before embarking on a weed management program, it is important to develop a straightforward rationale for the actions you plan to take. We believe this is best accomplished using an adaptive management approach as follows (see Figure 1): (1) establish management goals and objectives for the site; (2) determine which plant species or populations, if any, block or have potential to block attainment of the management goals and objectives; (3) determine which methods are available to control the weed(s); (4) develop and implement a management plan designed to move conditions toward management goals and objectives; (5) monitor and assess the impacts of management actions in terms of their effectiveness in moving conditions toward these goals and objectives; and (6) reevaluate, modify, and start the cycle again. Note that control activities are not begun until the first three steps have been taken. A weed control program is best viewed as part of an overall restoration program, so focus on what you want in place of the weed, rather than simply eliminating the weed. When selecting control methods, keep in mind that the ultimate purpose of the work is to preserve native species, communities, and/or functioning ecosystems.

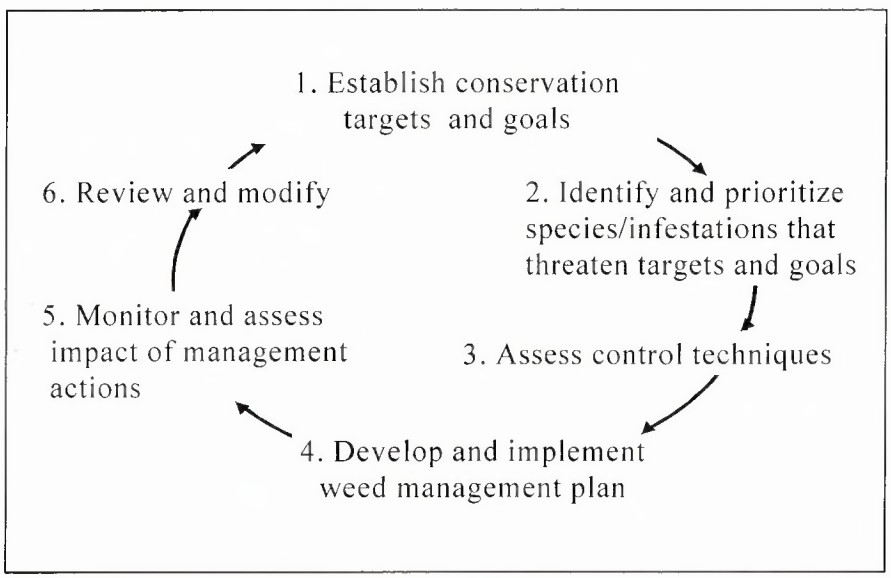


Figure 1. Adaptive Weed Management Approach

This Handbook is divided into eight chapters, covering a range of different control methods. More often than not, however, successful weed control requires the combination or sequential use of several methods (called integrated weed management). For example, cutting followed by herbicide applications has been used successfully in many programs, and prescribed fires followed by spot-applications of herbicides have been used well in others. Consider all available control options: manual, mechanical, promoting competition from native plants, grazing, biocontrol, herbicides, prescribed fire, solarization, flooding, and other, more novel, techniques. Each has advantages and disadvantages in terms of its effects against the target weed(s), impacts to untargeted plants and animals, risks to human health and safety, and costs. The chapters that follow discuss the advantages and disadvantages for each method and provide examples of their successful (and in some cases unsuccessful) use in natural areas.

Chapter 1 describes a variety of manual and mechanical techniques. Chapter 2 covers the use of grazing for weed control in natural areas including the types of animals that can be used and how to time grazing for best effect. Chapter 3 briefly discusses the use of prescribed fire to control invasive plants. TNC has specific guidelines and regulations for using prescribed fire that must be adhered to. See TNC's Fire Management Manual and contact TNC's Fire Initiative (http://www.tncfire.org) for details on the steps required to develop and implement a Site Fire Management Plan.

Chapter 4 covers biological control of invasive plants. Biocontrol agents typically have the capacity to persist, to spread to areas far from release sites, and may undergo genetic or behavioral changes that allow them to feed on new hosts. In spite of these risks, the use of biocontrol has the potential to be one of the most powerful tools available for invasive species control. TNC's policy is to not allow intentional releases of biocontrol agents on land it owns and manages, unless permission to do so has been granted by the Executive Director of TNC's Invasive Species Initiative. TNC's biocontrol release policy and standard operating procedures for requesting permission for releases are contained in this chapter.

Chapters 5 though 7 provide information on the use of herbicides to control invasive plants in natural areas. Chapter 5 discusses factors to consider when deciding whether to use herbicides or not, provides guidelines for herbicide use, and describes different application methods, who may apply herbicides and when they are most effectively applied. TNC staff should read the "Standard Operating Procedures & Guidelines" and "Herbicide Health & Safety Guidelines" in this chapter **PRIOR** to purchasing or using herbicides. Chapter 6 discusses general properties of herbicides, different types of herbicide formulations, their behavior in the environment, and human and environmental safety concerns. Chapter 7 provides detailed information for eleven herbicides that have been used in natural areas. It contains a table that summarizes important characteristics of each of the 11 herbicides, followed by detailed information about each one. Finally, Chapter 8 discusses the addition and use of adjuvants in herbicide tank mixes. Adjuvants are often added into a tank mix to improve herbicide penetration and/or to facilitate the mixing, application and effectiveness of that herbicide formulation.

Information on the biology and control of specific invasive plants are available from http://tncweeds.ucdavis.edu and other sites on the web. TNC staff that would like additional assistance are encouraged to contact TNC's Wildland Invasive Species Team. John Randall (530-754-8890 or jarandall@ucdavis.edu), Barry Rice (530-754-8891 or bamrice@ucdavis.edu) or Mandy Tu (503-230-1221 or imtu@tnc.org) are available to answer questions and provide advice, information and referrals regarding specific weed problems.

ACKNOWLEDGEMENTS

The authors would like to thank Ramona Robison, Dr. Joe DiTomaso and Dr. Tom Lanini for valuable contributions and substantial comments on this book. Dr. Barry Rice was instrumental in making this handbook web-accessible.

Date Authored: April 2001
Updated: June 2003

GLYPHOSATE

M. Tu, C. Hurd, R. Robison & J.M. Randall

Herbicide Basics

Chemical formula: N-(phosphonomethyl) glycine

Herbicide Family: None generally recognized

Target Species: most annual and perennial plants

Forms: salts

Formulations: SL, EC

Mode of Action: amino acid synthesis inhibitor

Water Solubility: 900,000 ppm

Adsorption potential: high

Primary degradation mech: slow microbial metabolism

Average Soil Half-life: 47 days

Mobility Potential: low

Dermal LD50 for rabbits: >5,000 mg/kg

Oral LD50 for rats: 5,600 mg/kg

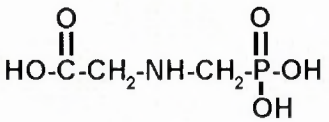
LC50 for bluegill sunfish: 120 mg/L

Trade Names: RoundUp®, RoundUp-Pro®, Rodeo®, GlyPro®, Accord®, Glyphomax®, Touchdown®

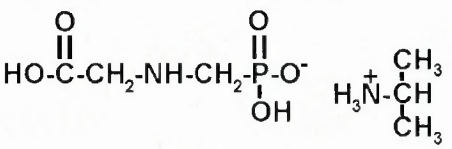
Manufacturers: Monsanto, Cenex/Land O'Lakes, Dow AgroSciences, Du Pont, Helena, and Platte.

Synopsis

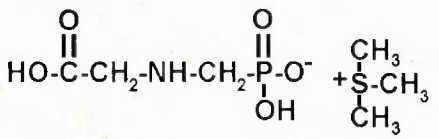
Glyphosate is a non-selective, systemic herbicide that can control most annual and perennial plants. It controls weeds by inhibiting the synthesis of aromatic amino acids necessary for protein formation in susceptible plants. Glyphosate is strongly adsorbed to soil particles, which prevents it from excessive leaching or from being taken-up from the soil by non-target plants. It is degraded primarily by microbial metabolism, but strong adsorption to soil can inhibit microbial metabolism and slow degradation. Photo- and chemical degradation are not significant in the dissipation of glyphosate from soils. The half-life of glyphosate ranges from several weeks to years, but averages two months. In water, glyphosate is rapidly dissipated through adsorption to suspended and bottom sediments, and has a half-life of 12 days to ten weeks. Glyphosate by itself is of relatively low toxicity to birds, mammals, and fish, and at least one formulation sold as Rodeo® is registered for aquatic use. Some surfactants that are included in some formulations of glyphosate, however, are highly toxic to aquatic organisms, and these formulations are not registered for aquatic use. Monsanto's patent for glyphosate expired in 2000, and other companies are already selling glyphosate formulations.



Glyphosate acid



Glyphosate isopropylamine salt



Glyphosate trimethylsulfonium salt

HEXAZINONE

Herbicide Basics

Chemical formula: 3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5-triazine-2,4(1H,3H)-dione

Target Species: annual, biennial, perennial, and woody weeds

Forms: not available as salt or ester

Formulations: SP, SC, WG, TB

Mode of Action: Photosynthesis inhibitor

Water Solubility: 33,000 ppm

Adsorption potential: low

Primary degradation mech: Slow microbial metabolism

Average Soil Half-life: 90 days

Mobility Potential: high

Dermal LD50 for rabbits: >6,000 mg/kg

Oral LD50 for rats: 1,690 mg/kg

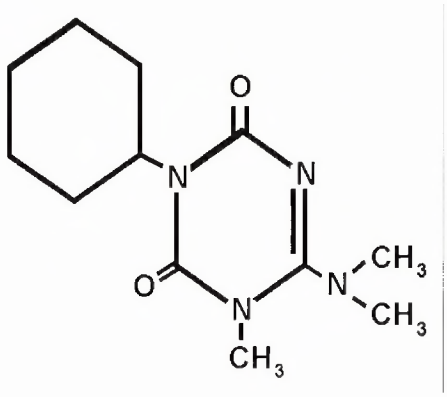
LC50 for bluegill sunfish: 370 mg/L

Trade Names: Pronone® and Velpar®

Manufacturers: DuPont and Pro-Serve

Synopsis

Hexazinone controls some grasses, many annual and perennial broadleaf herbs, and some woody species, by inhibiting photosynthesis. It is water-soluble and does not bind strongly with soils, and so is of particular concern for groundwater contamination. Hexazinone can enter aquatic systems through surface and subsurface runoff following application and drift during application. It is degraded by microbial metabolism, but not readily decomposed chemically or by sunlight, and can therefore persist in aquatic systems. The average half-life of hexazinone in soils is 90 days, but it can sometimes be found in runoff up to six months after application. Although it is of relatively low toxicity to birds and mammals, legal application rates can leave residues that exceed EPA's Level of Concern for aquatic and terrestrial plants and small mammals. It is of relatively low toxicity to fish and aquatic invertebrates but can be highly toxic to some species of algae. Hexazinone contamination has been detected in small water-bodies in episodic, low-level pulses that were rapidly diluted in mainstream flows. High concentrations of hexazinone, however, could lead to significant losses of algae and macrophytic biomass, which could produce a ripple effect in the food chain that ultimately could impact fish and wildlife species. Although hexazinone can accumulate in treated crops, concentrations in vegetation are not likely to reach toxic levels for foraging animals when hexazinone is applied properly. Care should be taken in preparing and applying hexazinone as it can cause severe eye damage.



IMAZAPYR

Herbicide Basics

Chemical formula: (±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid

Herbicide Family: Imidazolinone

Target Species: grasses, broadleaves, vines, brambles, shrubs and trees, riparian and emerged aquatics

Forms: acid & salt

Formulations: SL, GR

Mode of Action: Amino acid synthesis inhibitor

Water Solubility: 11,272 ppm

Sorption potential: low

Primary degradation mech: Slow microbial metabolism and photolysis

Average Soil Half-life: 25-141 days

Mobility Potential: high

Dermal LD50 for rabbits: >2,000 mg/kg

Oral LD50 for rats: >5,000 mg/kg

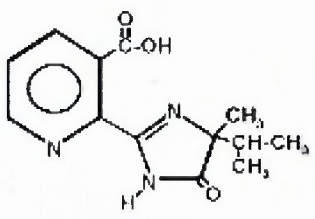
LC50 for bluegill sunfish: >100 mg/L

Trade Names: Arsenal®, Habitat®, Chopper®, and Stalker®

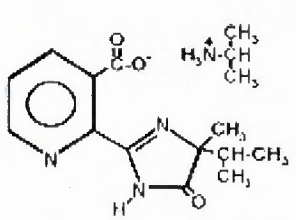
Manufacturer: BASF (previously American Cyanamid Company)

Synopsis

Imazapyr is a non-selective herbicide used for the control of a broad range of weeds including terrestrial annual and perennial grasses and broadleaved herbs, woody species, and riparian and emergent aquatic species. It controls plant growth by preventing the synthesis of branched-chain amino acids. Because imazapyr is a weak acid herbicide, environmental pH will determine its chemical structure, which in turn determines its environmental persistence and mobility. Below pH 5 the adsorption capacity of imazapyr increases and limits its movement in soil. Above pH 5, greater concentrations of imazapyr become negatively charged, fail to bind tightly with soils, and remain available (for plant uptake and/or microbial breakdown). In soils imazapyr is degraded primarily by microbial metabolism. It is not, however, degraded significantly by photolysis or other chemical reactions. The half-life of imazapyr in soil ranges from one to five months. In aqueous solutions, imazapyr may undergo photodegradation with a half-life of two days. Imazapyr is not highly toxic to birds and mammals, but some formulations (for instance, the inert ingredients in Chopper® and Stalker®) can cause severe, irreversible eye damage. Studies indicate imazapyr is excreted by mammalian systems rapidly with no bioaccumulation. It has a low toxicity to fish, and algae and submersed vegetation are not affected. Because imazapyr can affect a wide range of plants and can remain available, care must be taken during application to prevent accidental contact with non-target species. Further, a few studies have reported that imazapyr may be actively exuded from the roots of legumes (such as mesquite), likely as a defense mechanism by those plants. This exudate and the ability of imazapyr to move via intertwined root grafts may therefore adversely affect the surrounding desirable vegetation with little to no control of the target species.



Imazapyr acid



Imazapyr isopropylamine salt

PICLORAM

Herbicide Basics

Chemical formula: 4-amino-3,5,6-trichloro-2-pyridinecarboxylic acid

Herbicide Family: Pyridine (Picolinic acid)

Target Species: broadleaf herbs, vines, and woody plants, esp. leafy spurge

Forms: salt, & ester

Formulations: SL, EC

Mode of Action: Auxin mimic

Water Solubility: 430 ppm

Sorption potential: low

Primary degradation mech: Microbial and chemical degradation

Average Soil Half-life: 90 days

Mobility Potential: high

Dermal LD50 for rabbits: >2,000 mg/kg

Oral LD50 for rats: >5,000 mg/kg

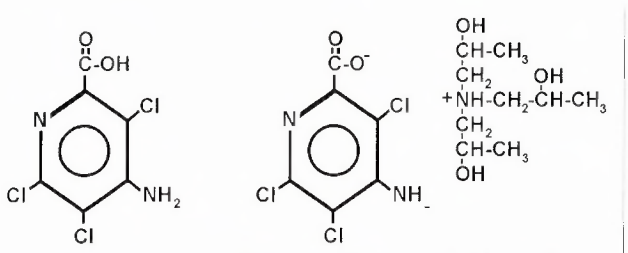
LC50 for bluegill sunfish: >14.5 mg/L

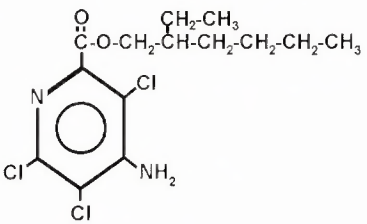
Trade Names: Grazon®, Tordon®, Access®, and Pathway®

Manufacturer: Dow AgroSciences

Synopsis

Picloram kills or damages annual and perennial broadleaf herbs and woody plants. It acts as an "auxin mimic" or synthetic growth hormone that causes uncontrolled and disorganized growth in susceptible plants. Picloram does not bind strongly with soil particles and is not degraded rapidly in the environment, allowing it to be highly mobile and persistent (half-life of picloram in soils can range from one month to several years). In soils, picloram is degraded primarily by microbial metabolism, but it can be degraded by sunlight when directly exposed in water or on the surface of plants or soil. Picloram can move off-site through surface or subsurface runoff and has been found in the groundwater of 11 states. Picloram may also "leak" out of the roots of treated plants, and be taken up by nearby, desirable species. Picloram is not highly toxic to birds, mammals, and aquatic species. Some formulations are highly toxic if inhaled, while other formulations can cause severe eye damage if splashed into the eyes. Because of the persistence of picloram in the environment, chronic exposure to wildlife is a concern, and studies have found weight loss and liver damage in mammals following long term exposure to high concentrations. Concentrations in runoff reported by researchers are often adequate to prevent the growth of non-target terrestrial and aquatic plants, and therefore, picloram should not be applied near waters used for irrigation.





Weed Control Methods Handbook, The Nature Conservancy, Tu *et al.*

Mowing

Mowing is one of the most common wildlife management techniques, though many who use it do not realize that they are actively managing habitat. For many landowners, mowing is simply a way to keep their property from growing up into "weeds," briars, shrubs, and trees or to keep their places "looking good." However, unless some serious thought is put into when, where, how, and why to mow, wildlife may suffer. The purpose of this article is to encourage landowners to question their reasons for current mowing practices and to offer guidelines on the best ways to mow to benefit wildlife.

There are some key facts that every landowner should be aware of with respect to mowing and wildlife. First, mowing during spring and summer will affect and may kill nesting and young animals, ranging from rabbits to deer fawns to northern bobwhite quail. Second, wildlife need uncut areas that have grown up during summer and fall for winter cover. Third, mowing entire fields in a single year is normally not needed to maintain them, and it is certainly not the most beneficial strategy of mowing. Rotational and pattern mowing are better alternatives for wildlife. Finally, a critical point to recognize is that your mowing objective should not necessarily be to rid your fields of "weeds." A weed is best defined as an undesirable plant, but many plants generally considered to be weeds are highly desirable for wildlife. For example, foxtail, ragweed, and beggars' lice are top foods of northern bobwhite quail and mourning doves, and insect-rich fields with "weedy" growth provide crucial habitat for quail and songbird broods.

Figure 1. Native grasses managed with prescribed burning (above) compared to tall fescue managed with mowing (below). In the burned stand above, note the open spaces at ground level where small animals can move unhindered.

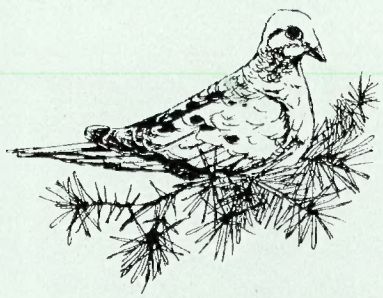
Objectives

The practical concerns of mowing, such as timing, pattern, frequency, and height, should be determined by the objectives for the area to be mowed. Mowing is often used to maintain grasses and/or legumes*, such as in a yard or pasture/hay field setting. Some of the most common objectives and the way those can be met are discussed below.

Lawns

While the height and frequency of cutting for most lawns will limit their benefits to wildlife, they can be enhanced for wildlife by maintaining a grass height of 3 inches, and setting aside extended yard areas, corners, and fencerows for plantings. Order a Backyard Wildlife Kit by calling 1-800-858-1549 to obtain in-depth information on backyard landscaping for wildlife.

Many native broadleaf plants commonly called "weeds" are very important to wildlife for food and cover.



Many different types of wildlife use areas that are mowed for some part of their life cycle, so mowing constitutes a type of habitat management—manipulating the food and cover plants of wildlife.

Haying

The type of forage being used for hay will dictate cutting time. However, making sure that you are cutting at the peak of production may improve the habitat value of the grass or legume being hayed. Grasses should be cut in the boot stage, when the seedhead is just beginning to form and before it fully emerges from the shoot. This is when nutritional quality is highest. For cool season grasses, this means the grasses should usually be cut in late May, which will allow some regrowth to occur or nesting to take place in June-July without the disturbance from mowing. If farmers wait until June or later to cut hay that was ready for cutting in May, the quality of hay will be much reduced and nests of birds like northern bobwhite quail and eastern meadowlarks are much more likely to be destroyed. If only one cutting is needed to meet the hay needs for a particular year, allow the grass to regrow during the following season and omit that cutting. If mowing is used to control summer weeds in cool season pastures*, wait as late as possible in summer to minimize nest destruction.

Conversion of portions of haylands to native warm season grasses*, including some late summer producers such as indiangrass and big bluestem, greatly benefits wildlife. These grasses grow most actively from mid to late summer (June-September), so they are cut after much of the wildlife nesting activity has taken place. Contact your local Kentucky Department of Fish and Wildlife Resources (KDFWR) wildlife biologist or call 1-800-858-1549 for more information about these grasses.

Maintaining Existing Cover

Many landowners mow during summer after the rush of spring activities such as crop planting. If the objective of the maintenance mowing is simply to keep the grass from being overtaken by competition, mow outside of the nesting period (see Timing on page 3). This will allow birds like the northern bobwhite quail and mammals like the eastern cottontail to rear their young during spring and summer without disturbance.

If the objective of mowing is to maintain thickets* of brambles or young trees for wildlife cover, set up a rotational mowing system. Mow a given strip or plot once every 3-5 years. This will keep woody stems small enough for most mowing equipment to handle.

Preparing for Other Treatments

Mowing can also be used in preparation for other treatments, such as burning, herbiciding, or overseeding. In the case of prescribed burning*, mowing can be used around the inside edges of firebreaks to limit flame height and lessen the potential for fire escapes, or on entire fields to ensure that most of the fuel is consumed by the fire. However, a thick thatch can produce more smoke, so if large areas are cut prior to burning you may want to fluff the cut grass with a hay tedder so it will dry more thoroughly before a burn. Mowing may be used before herbiciding to stimulate regrowth and improve herbicide uptake into the treated vegetation. The effectiveness of overseeding legumes during late winter (February) may also be improved with mowing. If a very thick mat of vegetation exists that may block seed from reaching the soil, mow low to the ground and follow with overseeding after the vegetation has decomposed enough to expose some bare soil; if there is a sparse canopy, mowing may be done after seeding to provide a

mulch for the seed.

Mowing is also an invaluable tool for maintaining paths, such as walking trails through fields and woods. Trails can offer you better access for wildlife enjoyment, and they can serve as firebreaks in the unfortunate event of a wildfire. You should mow these paths only as often as needed to maintain a comfortable height for you and others using them.

Figure 2. Prescribed burning is an economical and beneficial alternative to mowing.

Alternatives to Mowing

Prescribed burning should be considered as an alternative to mowing for managing many fields. Although burning requires more planning, it is usually much less expensive and time consuming than mowing, and produces many wildlife and forage benefits. Consult your local KDFWR wildlife biologist for more information.

Strip disking* is another good alternative for wildlife instead of just mowing. Rotational disking opens up grass stands and stimulates germination of seed-producing plants.

Sites that are too steep or rough to easily mow may be allowed to naturally revegetate* with shrubs and trees. Simply abandon the field and allow the wind, wildlife and gravity to establish seedlings. This will likely cut down on erosion and provide more habitat diversity on your property.

Timing

From a wildlife standpoint, mowing should be done outside of the nesting and brood-rearing season, which is mid March to mid August. Thus you should target late winter and late summer for mowing. Late February to mid March and late August to early September are the best times to mow areas that are being managed for wildlife. If an area is being managed intensively for rabbits, winter cutting should be done in January to early February because some nesting begins in late February.

In the case of cool season forages (orchardgrass, timothy, and clovers) that are being managed for hay, it is inescapable that some cutting will have to be done during the peak of nesting season. If you do not need hay from all of your fields to sustain your operation, consider rotating your fields so that portions of your hay fields are left uncut for a growing season or even a year at a time. This will aid wildlife and improve soil and possibly forage quality conditions. A strong advantage of using native warm season grasses (eastern gamagrass, switchgrass, big bluestem, and indiangrass) for hay is that they mature later in the growing season than their cool season counterparts, giving wildlife more opportunities to complete nesting. Do not mow native grasses past September 1 to allow enough regrowth for winter cover and spring nesting habitat. This will also allow the grasses to build up energy reserves necessary for vigorous spring growth.

Fields dominated by broadleaf plants and old field areas that have grown up in woody plants should also be mowed during late winter (February) or early fall (September) to main-

Perform maintenance mowing in late February to mid March, or mid August to early September, to avoid the nesting season for birds and other animals.

Figure 3. A field managed with strip mowing.

The best mowing patterns for wildlife habitat enhancement are strip mowing and random pattern mowing.

Figure 4. Random pattern mowing creates strips, blocks and islands of cover with different heights.

tain cover and forage for wildlife. The key is avoiding the prime nesting period for birds and other animals.

Pattern and Frequency

Your objectives should determine the mowing pattern. If you are simply using rotational mowing to maintain an area, then it may not matter whether you strip mow or mow in a random pattern, as long as you mow any given piece of ground periodically. On the other hand, if you are mowing field sections for hay, you will want to keep the sections regularly shaped (rectangular or square) to make harvesting more efficient. If you are a rabbit hunter and your objective is visual access, use relatively narrow strips alternated with uncut swaths to allow your dogs to run rabbits across relatively low cut areas. Whatever pattern you use, try to avoid leaving unmowed cover strips too narrow (less than 100 feet wide) or too small (less than a half acre), as this makes it easier for predators to find the small animals you may be trying to benefit.

Strip Mowing

This involves dividing a field into fixed or variable width strips, and rotating your cutting so that a given strip is mowed periodically according to the desired maximum regrowth stage (Figure 3). Most fields that are being rotationally mowed should be cut at least every 3-5 years to keep them from being overtaken by trees. Plots of clover, lespedeza or other legumes should be cut once or twice every year, preferably during the late winter (early March) or late summer (early September) seasons. Areas to be kept in an early successional stage (dominated by grasses and broadleaf plants) for bird brood cover should be clipped only every year or two.

Random Pattern Mowing

As the name suggests, this involves passing over a field with random twists and turns of the mowing equipment to produce an irregular-shaped pattern (Figure 4). The randomness created by this type of mowing provides some strips, blocks, and islands of cut and uncut cover.

Block Mowing

This mowing pattern is best applied when fields are long and narrow (less than 150 feet wide), where strip mowing or mosaic mowing would create strips of cover that are too narrow. With block mowing, you simply divide a field into thirds or fourths (end to end) and mow each block on a rotation. Mowing entire fields at once should be avoided except in a few situations, such as when you are preparing for other treatments (like spraying, burning, or overseeding), or possibly when you are mowing fields for hay. Another acceptable application of whole field mowing is when you have a series or patchwork of relatively small fields (3 acres or less), where the

entire fields could be mowed on a rotation. Otherwise, mowing an entire field minimizes cover diversity within the field, and increases predation risks for small grassland animals that need the above-ground structural cover that unmowed areas provide.

Height

The height of mowing is another important consideration. For native warm season grasses, it is critical that you never mow below 6-8 inches or you may damage or kill the grasses. This is because these grasses store a significant amount of their energy in the base of the plant, just above the ground. Native grass seedlings that have strong broadleaf competition the first growing season can be clipped high (10-12") to allow sunlight to reach the seedlings. Cool season grasses are not as susceptible to damage by low cutting, but to provide healthier and more productive stands that will withstand drought conditions you should avoid cutting below 6 inches. In general, areas being managed exclusively for wildlife are best clipped as necessary to about 8-10 inches; this leaves enough stubble to provide some cover until regrowth of the plant canopy occurs. If you are cutting fescue during spring or fall prior to spraying*, mow it down to 6 inches and allow it to regrow to 8-12 inches before spraying.

Equipment and Safety Concerns

Mowing can be accomplished with a variety of equipment. Weed trimmers may be used for small areas or fencerows. Lawnmowers with highly adjustable decks may be used for extended yards and some grassland management. Brush hogs (Figure 5) are pull-behind rotary-cutting tractor attachments that are commonly used for mowing grasslands, shrubs, and saplings. Garden and farm tractors with sufficient power can operate brush hogs, which are powered by the tractors' power take-off drives. For higher mowing, some brush hogs may need to have the wheel(s) lowered by inserting blocks above the wheel mounts. For haying, haybines or sickle mowers are often used; these cutting devices have horizontal blades that sever grasses with a single cut, rather than the multiple chops that rotary blades often make to plants.

Mowing can be dangerous, so you should familiarize yourself with accident prevention techniques. The most obvious danger is the cutting mechanism itself; you should never put yourself or another person in close proximity to blades while they are mowing. Another concern is equipment sliding or overturning on steeper slopes. There are many variables that influence tractor stability on slopes, particularly the height and weight distribution of the tractor, so you should follow the manufacturer's safety guidelines for mowing on hills. Operation of mowers on wet grass is also dangerous, so only mow when grass is dry. Another safety concern is debris being thrown from the mower. Mowing equipment should have safety guards, shields, or chains to minimize this danger, but to further reduce it you should never cut with another person close by or in the path that the mower is ejecting debris. Consult with your county Extension agent or equipment manufacturer about available equipment safety information or training.

Consider using prescribed burning (controlled fire) to manage your fields instead of mowing; it is cost effective, stimulates grasses and legumes, and removes leaf litter that can stifle productivity and impede animal movement.

Figure 5. Brush hogging is a common mowing technique.

SUMMARY OF OPTIONS:

Objectives:
Hay Production, Herbaceous/Woody Plant Maintenance, Preparation for other Treatments

Timing:
Late Winter, Spring, Summer, Early Fall

Pattern:
Strip Mowing, Random Pattern Mowing, Block Mowing

Frequency:
Annually, Biannually, 3-5 Year Rotation

Height:
6-8 inches, 8-10 inches, 10-12 inches

***Related *Habitat How-To* references:**

Cool Season Grasses
Cover Thickets
Edge Feathering
Fescue Eradication
Grazing and Haying
Legumes
Native Warm Season Grasses
Natural Revegetation
Prescribed Burning
Strip Disking
Wildflowers
Wildlife Corridors
Trees and Shrubs

Planning for My Property

A portion of this publication was underwritten by the Forest Stewardship Program in cooperation with the Kentucky Division of Forestry.

Woodbridge Conservation Commission Minutes Regarding a Possible Watershed Easement

Minutes February 16, 2006
Attendance: Kathy Gartland, Mike Walter, Jim Urbano, Laurence Grotheer, Maria Kayne and Paul DeCoster.

5. Fitzgerald Easement. Kathy Gartland raised the advisability of a sale of a conservation easement on the Fitzgerald Tract to the South Central Regional Water authority. In 2001 the RWA expressed an interest in such a purchase for that portion of the Tract which is within its watershed (approximately 111 acres) and it is felt that this interest continues. In discussing the subject, the consensus of Commission members was in favor of such a sale provided that residents' activities currently undertaken on the site (gardening, bird watching, hiking, etc.) be permitted to continue. Mike Walter raised objection to placing an easement on the entire property. He believes that a portion of the site should be reserved for future development needs of the Town, leaving 80 acres (the back field of the property) to be subject to the easement. After discussion, Paul DeCoster moved, with Jim Urbano's second, that the following motion be adopted by the Commission:

> Resolved, that this Commission endorse the sale and assignment by the Town to the South Central Regional Water Authority of a conservation easement on that portion of the Fitzgerald Tract which is within the Authority's watershed, excepting only that portion of the Tract on which the proposed new fire station is to be built, provided that the easement preserve to the residents of the Town the right of access to and use of the property for those purposes for which it is currently being used.

The Commission adopted the motion by a vote of 5 to 1 with Gartland, Grotheer, Kayne, Urbano, Urbano and DeCoster voting in favor and Walter voting against.

Minutes March 28, 2006
Attendance: Kathy Gartland, Mike Walter, Jim Urbano, Laurence Grotheer, Maria Kayne and Paul DeCoster.

6. Open Space Priorities. Kathy Gartland reported that of the top priorities of the Commission's Open Space Plan of 2003, three in particular are of most immediate concern: the RWA Race Brook Tract, the Shepherd farm, and the Meiss, Kelso and Bozak Properties on Ford Road. The Town is in the process of acquiring the RWA tract. The only other of these properties which has been placed on the market is the portion of the Shepherd farm which has been put on the market; to date it has not been sold. Various community representatives have been in touch with the owner to determine the possibility of Town acquisition of the property but the status of these discussions is not known to anyone on the Commission. Paul DeCoster was directed to find out the status of these discussions and report back to the Commission about them.

Another priority item is the possible sale of a conservation easement on the Fitzgerald Property to the RWA, which a majority of the Commission approved in principle at its last meeting. Kathy Gartland was directed to find out the sentiment of the Woodbridge Land Trust, CUPOP and the Woodbridge Parks Association about this possible easement. If there is unanimous

approval for sale of a conservation easement on all or part of property, the groups' views should be presented to the Board of Selectmen, with a possible ratification of such a sale to come before the voters simultaneously with the approval of funding for the new firehouse.

April 20, 2006
Attendance: Kathy Gartland, Jim Urbano, Cathy Shufro, Maria Kayne, Mike Walter and Paul DeCoster

6. Joint Meeting with CUPOP (CUPOP - Publicly Owned Properties Commission). Kathy Gartland reported that the Chairman of CUPOP is suggested a combined meeting of CUPOP and the Commission to discuss topics of mutual interest to both organizations. These would include, among others, the sale and assignment of a conservation easement on the Fitzgerald Property to the Regional water Authority. It was agreed that all members of the commission who can do so would attend the CUPOP meeting scheduled for May 3rd.

May 18, 2006
Attendance: Kathy Gartland, Jim Urbano, Mike Walter and Laurence Grotheer

4. Meeting with CUPOP. Kathy Gartland reported that four members of the Commission attended the May ___ meeting of CUPOP, also attended by members of the Land Trust. The CUPOP meeting took up several matters previously discussed by the Commission. Among them was possible acquisition of the Shepherd Farm and other open space properties, giving attention to the most pressing priorities among them. Also discussed was possible sale of a conservation easement on the Fitzgerald Property to the Regional Water Authority. There was not agreement on this matter, with the Land Trust members in favor of granting such an easement to the Trust rather than the RWA. The Commission decided not to pursue presenting its ideas on the subject to the BOS until a consensus on the subject could be reached among all interested the parties. There was general agreement that action be taken to try to save from destruction the historic houses on the RWA properties on Litchfield Turnpike and Sperry Road. Jim Urbano and Don Menzies, President of the Woodbridge Historical Society, are preparing a letter to the RWA Board of Trustees to present a plan that would permit all or at least some of these houses to be preserved.

September 20, 2007
Attendance: *Present:* Michael Walter, Jim Urbano, Suzanne Rosenberg, Suzanne Mizzoni, Maria Kayne, Cathy Shufro, Harriet Cooper

Fitzgerald Property
It was reported while there has been respect given to the 100ft buffer to the Fitzgerald property by the Fire Station building Committee, the Conservation Commission will need to go to the Board of Selectmen to request a referendum be approved to seek permanent protection of the Fitzgerald Property, protecting against development. It was reported the Regional Water Authority was seeking to purchase a Conservation Easement on their approximate 22 acres of the property.

Forest Regeneration Handbook

A guide for forest owners, harvesting practitioners, and public officials

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Funding provided by

U.S. Forest Service, Northeast Area, State and Private Forestry
The Connecticut Agricultural Experiment Station, New Haven
University of Connecticut, Cooperative Extension
Connecticut Department of Environmental Protection

Introduction

Forests are dynamic. Seedlings germinate, grow, compete with each other and with larger trees. Some survive for hundreds of years. Change will happen. Which species will be predominant in the future forest depends not only on climate and soils, but also on management decisions made today. Changes in forest composition will affect the quality and variety of forest resources available to future generations and wildlife.

This handbook was developed to provide an appreciation of how our forests developed and an understanding of forest regeneration concepts, including the importance of disturbance. This information will help landowners and public officials, in concert with professional foresters, make informed decisions about forest regeneration options tailored to their management objectives.

This handbook is divided into five sections.

• The first section provides a short history of the forest from the period of European colonization and large scale land clearing through the present suburban forest. It concludes with the challenges (fragmentation, parcelization, deer, invasive species) that must be met to maintain a healthy and vibrant forest for future generations.

• The second section explains basic concepts in forest regeneration. The importance of different combinations of light, moisture, and soil in determining success or failure of regeneration is discussed. It then details the adaptations of different species to distinct combinations of light, moisture, and soil conditions. The section concludes with an examination of competitive interference among trees striving to form part of the upper canopy.

• The third section examines the role of disturbance in maintaining habitat and species diversity. The influence distinct disturbance regimes have on forest composition is also explored.

• The fourth section introduces different methods (prescriptions) of forest management. The influence of each management style on the availability of light, moisture, and growing space for new regeneration is discussed. Because the primary reason for harvesting is often either income or a non-commodity amenity such as wildlife, the economic and esthetic considerations of each management method are also presented.

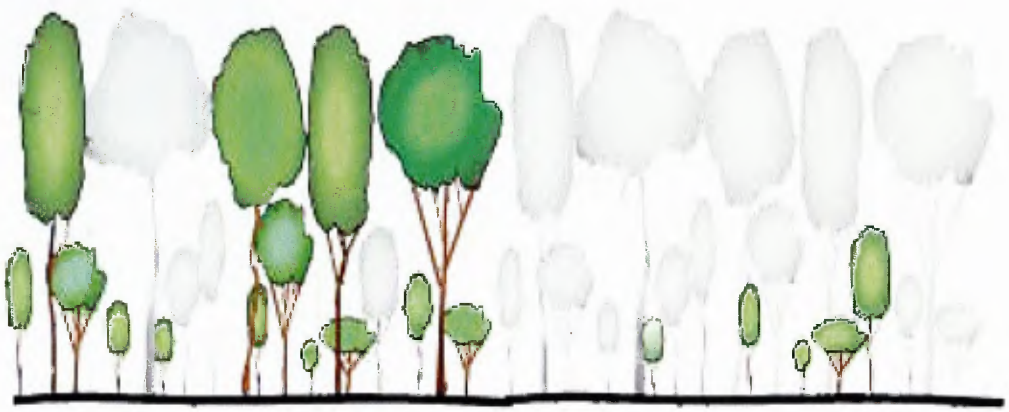
• The handbook concludes with a section detailing requirements to successfully regenerate specific species. As with the other sections, this section is not intended to be an authoritative reference, but rather to provide readers with sufficient information to make informed decisions about forest management options.

Disturbance Intensity. Disturbance *intensity* affects the success of regeneration through its influence on limiting factors. Within a given stand, whether windthrow or mortality results in the loss of a single tree, or a large group of trees, seedlings will become established and grow in those openings. The species that survive and continue to grow will vary depending on the intensity of the disturbance.

Slow, gradual mortality of individual trees favors shade tolerant species (sugar maple, beech) that can germinate and become established in the duff, or undisturbed leaf litter of the forest floor, and compete in the presence of a mature overstory.

A storm microburst that uproots a small group of trees gives the advantage to species (black birch, red maple) that can become established in partial to full sunlight and may be more competitive where some bare mineral soil is exposed.

An intense disturbance, such as a crown fire or clearcut, will favor species (aspen, pitch pine) that are adapted to full sunlight for best development. These species are unlikely to be able to compete unless an intense disturbance removes both overstory and understory trees.



SINGLE TREE DISTURBANCE

STAND REPLACEMENT DISTURBANCE

Disturbance Frequency. The *frequency* of forest disturbance can vary from yearly (single tree mortality), to decades (drought), to once a century (hurricanes). Indeed, many of the stands in state forests are currently managed on 100-200 year intervals between regenerations. This is similar to the return cycle for major hurricanes in southern New England.

In contrast, forests in Connecticut burned an average of once every 7 years before the 1920s. Before modern forestry practices became widespread in the early 1900s, many stands were cut every 30-60 years for firewood and charcoal production. Frequent cuttings in younger stands of dense saplings and poles for fuelwood or biomass certainly favors those species that can regenerate rapidly from root or stump sprouts such as oak and some shrub species (blueberry).

Species that compete well as seedlings and saplings in partially shaded conditions, such as red maple and white pine, may benefit from disturbances every decade or so, in which the upper canopy is "re-opened" in stages as the mature forest is removed. Examples of intermediate term frequencies include drought, ice storms, and partial cutting.

Stands in which disturbances do not occur over long periods of time ultimately tend to be comprised of mostly shade-tolerant, slow-growing species with long life spans. These species, such as hemlock, beech and sugar maple create thick dense canopies that prevent sunlight from reaching the forest floor, holding in the soil moisture, and effectively out-competing shade-intolerant species.

Forest Management

Forest regeneration methods are based on three premises: 1. Natural disturbances vary in type, intensity, frequency, and scale. 2. Each species is adapted to, and will regenerate successfully under conditions created by specific disturbance regimes. 3. Harvesting for forest products is a disturbance.

Therefore, it stands to reason that for a harvesting method to result in successful regeneration of a desirable species or mix it should most closely mimic the natural disturbance regime for which the desired species is adapted. Because many species possess adaptations for more than one disturbance scenario they can be expected to have some success regenerating under more than one, or a combination of, harvesting methods.

In light of the long-range management goals and objectives for a forested parcel, as identified by the owner, when planning to harvest forest products a forester should recommend and implement a harvesting method that is most similar to the natural disturbance regimes for which the desired regeneration species are most closely adapted.

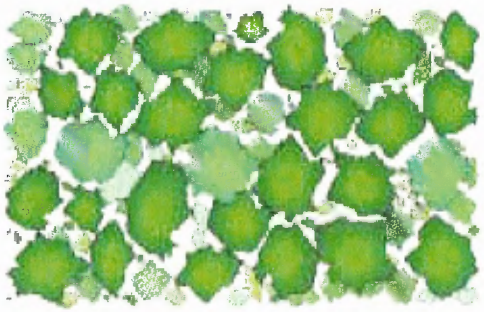
On the following pages, you will find descriptions of different silvicultural systems, or harvesting and regeneration methods, that are commonly prescribed in Southern New England. They are compared to the natural disturbance regimes they mimic, and a comparative listing of management objective considerations is provided. This listing can be viewed as pro/con or advantage/disadvantage, but that judgment must be made within the context of clearly stated management objectives.

Examples of management objectives for any piece of forestland could include such things as: Maximize habitat value for game bird; Increase recreational value; Preserve privacy and aesthetic values; and Maximize periodic income from forest products

It is readily apparent even from this partial list that two or more of these objectives can be achieved with an appropriate management prescription. It should also be recognized that some of these objectives might not be compatible with each other within the same stand of trees or even on the same forested tract. So before deciding the pro or con of the consequences of any particular harvesting method, the management objectives and priorities for a stand must be clearly stated.

UNEVEN-AGED (e.g. forest preserve, diameter limit, single-tree selection)	Trees	Sugar maple, American beech, black and yellow birch, eastern hemlock, basswood, pignut hickory
	Shrubs	Flowering dogwood, mountain laurel, hobblebush, striped maple, witchhazel, ferns
	Wildlife	Pileated woodpecker, flying squirrels, Acadian flycatcher, Cerulean warbler, Scarlet tananger
EVEN-AGED (e.g., shelterwood, clearcut, coppice with standards)	Trees	Oak, eastern white pine, black cherry, paper birch, white ash, tulip-poplar, aspen, eastern red cedar
	Shrubs	Beaked hazelnut, sheep laurel, staghorn sumac, blackberries, blueberries, sweet fern, huckleberries
	Wildlife	Red-tailed hawk, indigo bunting, white-tailed deer, eastern bluebird, cedar waxwing, eastern cottontail

Forest Preserve/Unmanaged Forest. Forest preserves are not dioramas. Change happens. Where the vegetation remains unmanaged by any human intervention, slow changes accumulate gradually through the natural mortality of individual trees, or suddenly and catastrophically through the action of weather, fire, insect infestation or rampant disease. In the absence of natural catastrophic disturbances, these forest tracts progress in succession toward a more shade-tolerant and longer-life-span species mix that tends to perpetuate itself.



Unmanaged forest

Responsible stewardship requires that all forests, including unharvested forest preserves, have a management plan with a detailed map. At a minimum, management plans for forest preserves include provisions for determining and permanently marking the preserve boundaries to prevent damage to the preserve by accidental encroachment of human activities in adjacent parcels. Where the property abuts a public road, or if hiking trails are present, provisions for hazard tree management should be included. The property map should indicate the location of other potential hazards (e.g., abandoned wells).

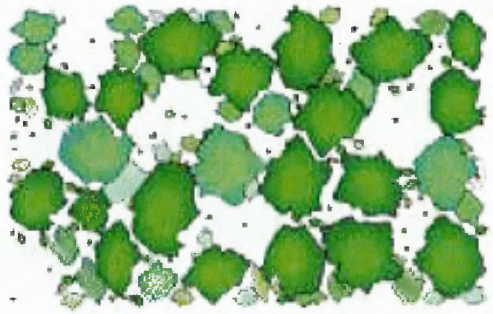
Prioritizing the relative importance of natural features will facilitate objective management decisions and allocation of limited resources. This is especially crucial when there is a potential conflict between priorities (protection of deer herd vs. maintenance of viable wildflower communities). The plan should also include strategies for monitoring and controlling invasive alien species, such as barberry and Norway maple, that could threaten the integrity of native populations.

Advantages

Easy to implement; Maintains continuous forest cover; Higher number of cavity and den trees; Favors shade tolerant species (hemlock, beech, maple); Increase in coarse woody debris (snags, dead logs); High watershed protection value

Disadvantages

No income for landowner; Change happens, unplanned and uncontrolled; More prone to some insect and disease infestations; Lower diversity over time; Shade intolerant species will disappear without severe natural disturbance



Single tree selection

Single-Tree Selection. Single-tree selection (or simply the Selection Method) is used by foresters to create or maintain multiple aged or uneven age conditions in a forest stand. Individual trees that are mature or declining in health are harvested from the stand in a manner that minimizes disturbance to the residual stand. This regeneration method most closely mimics the processes found in unmanaged forests, albeit at an accelerated pace, where trees die and drop out of the stand gradually. Removals are done on a periodic basis, so that trees of a variety of age classes are established and growing in the stand. The openings created for regeneration, however, tend to provide conditions most favorable for slower-growing shade tolerant species.

Landowners who consciously practice uneven aged management by the selection method are generally most interested in maintaining a continuous forest cover with trees of differing ages. High-value growing stock can be identified and their growth enhanced through the gradual removal of poorer competing trees. Fast growing trees and high-income yields are generally a lower priority for these landowners. This method is commonly applied in settings where multiple objectives, such as habitat, aesthetics, recreation, and income all must interact. *This method should not be confused with the commonly used and abused phrase, "selective cutting," which has no basis in scientific forestry practice or terminology. See "Diameter limit/High grading."*

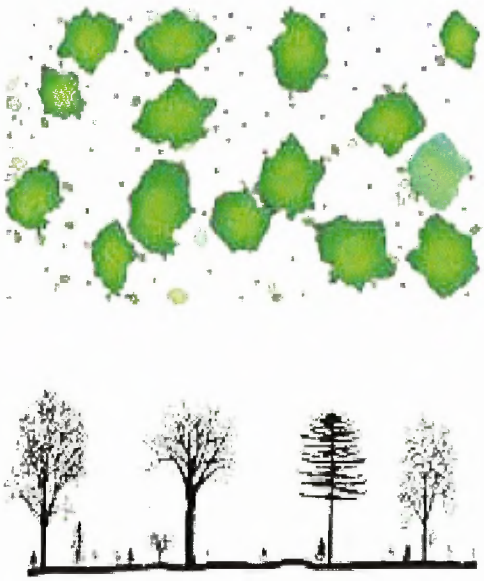
Advantages

Maintains continuous forest cover with low visual impact; Periodic income for forest owner, albeit low; Favors shade tolerant species (where desired); Ability to remove declining trees; Harvest schedules can be adjusted for market conditions

Disadvantages

High skill required for successful implementation; Higher costs for inventory, marking, and harvesting; May result in lower fiber productivity/yield in subsequent harvests; Will lead to long-term loss of diversity; Increased potential of damage to residual trees

Shelterwood. As its name implies, this method regenerates a new forest under the shelter of older trees. Mimicking disturbances in which only the healthiest dominant trees survive, the best growing, most desirable trees in the stand are left during the initial harvests. The residual overstory provides the seed source and cover for the regenerating forest, which becomes established over a number of years and will essentially be another even-aged forest. Simultaneously extra growth will be gained on the best stems, increasing stand value. The landowner would derive relatively substantial income from each of the harvests. However, following the final overstory removal a period of no income will occur until the new forest is old enough for commercial thinning.



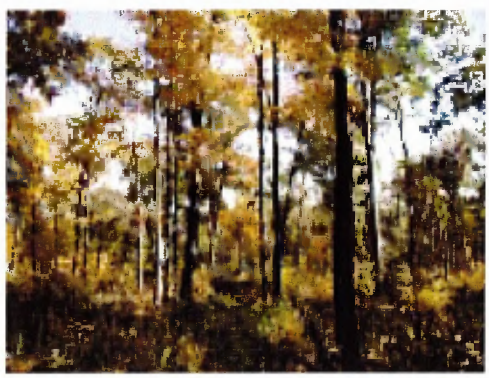
Shelterwood

The Shelterwood regeneration method can be applied over two, three, or more stages, depending on physical, biological and economic factors. This method dovetails well with recreational and habitat objectives. The initial harvests create a park-like tableau of majestic trees canopied over a carpet of new regeneration and wildflowers.

The overstory is harvested in two or three clearly defined stages scheduled several years apart. The number of overstory removal stages, and the interval between them, are scheduled according to the desired regeneration species mix. If, for example, a three-stage shelterwood system is applied in a stand at 15-year intervals, then the overstory trees will be harvested over a 30-year time frame, and the new forest will be almost 30 years old by the time the final cut is made.

Advantages

Can increase midtolerant (e.g., oak) regeneration; Increased volume growth of residual trees can maintain stand volume growth; Possible genetic improvement in regeneration; Damage to residual sawtimber usually minimal; Increased vertical structure heterogeneity; Regular periodic income to the landowner during harvest stages



Disadvantages

High skill required for successful implementation; Requires market for smaller trees; Residual volume may be lost to storm damage or epicormic branches (water sprouts); Delay in removing residual trees can lead to loss of midtolerant species and damage to new regeneration

Silvicultural clearcut

Silvicultural Clearcutting. It comes as a surprise to some people that clearcutting, when properly planned and executed, is a legitimate and indispensable regeneration method. There are certain species of trees that fully develop only under the full sunlight conditions found after clearing all competing vegetation. This group of species includes tulip poplar, aspen, paper birch, most oaks, eastern red cedar, butternut, and others. Without clearcutting or final overstory removal during a shelterwood these species will gradually decline and become rare in most of our forests.

There are other situations when clearcutting is appropriate. Sometimes a forest stand is in such terrible condition as a result of insect damage or other past abuse, that it does not fit with the long range objectives of the landowner. Faced with this situation, a landowner may be better off to remove the existing stand and start over. There may also be times when a landowner wishes to convert an area from one type of species to another (e.g., diversifying habitat by converting a stand of red maple to eastern white pine).

Regardless of the reason, a clearcut, while perhaps producing a one-time substantial income for the landowner, sets the forest back to its earliest successional stage. A clearcut mimics the conditions found following a catastrophic windstorm or fire and provides the best competitive advantage to the species that require full sunlight to survive. Regeneration must come as seedlings from a seed source nearby or from root or stump sprouts. It is important to understand that for regeneration to be successful *complete removal of all competing vegetation is required.* Just removing trees that are most valuable or larger than a certain size and leaving the others behind does not constitute a silviculturally correct clearcut system. Rather, this is a commercial clearcut with all of its potentially negative impacts. *See: "Diameter Limit/High Grading."*

Advantages

Easiest method to mark and harvest; Necessary to regenerate shade intolerant species; High diversity of grasses and herbs until crown closure; Provides early succession habitat; Potentially substantial one-time income for landowner

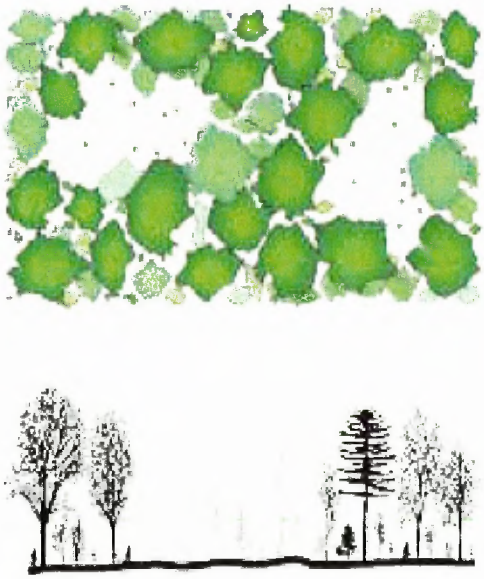
Disadvantages

Aesthetically less desirable for general public; Unacceptable for many small forest owners; It costs money to remove residual poles and large saplings; No income from forest for at least 30-40 years; Susceptible to soil erosion if poorly implemented

Group Selection/ Patch Cutting. Group selection is a hybrid incorporating some of features of both the selection and silvicultural clearcutting methods. This approach does not select individual trees, or distribute the intensity of the harvest evenly throughout the stand, but rather removes groups of trees within pre-defined areas scattered through the stand. It leaves undisturbed forest in between, much like the conditions one would find following a severe "microburst" wind event. This method is very suitable for certain habitat enhancement, and can also be used to create a multiple aged condition within a forested parcel. Note that proper management dictates that poorly formed and less valuable trees be cut or removed along with the commercially marketable ones.

A greater diversity of regeneration species can result if the patches created are large enough to permit full sunlight to reach the forest floor in part of the patch, so as to create conditions in which shade-intolerant species can compete. A good rule of thumb for shade-intolerant species is to make the minimum opening twice as wide as the surrounding trees are tall. This will result in openings that are at least half an acre in size. Smaller openings (1/4 acre) may be sufficient for midtolerant species or to release white pine saplings.

A forest managed using the group selection method will soon resemble a quilt of multi-aged and multi-sized trees. Crucial to the long-term success of group selection is careful placement of the skid trails and roads. A well-designed road system will not only lower harvesting costs, but provides the landowner with a trail system for recreational use.



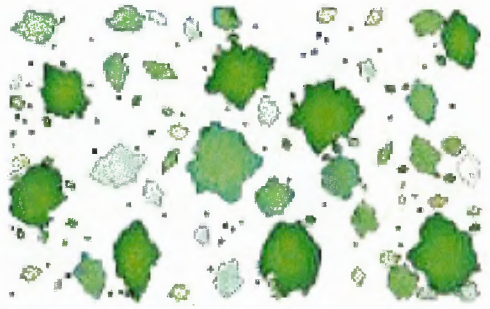
Group selection

Advantages

Allows regeneration of shade intolerant species without clearcutting; Provides landowner with periodic income; Provides a variety of habitats from early to late successional; Harvest schedules can be adjusted for market conditions

Disadvantages

Resulting patchwork forest increases management costs; Patches may be too small for midtolerant/intolerant species; Deer may concentrate feeding in recent patches; Residual trees near patch edges may be susceptible to damage



Coppice with standards

Coppice with Standards. The coppice with standards method, originally developed in Europe to provide fuel and wattle for tenant farmers and timber for estate owners, may be useful for small accessible tracts where a market for fuelwood exists. This system favors selected crop trees (i.e., standards) for the production of high value timber or veneer logs while periodically removing all other merchantable trees. Harvests at 10-20 year intervals provide the landowner with flexibility to accommodate market conditions and growth. Reserve trees are kept free-to-grow to obtain maximum size, provide mast for wildlife purposes, and aesthetic reasons. The regenerating forest is primarily of sprout origin, even aged and dense, ideal habitat for game birds and other species. Landowners such as game clubs and wildlife preserves can use this method effectively to achieve a mix of objectives in which income from forest products is helpful, but other objectives are more important. This method can also be applied effectively in a forest managed for fuelwood. The pleasing visual mix of mature trees, small sawtimber, and poles with a scattering of shrub patches may make this the ideal method for landowners desiring both continual forest cover and periodic income. Initiating this treatment requires selection of approximately 55 standards (potential crop trees) per acre from existing pole and sawtimber. The goal is to have an even distribution of diameters over all classes. At each harvest, eight to ten new standards per acre are chosen in the pole size class. Concurrently, one fifth of the largest crop trees are harvested along with all other stems larger than 5 inches dbh.

Advantages

Maintains continuous forest cover with low visual impact; Periodic income for forest owner; Harvest schedules can be adjusted for market conditions; Provides regeneration conditions favoring midtolerant species; Reserve trees will be very large at end of next rotation

Disadvantages

High skill required for successful implementation; Higher costs for inventory, marking, and harvesting; Lower yield at each harvest entry; Increased taper of main bole may decrease grade volume; Large crowns may damage other trees when harvested

Reserve Tree/Seed Tree. The reserve, or seed-tree method is like a clearcut, although more aesthetically pleasing, in that not all the overstory vegetation is removed. Borrowing an idea from the shelterwood method, a few trees are left scattered in the stand to provide a source of seed. The residual trees should be chosen from the healthiest and best seed producers in the stand. The main difference between this and a shelterwood system is that this method is a very high-intensity, but one–time (low frequency) disturbance event. All of the remaining vegetation is removed at once, and the new forest will be even aged. The reserve, or seed, trees are retained because other sources for new seedlings may not be reliable, and generally they are kept in the new stand until the time of the first commercial harvest. The new forest will be composed mainly of offspring from the reserve trees, and some habitat enhancement value from retaining these large scattered trees can be realized as well.

Reserve tree method

Advantages

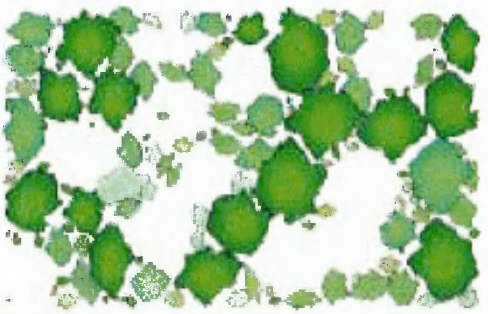
Aesthetically more pleasing than a clearcut; Provides regeneration conditions similar to a clearcut (i.e., beneficial for mid- and intolerants); Reserve trees will be very large at end of next rotation; Provides roost trees for raptors and other birds; Reserve trees serve as a supplemental seed source, especially for pine and tulip-poplar

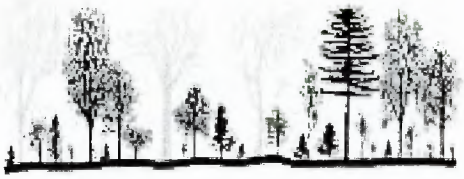
Disadvantages

Reserve trees susceptible to windthrow and lightning damage (and lost volume); Crown breakage of reserve trees (see above) can damage smaller regeneration; Large crowns of reserve trees may damage other trees during next harvest operation; No income for 30-40 years

Beware!

Diameter Limit/High Grading. All too often a high-grade is disguised as a "selection" harvest where the most profitable trees are removed with little, or no, consideration given for future conditions. High-grade cutting, regardless of how "light" the cut is, has a negative long-term impact on both economic value and on forest health. Diameter limit cutting may appear to be a sensitive method, cutting the largest trees to release smaller, younger trees. Landowners are mistakenly persuaded that the largest trees are overmature and should be harvested before they die. However, most large trees with deep, healthy crowns will not only survive for decades, but, if the stand is thinned, will grow faster and increase in multiple values. In even-aged stands it is the poorly-growing trees that should be removed until the stand can be properly regenerated.





Diameter limit harvest

Where economic necessity dictates a diameter limit cut to generate sufficient income for a financial emergency (e.g., inheritance taxes, medical expenses, etc.) the negative impacts can be minimized. Cut or girdle all trees with poor form and low vigor. Trees with poor form will develop into wolf trees that prevent the development of more valuable regeneration. Trees with poor form are also more susceptible to damage from wind, ice, and snowstorms. Trees with low vigor grow slowly and are susceptible to insect and disease infestations.

Marking a diameter limit cut is simple. All merchantable trees larger than a certain diameter are harvested. The landowner may have to wait decades before another commercially viable harvest would be possible if all trees with diameters larger than 11 inches were harvested (a commercial clearcut). Typically, many of the smaller residual trees (5-10 inches diameter) are slower growing, less valuable maple and birch.

Beware!

Advantages

Harvesting method generates highest short-term income; Minimal skill and cost required; Increased proportion of cavity and den trees; Increased vertical structure heterogeneity

Disadvantages

Long-term loss of fiber productivity and increased harvest intervals; Increased proportion of cull and slow growing trees in stand; Increased potential of damage to residual trees; Loss of valuable midtolerant species (e.g., oaks); Detrimental to wildlife species requiring early successional habitat

Species regeneration notes

The following pages outline the general requirements for successfully regenerating some species groups (e.g., oak, map). The first page of each species group gives some background information on history, distribution, and mature size. This page also notes the commercial, ecological, and aesthetic value of the species group. The second page provides information on regenerating selected species. This section is meant as a general guide and starting point for discussion with a professional forester. The meaning of the symbols used in this section is given below. Specific guidelines will depend vary by species (i.e., northern red oak vs. scarlet oak), local soils, and other factors.

Seed dispersal mechanisms: Tree species utilize a variety of mechanism to disperse seed. Some species spread their seed upon the wind. Other species depend on small mammals to bury their seed, while birds carry some seeds great distances.


Small mammals


Birds


Wind

Reproductive modes: While all trees begin as seedlings, only the older, established seedlings (advanced regeneration) of some species can grow into canopy openings. Some species develop vigorous, fast-growing sprouts from buds hidden in stumps and roots.


Seedlings


Advanced regeneration


Stump sprout


Root suckering

Light requirements: The relative minimum requirement for sunlight varies among species. Tolerant species can survive and grow in full shade. midtolerants in partial shade, and intolerants only in full sunlight. Some species require clearcutting to develop into mature trees.


Tolerant


Midtolerant

Intolerant


Best with clearcutting

Special considerations: This section provides information on some problems that might be encountered when regenerating specific species. For example, regenerating oaks will be difficult in areas with large deer herds. Species with thin bark are susceptible to damage by careless logging. This wounding increases the possibility of heart rot.


Browsed by deer


Adapted to fire


Damaged by fire


Thin bark


Insect problems


Disease problems

Oak (*Quercus* spp.)

Oaks dominate the landscape throughout most of Connecticut. Oaks are disturbance-dependent species and most of our oak forests arose on lands that were repeatedly burned and harvested prior to 1900. Native Americans would soak the acorns in streams during the winter to remove the tannins that made them inedible. These large, majestic trees can live for several centuries, especially northern red and white oaks. Mature trees can reach over 120 feet tall with diameters of 2 feet or more. Northern red oak is Connecticut's most valuable timber tree in both value and volume (19% of total).

USES

Wood products

Veneer, fine furniture, cabinets, railroad ties, pallets, firewood, and flooring. White and chestnut oak are used to make barrels and ship hulls.

Wildlife

Acorns are used by many species, including white-tailed deer, turkey, squirrels, chipmunks, and blue jays. White and chestnut oak acorns, because of their lower tannin content, are eaten before the acorns of other species.

Aesthetics

The massive trunks and wide spreading branches typical of oaks lend the forest a gnarly, primeval sense of permanence. The leaves of scarlet and red oak often create a second peak in fall color during late October.

Seed dispersal

Oaks produce large seed crops at 2-10 year intervals. The large acorns that are dispersed by blue jays and small mammals germinate in the spring.

Reproductive modes

Successful oak reproduction develops from stump sprouting and from advanced regeneration (seedlings with root systems that are 5-20-years old).

Light requirements

Although oak seedlings can grow in partial shade, eventually over-story removal (final stage shelterwood, clearcutting or patch cutting) is required to achieve the full sunlight conditions necessary for seedlings to develop into mature trees.

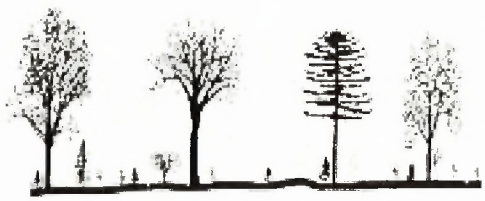
Site requirements

Northern red oaks grow on good to average quality sites common to middle and lower slopes. Black and white oaks are on middle slopes with average site quality. Chestnut and scarlet oaks grow on low quality sites on upper slopes and ridgetops.

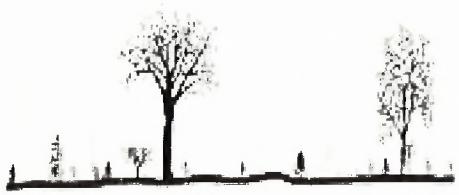
Special considerations

Oaks need protection from browsing where deer herds are large. Prescribed burning can enhance seedling height growth.

Best methods successfully regenerate oak



Shelterwood method



Reserve tree method

Maple (*Acer* spp.)

Red maple has become the most common tree in Connecticut, accounting for one-quarter of all trees. This increase has been attributed to fire suppression and the increased use of partial cutting (as opposed to the earlier practice of clearcutting). Their ability to grow in light (red maple) to heavy shade (sugar maple) allow both species to persist for decades as small saplings under the shade of larger trees.

Sugar maple is a long-lived species that can survive for over 300 years, red maple commonly less than 150 years. Sugar maple is the larger of the two species with mature trees commonly reaching over 100 feet tall with diameters of 2 feet or more.

USES

Wood products

Maple syrup, furniture, lumber, railroad ties, pallets, firewood, specialty products.

Wildlife

The large hollows commonly found in centenarians are favorite den sites of raccoons, porcupines, and flying squirrels. Chickadees, wrens, and cardinals eat the seeds and deer will eat the leaves and twigs.

Aesthetics

The early kaleidoscope of fall colors in red maple swamps herald the arrival of autumn. During early spring, red maple flowers mist the hills with a twinkling of reds and yellows. Sugar maple is the queen of the fall with leaves turning every hue from clarion yellow through bright orange to beet red; often with the full range of colors on the same tree.

Seed dispersal

Sugar maple produces large amounts of winged seeds (samara) at 3-7 year intervals, red maple about every other year. The seeds are primarily dispersed by the wind.

Reproductive modes

Both species depend on advanced regeneration that develops after partial cutting or gaps creating by the death of larger trees. Red maple reproduction can develop from stump sprouts.

Light requirements

Sugar maple is among the most shade-tolerant species in southern New England. Red maple is competitive in partial shade created by partial cutting.

Site requirements

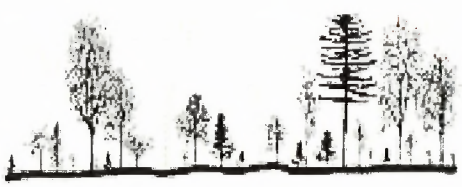
One of the reasons that red maple continues to increase in southern New England is its ability to grow on all but the driest and wettest of sites. Sugar maple regeneration is found on lower slope positions where soil moisture is adequate. There is some evidence that its distribution is limited by the amount of calcium in the soil.

Special considerations

Although logging damage rarely kills maples, it often creates wounds that cause extensive internal rot. Both species are weakened by wildfire.

Best methods to successfully regenerate maple

Single tree selection



Diameter limit harvest

Eastern White Pine (*Pinus strobus*)

Eastern white pine can grow on sites ranging from dry ridgetop to swampy valley. In 1710, the English Parliament passed the *White Pine Act* to protect the large white pine needed for masts. Although largely ineffective, this was one of the first acts that set colonists and England on a collision course.

This large, majestic species can live for 300-400 or more years. Mature trees can reach heights of 150 feet with diameters approaching 3 feet.

USES

Wood products

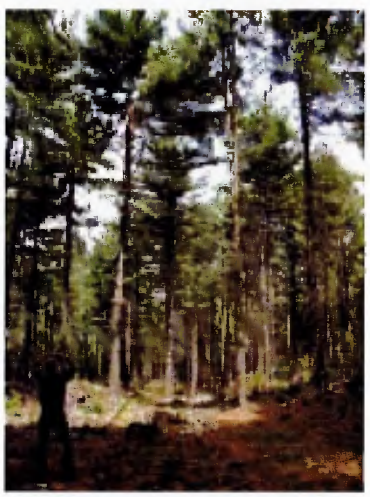
Furniture, lumber, bark mulch, ship masts.

Wildlife

Where eastern white pine is not common, deer will eat needles and terminal buds of seedlings and saplings. Red-breasted nuthatches both eat pine seeds and nest in cavities. Red squirrels also eat pine seeds by methodically dismantling the cones.

Aesthetics

Mature eastern white pine stands with their massive boles soaring high above inspire a sense of awe and reverence, especially when the wind whispers through the needles. The green of scattered pines accent fall colors and provide a reminder of life during the monochrome months of winter.



Seed dispersal

Eastern white pine produces large amounts of seeds at 3-10 year intervals. The seeds are dispersed by the wind in the fall.

Reproductive modes

Successful white pine reproduction can be obtained from seedlings in large openings or clearcuts where a seed source is abundant and some mineral soil is exposed. Advanced regeneration is more important when using multi-aged stand management.

Light requirements

Although eastern white pine seedlings can grow in partial shade, eventually overstory removal (final stage shelterwood or clearcutting) is necessary for seedlings to develop into mature trees.

Site requirements

Eastern white pine can be found in every site from deep sands to swamps. However, regeneration success is best on sites that are droughty at some period during the year.

Special considerations

Eastern white pine seedlings need protection from wildfire and occasionally deer browsing. Ideally, regeneration should be established under a partial-shade overstory to reduce pine weevil damage.

Best methods to successfully regenerate white pine

Silvicultural clearcut

Reserve tree method

Birch (*Betula spp.*)

Black birch is often found on average sites, and yellow birch on moist to wet sites, throughout the state. Black birch is now the second most common tree species in Connecticut. Both species contain oil of wintergreen, methyl salicylate, which gives birch beer its distinctive taste. The presence of this chemical, poisonous at high doses, provides some protection from deer browse damage. Many of the larger black birch trees have one or more large cankers that reduce the potential economic value of this species. Although both species can survive for 200 years, maximum ages of about 120 are more typical. Mature trees are commonly 80 feet tall, with diameters slightly larger than a foot.

USES

Wood products

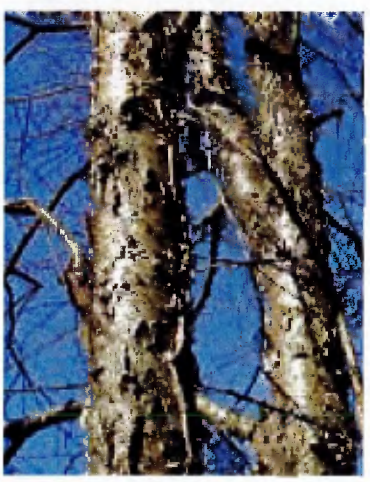
Veneer, lumber, railroad ties, pallets, and firewood.

Wildlife

The seeds of these trees provide some winter food for chickadees, ruffled grouse, and chipmunks. The bark of yellow birch is utilized for nesting material by some birds.

Aesthetics

The golden fall foliage of birch leaves adds gaiety to autumn landscapes. The frilly, peeling light-colored bark of yellow birch is a unique feature of moist woodlands



Seed dispersal

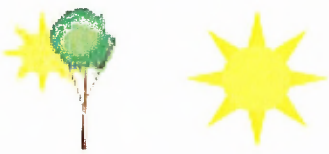
Black and yellow birch produce large amounts of seeds at 1-2 year intervals. The small seeds are dispersed 300 feet or more across crusted snow by the wind in mid winter.

Reproductive modes

Successful birch reproduction can be obtained from seedlings in large openings or clearcuts. Black birch can also produce successful regeneration in openings created by shelterwood operations.

Light requirements

Although birch seedlings can grow in partial shade, overstory removal or death is necessary for seedlings to develop into mature trees.



Site requirements

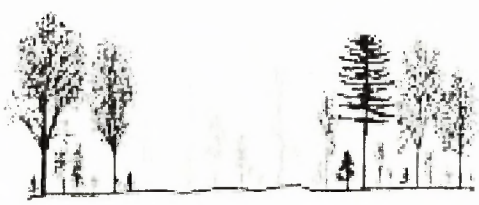
Black birch is commonly found on average quality sites; yellow birch on moister sites. In the northern part of the state, black birch is found towards ridgetops and yellow birch on midslopes.

Special considerations

Both black and yellow birch are very susceptible to fire and logging damage. Although nectria canker is common on black birch and can make the wood unmerchantable, it rarely kills seedlings.

Best methods to successfully regenerate black and yellow birch

Commercial clearcut



Group selection

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J.P. Barsky: 11m. 14mb, 17t, 22m, 25b, 26b, 27b, 30b, 32b, 34tb, 36t, 38tm, 40t, 42tm; Fred Bormann: 10mb
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A special thanks to Hull Forest Products for permission to photograph their mill operations (page 11). We would also like to thank J.P. Barsky, M.J. Bartlett, G. Milne, D. Beers, and J.E. Gillespie for their helpful comments

An expanded version in electronic format is available at:

www.canr.uconn.edu/ces/forest
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Forest Science Becomes Forest Practice

Reviewing practical science to help forest owners sustainably manage their woodlands

PETER SMALLIDGE

Controlling beech sprouting through limited use application of herbicides.

Article Reviewed:
Kochenderfer, JD, Kochenderfer, JN, and Miller, GW. 2006. Controlling beech root and stump sprouts using the cut-stump treatment. Northern Journal of Applied Forestry. 23(3):155 – 165.

Issue and Background:

Landowners are often tempted to cut mature beech (*Fagus grandifolia*) for firewood or during forest improvement to provide additional growing space for more valuable species. However, cutting beech typically results in the prolific development of root sprouts. The density of sprouts from the roots can sometimes exceed 10,000 stems per acre, forming a "beech thicket". Death of mature stems, by cutting or disease, causes a redistribution of hormones that activate new growing tissue on roots that form into shoots. Overly abundant seedling and sapling beech can produce enough shade to effectively inhibit the reproduction of other hardwood species, reduce forest diversity, and limit owner access for other objectives. In areas with mature beech and a landowner objective to reduce the abundance of beech, what cost effective tools exist to control all beech size classes?

Review of Kochenderfer et al. 2006:

The herbicide chemical glyphosate (originally marketed as Roundup™) has been successfully applied to freshly girdled stems to kill above ground stems. Other types of herbicides are applied via a basal application which chemically girdles the tree. Because glyphosate translocates to actively growing tissue, applications to girdled stems would typically move up the tree, but not into the root system. While girdle, basal and ground-mist herbicide treatments are effective, Kochenderfer et al (2006) investigated the potential of cut-stump treatments to distribute the herbicide more fully into the root system and gain additional control beyond the treated stem. The authors note that cut-stump treatments of beech are "target-specific, applicable to small ownerships, and easy to apply. It entails applying herbicide to the cambium layer of freshly cut stumps."

The research conducted by Kochenderfer et al. (2006) assessed the use of cut stump treatment with a 53.8% active ingredient (ai) glyphosate solution[1] applied within one hour of cutting the tree. The authors investigated the spread of the herbicide into the root system and death of adjacent trees based on the size of the treated stump. One-third acre plots in each of two study areas in West Virginia were designated for treatment (cut plus herbicide) or no treatment (cut without herbicide). All beech stems in the plots that were greater than 6" dbh (diameter breast height) were cut, and all cut stumps within the treatment plots were treated with the herbicide solution. Glyphosate was applied to the stump within one hour of cutting at a target rate of 0.12 fl. oz (3.5 ml) per inch of stump diameter. The actual application rate was closer to 4.2 ml per inch of stump diameter. The authors used the equivalent of 1.0 to 1.6 gallons of herbicide per acre to treat approximately 80 stumps per acre. All cutting and treatment was done during September.

As a result of the treatment, the

The glyphosate should be applied to the outer two inches of the freshly cut stump to focus the effects on the active plant tissue. The tissue towards the center of the stump is less conductive and does not as effectively transfer the chemical to the root system.

Pete Smallidge (left) (you'll need to crop the part of a person in the actual left) explaining beech stump study plot to Master Forest Owner Regional Coordinators at June 8 coordinators meeting at Arnot Forest. Four of the 13 coordinators are shown here (from left to right): Mike Birmingham, Dick Patton, Keith Hedgecock, and Jerry Michael.

authors found significant mortality of uncut beech seedlings and saplings within the treated plots. Because trees greater than 6" dbh were cut, the herbicide activity was directed into the smaller sprouts resulting in high levels of beech mortality. The treated plots had mortality of more than 90% of the equivalent of 6000 to 9000 beech stems per acre in the two study areas. The cut but untreated control plots had approximately 2% mortality of beech and attributed mortality to damage caused by the felled stems.

In another aspect of the study the authors investigated the dose-distance mortality response of beech to determine how far away from a cut stump seedlings and saplings were controlled. The distance away from treated stems that untreated beech stems died depended on the diameter of the treated stumps. Treated 5" diameter stumps controlled more than 50% of all beech stems within 10 feet of the stump. Treated 10" diameter stumps controlled more than 50% of all beech stems within 15 feet of the stump. Treated 17" diameter stumps controlled more than 50% of all beech stems within 25 feet of the stump. As an approximate guide based on a calculation of data presented by the authors, at least 50% of uncut beech stems were controlled at a distance equal to 20 times the stump diameter treated, although somewhat further for trees between 5" and 10" dbh. For example, treatment of a 7" dbh beech would be expected to achieve 50% mortality of beech stems within 140" (11.6') of the stump. In all situations, mortality was almost 100% near the stump and decreased further from the stump.

The cost estimate for treatment varied with treatment intensity. The basal area of treated beech stems at the two study sites ranged from approximately 40 to 80 sq. ft of basal area per acre. Cost, including labor and chemical, ranged from approximately $1.00 to $0.75/sq ft of basal area treated. The cost of chemical represented 85% of the treatment cost. This was the equivalent of approximately $45 to $60

continued on page 22

[1] The authors used Glypro, which is a restricted-use herbicide in NY and only available to certified herbicide applicators. Most owners can obtain glyphosate based products with an active ingredient concentration of 40 to 48% in their local garden or hardware store. Always read and follow the label specifications.

The methods described by Kochenderfer et al. (2006) have potential for use by many NY forest owners. Most glyphosate-based herbicides are not restricted in New York, meaning that people can purchase them through many local farm and garden stores. Cut stump treatments of beech provide a means to kill numerous beech stems with treatment of a small percentage of stems. Treatment costs, in conjunction with fuel wood harvesting, are highly favorable when compared to other herbicide and mechanical treatments. A reasonable approach for applying this research by NY forest owners would include:

1. Evaluate ownership objectives to assess the desired role of beech.
2. Inventory to identify areas needing control of beech, focusing perhaps on areas with diseased rather than healthy mature beech.
3. Read the herbicide label and assemble equipment to comply with provisions of the label.
4. Review safe chain saw use protocols and inspect personal protective equipment. Take safety course if appropriate.
5. Cut the largest beech stems, especially those with beech bark disease, and treat the outer 2" of stump diameter (Figure 1) with the herbicide solution comprised of a concentrated active ingredient of glyphosate. Large diameter beech left uncut may act as a sink of the herbicide and reduce the mortality of smaller sprouts. Apply treatment to the stump within one hour of cutting and after brushing away sawdust. Treatment should be applied from mid summer to late fall for best effect. Treatments during all times of the year except March and April showed reasonably good control in the southern Appalachian study sites. Dates for NY treatments would likely be best from late June through late fall. Frozen wood in New York would likely limit treatment effects.

per acre, and represented a relatively small proportion of the fuel wood value of the cut stems. Thus, selling the beech as firewood, those cut for treatment, would have more than covered the costs of treatment. These costs are significantly less than other types of herbicidal control of beech.

If you have any questions about the possible use of this forest management activity, please contact your local office of Cornell University Cooperative Extension, NYS Department of Environmental Conservation, or a forester who is a certified pesticide applicator.

Science Disclaimer: Scientific research is typically applied in a single area under a limited set of environmental conditions. Researchers, and the interpretation of that research, attempt to describe how different conditions might affect the application of results. The results interpreted here should be applied with due diligence by forest owners, incorporating their specific conditions into the practices described. If any questions exist, seek assistance from professionals before proceeding.

Pesticide Disclaimer: Please read the pesticide label prior to use. Use pesticides only in compliance with the label instructions. The information contained in this article is not a substitute for a pesticide label. Trade names used herein are for convenience only. No endorsement of products is intended, nor is criticism of unnamed products implied. For assistance with pesticides, please contact your local office of Cornell Cooperative Extension or NYS Department of Environmental Conservation.

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CERTIFIED FORESTERS CLOSE TO THE TOWN OF WOODBRIDGE

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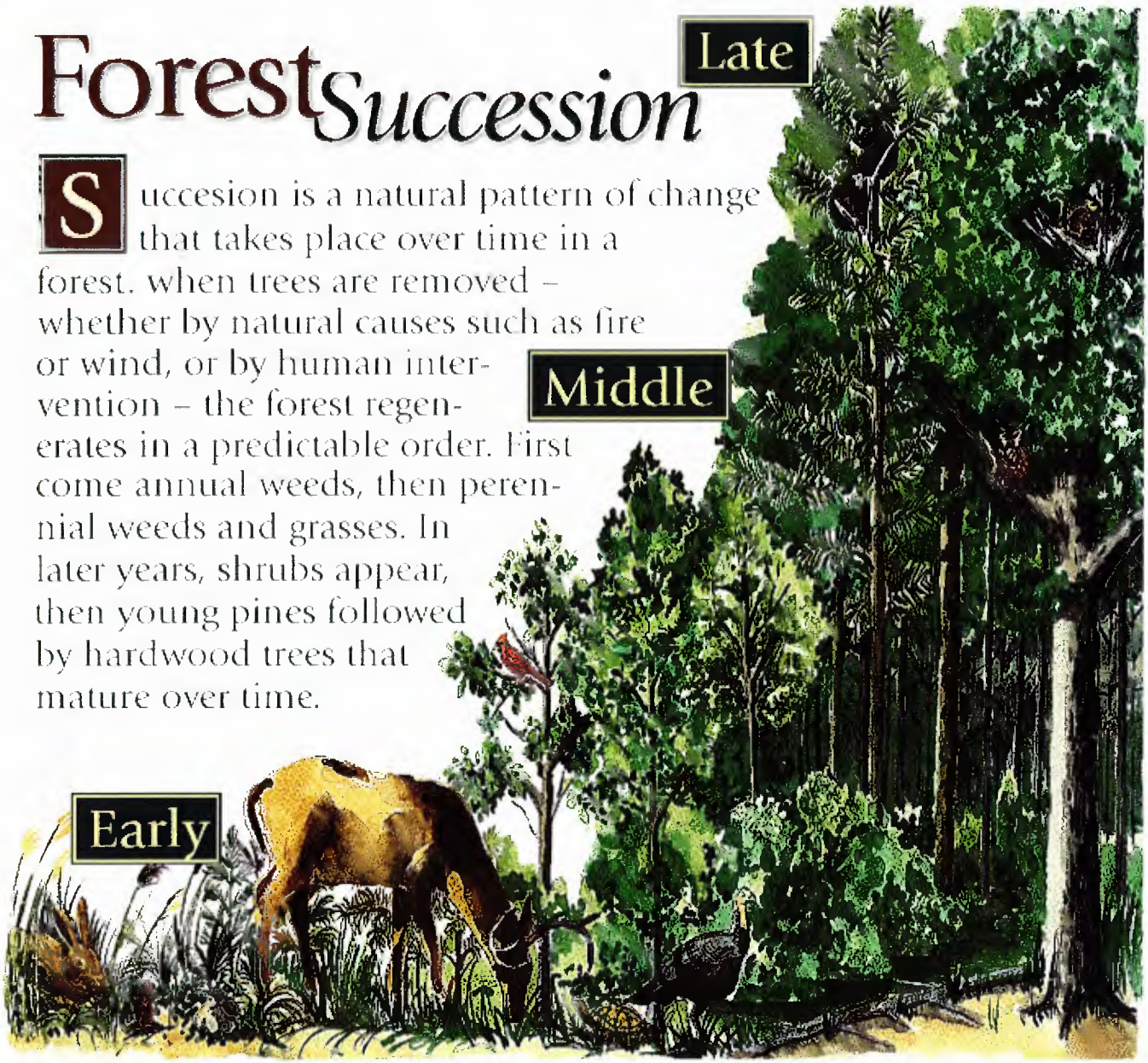
Forest *Succession*

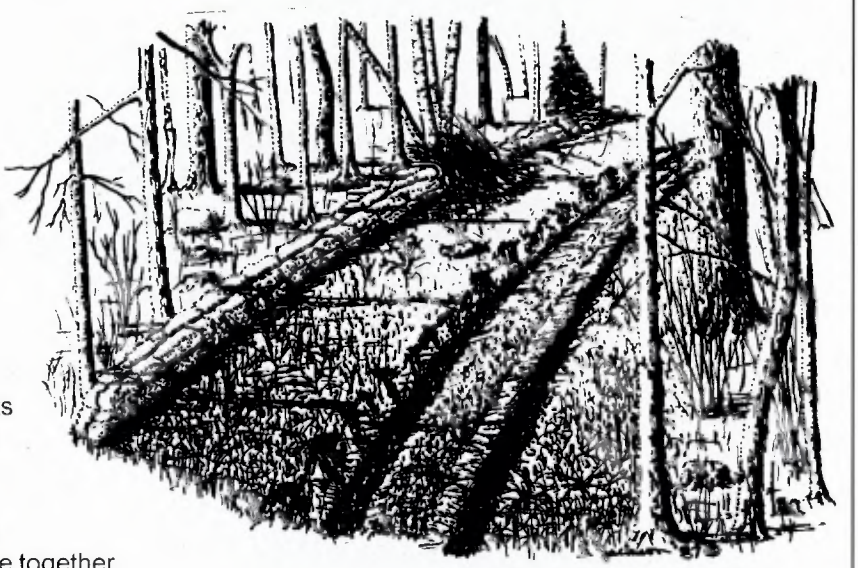
Succesion is a natural pattern of change that takes place over time in a forest. when trees are removed – whether by natural causes such as fire or wind, or by human intervention – the forest regenerates in a predictable order. First come annual weeds, then perennial weeds and grasses. In later years, shrubs appear, then young pines followed by hardwood trees that mature over time.



WILDLIFE IN CONNECTICUT

WILDLIFE HABITAT SERIES

Daylighting Roads and Trails to Create Edge



Daylighting refers to the cutting and release of vegetation along areas within forested habitat for the purpose of increasing sunlight on the forest floor. This encourages growth of shrubs and herbaceous vegetation. Daylighting is primarily used to open up the edge of trails, roads and fields.

In order to understand wildlife benefits that result from daylighting, the edge concept must be explained. Edge is the place where plant communities meet, or where various successional stages within plant communities come together. The area influenced by this transition is called an ecotone. Edges and their ecotones are typically richer in wildlife than the adjoining plant communities because they provide more of the needs required by wildlife than a single vegetative or community type. Ideally, brush and grass form a narrow border along daylighted areas. These vital openings provide an abundant food source of various seeds and insects for wildlife. Edges are also used by wildlife as travel lanes.

Enhancement Practices

Establishing edge along roads and trails is best accomplished when the actual construction of the road or trail takes place, since equipment is at hand. If construction has long since been completed, cordwood cutting would be the best method for creating edge habitat.

Vegetation should not be removed from roads or trails where the existence of excessive slopes or water courses may cause erosion problems.

Generally speaking, the following enhancement practices will meet the requirements for establishing an edge effect:

- *Remove all woody vegetation within 10 feet of both sides of a road or trail. Of this 10 feet, five feet (closest to the road or trail center) should have stumps and rocks removed, if possible. Clear the ground and break up the soil so that grasses and forbs can be planted and maintained.*
- *Remove approximately 50 percent of the trees on both sides of the road or trail extending 25 to 30 feet into the forest. This will create a transition of vegetation from grass/forb to seedling/sapling to open forest to forest.*

Maintaining a daylight area is an important concept in habitat management. This area must be regularly maintained or else wildlife species richness will decrease as the cut-over area reverts to a less desirable vegetative stage.

- *Every three to five years, the five-foot-wide grass/forb areas should be brush mowed. This helps curtail and retard the enroachment of unwanted woody vegetation.*
- *Every 12 to 15 years, the outer areas closest to the forest land border should be cut to allow additional sunlight for stimulation of understory vegetation.*
- *In areas where it would not be aesthetically pleasing to practice daylighting, the total length of a road or trail could be broken up into smaller release sites.*

Additional wildlife enhancement practices may include creating brush piles along the edge of forested land and erecting bird nest boxes along the edge of grass and brush openings.

Glossary

Forb *any herbaceous plant species other than those in the grass, sedge and rush families; fleshy leaved plants.*

Herbaceous *a plant that grows from seeds or perennial roots rather than from woody, above-ground parts.*

Succession *the changes in vegetation and in animal life that take place as the plant community evolves from bare ground to the climax stage (e.g., old growth forest).*

Successional stage *a stage or recognizable condition of a plant community which occurs during its development from bare ground to climax.*

References and Further Reading

Shaw, S. 1978. Managing woodlands for wildlife. U. S. Dept. of Agriculture, Forest Service, Northeast Area, Bromall, PA. Booklet 1978-709-896/523. 15 pp.

Illustrated by Steve Jackson and Paul Fusco

The Technical Assistance Informational Series is 75 percent funded by Federal Aid to Wildlife Restoration—the Pittman-Robertson (P-R) Program. The P-R Program provides funding through an excise tax on the sale of sporting firearms, ammunition and archery equipment. The remaining 25 percent of the funding is matched by the Connecticut Wildlife Division.

Rev. 12/99

Preventing tick bites can seem nearly impossible, but we are trying to make it simple enough so that it becomes part of life for people living or visiting wherever ticks occur. Effective strategies are available - don't forget to:

Protect Yourself

- ☐ Tick Checks
- ☐ Tick-Protective Dress
- ☐ Use Repellents

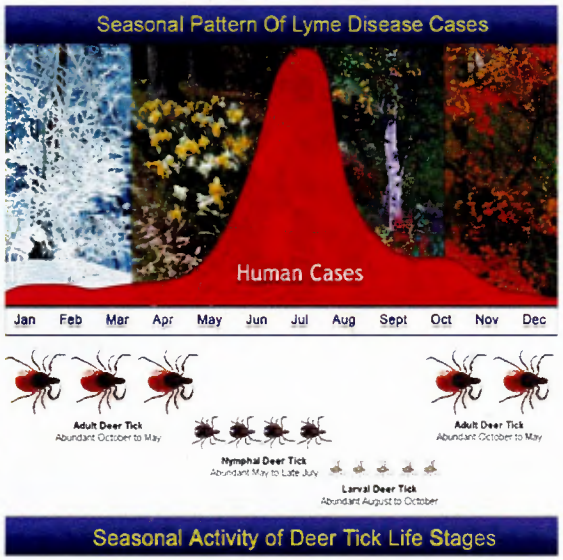
Protect Your Yard

- ☐ Eliminate Tick Habitat
- ☐ Don't Attract Wildlife
- ☐ Perimeter Sprays and Granules
- ☐ Mouse-Targeted Devices

Protect Your Pets

- ☐ Topical Sprays and Spot-ons

Increasing your knowledge about ticks and tick encounters will make you better prepared to protect yourself and others.



State Of Rhode Island
DEM Division of Parks and Recreation

2321 Hartford Avenue
Johnston, RI 02919

Phone: 401-222-2632

Web Site: www.riparks .com

Deer Tick Information

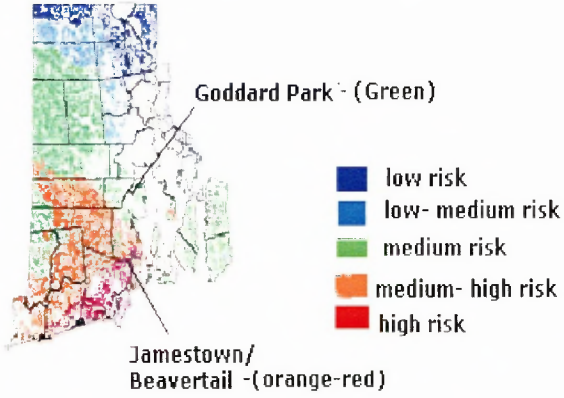
Take Notice

High risk deer tick population in this area.

Ticks carry diseases including Lyme disease.

State Of Rhode Island
DEM Division of Parks and Recreation

Tick Encounter Risk Area Maps



Helpful hints to prevent Tick Encounters:

- Check thoroughly every day for ticks
- Use a sharp tick removal tweezers to safely remove attached ticks
- Treat clothing with a repellent containing Permethrin and wear the treated clothing whenever going in areas where ticks may lurk
- Keep the edge of your yard clear of leaf litter because that's where exposure to ticks is most likely to occur
- Hire a trained professional pest controller or arborist to apply an appropriate tick treatment around the yard
- Tuck pant legs into socks in tick infested areas

Deer ticks transmit Lyme disease, Babeosis and Ehrlichiosis.

Lyme Disease

Lyme disease is caused by infection with a spirochete (a type of bacteria) which can be transmitted to people by bites from nymphal and adult black-legged ticks. American dog ticks are NOT able to transmit Lyme disease spirochetes.

Symptoms and signs of Lyme disease

Early Lyme Disease: The early stages of Lyme disease is usually marked by one or more of the following symptoms:

- fatigue
- chills and fever
- headache
- muscle and joint pain
- swollen lymph nodes
- a characteristic "bulls eye" skin rash

Late Lyme Disease

Some symptoms and signs of Lyme disease may not appear until weeks, months, or years after a tick bite:

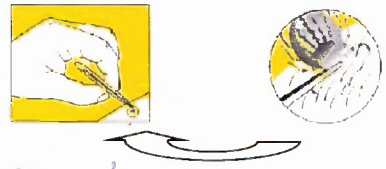
- Arthritis is most likely to appear as brief bouts of pain and swelling, usually in one or more large joints, especially the knees.
- Nervous system abnormalities can include numbness, pain, Bell's palsy (facial paralysis which usually occurs on one side), and meningitis (fever, stiff neck, and severe headache).
- Less frequently, irregularities of the heart rhythm occur.

In some persons the rash never forms; in some, the first and only sign of Lyme disease is arthritis, and in others, nervous system problems are the only evidence of the disease.

How to Remove Ticks:

Because it takes roughly 24-48 hours for a tick to transmit bacteria, it is important to remove ticks from your skin as soon as you discover them.

- Use fine-point tweezers to grasp the tick
- Grasp the tick as close to the skin surface as possible and pull upward with a steady, even pressure. Try to avoid squeezing the body of the tick
- Do not twist or jerk the tick because this may cause the mouth parts to detach and remain in the skin.
- You should pull firmly enough to lift up the skin. Pull the tick straight out with a firm and steady force.
- If doesn't come out immediately, hold this tension for 3 to 4 minutes and the tick will back out.
- Place the tick in a vial or jar of alcohol to kill it
- Call doctor immediately. Some doctors will want you to save the tick so it can be identified.



Protecting your pets:

- When walking or exercising your outdoor pet, try to keep it away from grassy or wooded areas and leafy debris.
- Check your pet regularly for ticks, especially after any trips through grassy or wooded areas. Comb your pet's hair thoroughly. If you find a find a tick, remove it promptly.
- Topical Sprays and Spot-ons:
  You not only want to keep your pets healthy but dogs and cats that roam in tick areas can be of risk to your family. Products when correctly and timely applied to your pets body can greatly reduce the chances of tick bites.

Mast for Wildlife

General Information

Mast is the dry fruit from woody plants. Examples include samara from maple, elm and ash; various pine seeds; and nuts from oak, hickory, beech, witch hazel and black walnut. Mast is the primary fall and winter food for most forest wildlife species. In some areas, acorns may comprise more than 50 percent of the fall diets of white-tailed deer and wild turkey.

A combination of mast-producing trees and shrubs is more favorable in the event that one type fails to produce for one or more years. In Connecticut, oaks are the most valuable mast producer. White oaks produce a very palatable, sweet mast every year and red oaks produce a bitter mast crop every other year. White oak acorns, because of their palatability, generally do not last through the winter, while red oak acorns remain available, providing a food supply during critical periods of scarce food.

In a hardwood forest, a minimum of 15 oak trees, 14 inches diameter at breast height (dbh) or larger, will provide the necessary food source for mast dependent wildlife species such as deer, turkey and squirrels.

Hickory trees also produce nuts which are eaten by squirrels, turkeys and other wildlife. Beechnut, black walnut, butternut and hazelnut are used by wildlife too, but are either not reliable, consistent food producers or they are scattered and limited in quantity.

Management for Mast

Pole stands, with their tight crown canopies and sparse understories, are the least productive mast producers. These stands can be managed by group selection in order to open up the crown canopy and increase potential acorn production. This benefits wildlife by creating understory growth and encouraging the regeneration of oaks, maples, birches, hickories, cherries and other species.

Ideally, 48 percent of forest land should be in sawtimber size (12 inches dbh or greater) to maximize mast production. At suitable sites, mast trees with a dbh of 20 inches or more should be encouraged.

Glossary

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

Diameter at breast height (dbh) *the standard diameter measurement for standing trees, including bark, taken at four and one-half feet above ground.*

Group selection *an uneven-aged silvicultural system; trees are removed in small groups, here and there, from a large area each year; regeneration is mainly natural and the stand is ideally composed of many ages.*

Pole tree *a young tree (from five to 11 inches dbh), from the time its lower branches begin to die until the time the rate of crown growth begins to slow and crown expansion is noticeable.*

Samara *a winged, usually one-seeded fruit that does not split open.*

Sawtimber *trees (12 inches dbh or greater) fit to yield saw logs or logs that will yield sawn timber.*

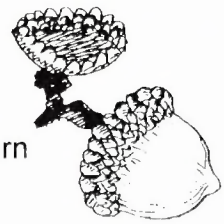
Understory *herbaceous vegetation, shrubs and small trees growing under the canopy formed by taller trees.*

References for Further Reading

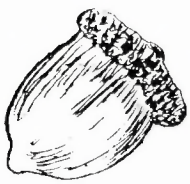
Martin, A. C., A. L. Nelson and H. S. Zim. 1951. American wildlife and plants, a guide to wildlife food habits. Dover Publ., New York, N.Y. 500 pp.

Shaw, S. 1975. Managing woodlands for wildlife. U.S. Dept. of Agriculture, Forest Service. 14 pp.

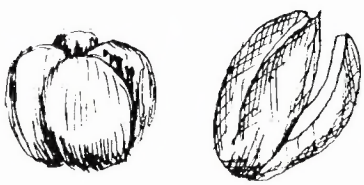
White Oak Acorn



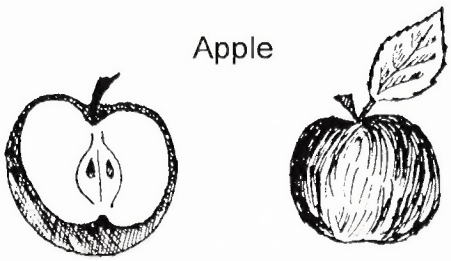
Red Oak Acorn



Shagbark Hickory Nut



Apple



Black Ash Samara

White Ash Samara

Squirrel illustration by Paul Fusco

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Rev. 12/99

WILDLIFE IN CONNECTICUT

WILDLIFE HABITAT SERIES

Openings for Wildlife

Openings in continuous and extensive forest blocks can provide the diversity needed to sustain a greater variety of wildlife species. Such openings provide food, nesting, resting and brooding sites. Natural forest openings occur as a result of damage by insects, fire, storms and disease.

Benefits of Wildlife Openings

Openings provide edge, the place where different plant communities, successional stages or stand conditions come together. The area influenced by the transition between communities is the ecotone. Ecotones are rich in both the number of wildlife species and individual animals because they provide more of the needs for a variety of wildlife than does a single vegetative type.

The vegetation in an opening furnishes forage for deer, wild turkey, cottontail rabbits, grouse, song sparrows, broad-winged hawks, flickers and other wildlife. The value of a clearing is increased if it is managed for herbaceous vegetation and shrubs which provide valuable wildlife food and cover. Clearings also attract a variety of insects which some birds are dependent on as a source of protein.

Openings in forest lands fall into two categories:

Permanent: (1) Those that will be maintained as a herbaceous opening (grass and legumes), and (2) those that will be maintained to encourage succession and native vegetation (brushy areas).

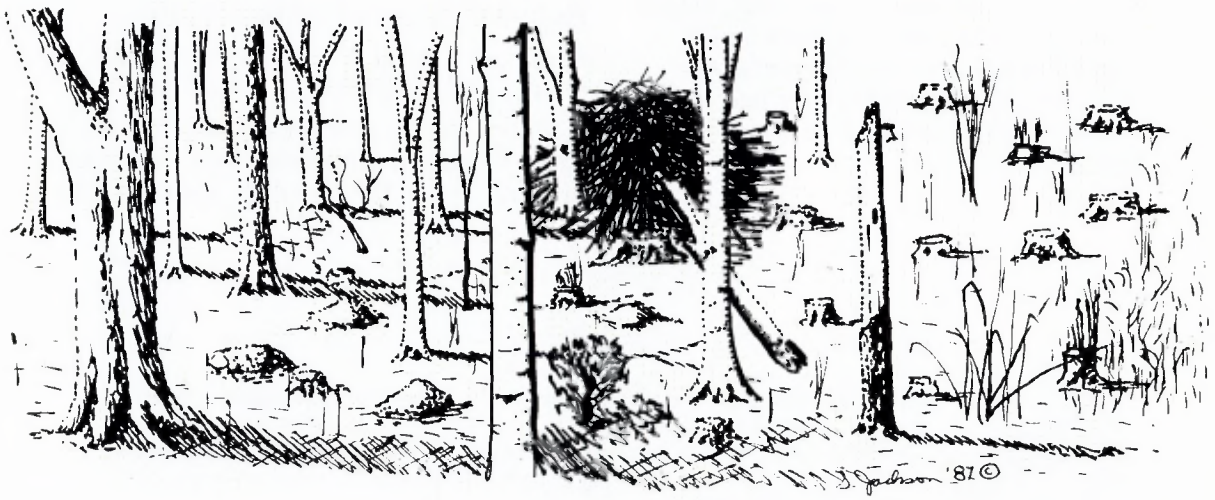
Non-permanent: (1) Those that will be cut and allowed to revert to native vegetation or planted to a more desirable tree species. Non-permanent openings are important to wildlife, but their benefits are short-lived.

Permanant herbaceous openings are the most valuable to wildlife. Grasshoppers and other insects that thrive in the grasses and forbs provide food for growing chicks, turkey poults and a variety of songbirds.

Creating and Maintaining Openings

In general, the following guidelines can be applied to forested land:

- *Maintain at least two percent of the total acreage in permanent herbaceous openings.*
- *Maintain at least five percent of the total acreage in permanent openings, encouraging early successional native vegetation.*



CONNECTICUT DEPARTMENT OF ENVIRONMENTAL PROTECTION ● WILDLIFE DIVISION

Openings in forested land can be developed in favorable locations through cordwood cutting, regeneration cuts or by widening existing openings along access roads and trails. The guidelines described below should be followed for creating openings:

- *Openings should be no less than one-quarter acre (ideally between one-half to one acre) in size and located in an east/west direction for maximum sunlight.*
- *Openings should be irregular in shape, preferably long and narrow, taking on an "S" or "J" pattern. The width should be no less than one and one-half times the height of uncut adjoining trees.*
- *Once trees are cut, stumps and rocks should be removed by a bulldozer if a herbaceous opening is desired. This allows for site preparation for seeding and periodic future maintenance.*
- *Locate openings close to early successional stage conifer patches to provide valuable wildlife cover nearby.*

Openings that will be maintained for herbaceous growth should be seeded to provide optimum wildlife food sources, and mowed every two to three years to discourage the natural invasion of woody plants. Early successional openings should be mowed (brush-hogged) every four to six years.

Site preparation for seeding should be as follows: (1) disking, (2) liming, (3) fertilizing, (4) disking again and (5) seeding. Soils can be tested for lime and fertilizer requirements through a local Natural Resource Conservation Service office or University Extension Service. Commonly used seeds include ladino clover, birds foot trefoil, rye grass, millet, sorghum, buckweat and various conservation mixes. In Connecticut, unseeded openings generally revert back to blackberry, pokeweed, sumac and elderberry.

Plantings for Food and Cover

Shrubs, such as gray dogwood, honeysuckle and highbush cranberry, can be planted and encouraged at the edge of forest land openings. These shrubs provide valuable food and cover and do not require annual maintenance, except for occasional fertilizing and cutting of undesirable plants around the plantings.

Coniferous cover can be incorporated into opening schemes. Once a conifer has reached 10 to 12 feet, it may be cut to about four feet to provide heavy cover close to the ground.

Glossary

Community *a group of one or more populations of plants and animals in a common spatial arrangement.*

Conifer *includes a wide range of trees, mostly evergreens that bear cones and have needle-shaped or scale-like leaves.*

Forage *vegetation used for food by wildlife.*

Forb *any herbaceous plant species other than those in the grass, sedge and rush families.*

Herbaceous *a plant that grows from seeds or perennial roots rather than from woody, above-ground parts.*

Regeneration cut *any removal of trees intended to assist regeneration (renewal of the tree crop) already present or to make regeneration possible.*

Stand *a plant community, particularly of trees, sufficiently uniform in composition, constitution, age, spatial arrangement, or condition to be distinguishable from adjacent communities.*

Succession *the changes in vegetation and animal life that take place as the plant community evolves from bare ground to the climax stage (e.g., old growth forest).*

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The Technical Assistance Informational Series is 75 percent funded by Federal Aid to Wildlife Restoration—the Pittman-Robertson (P-R) Program. The P-R Program provides funding through an excise tax on the sale of sporting firearms, ammunition and archery equipment. The remaining 25 percent of the funding is matched by the Connecticut Wildlife Division.

Illustrated by Steve Jackson

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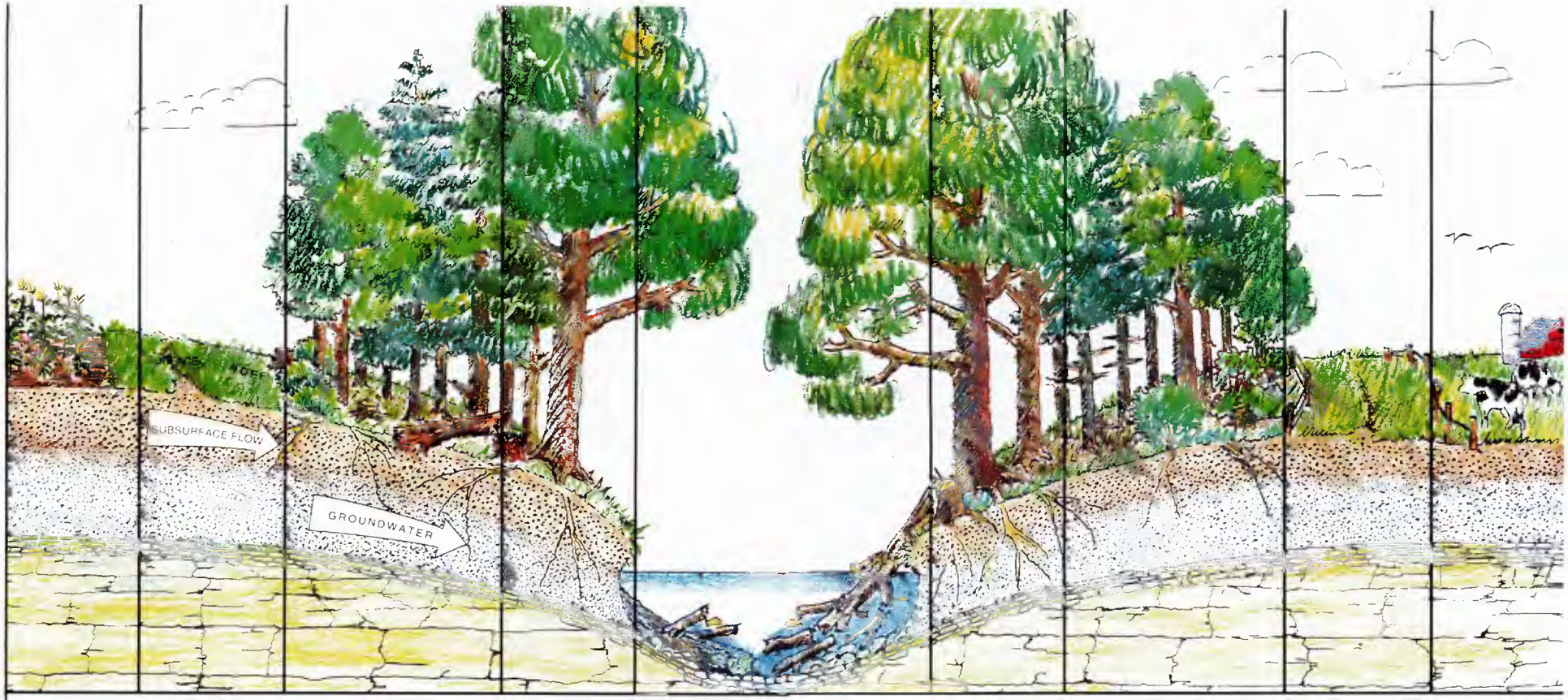
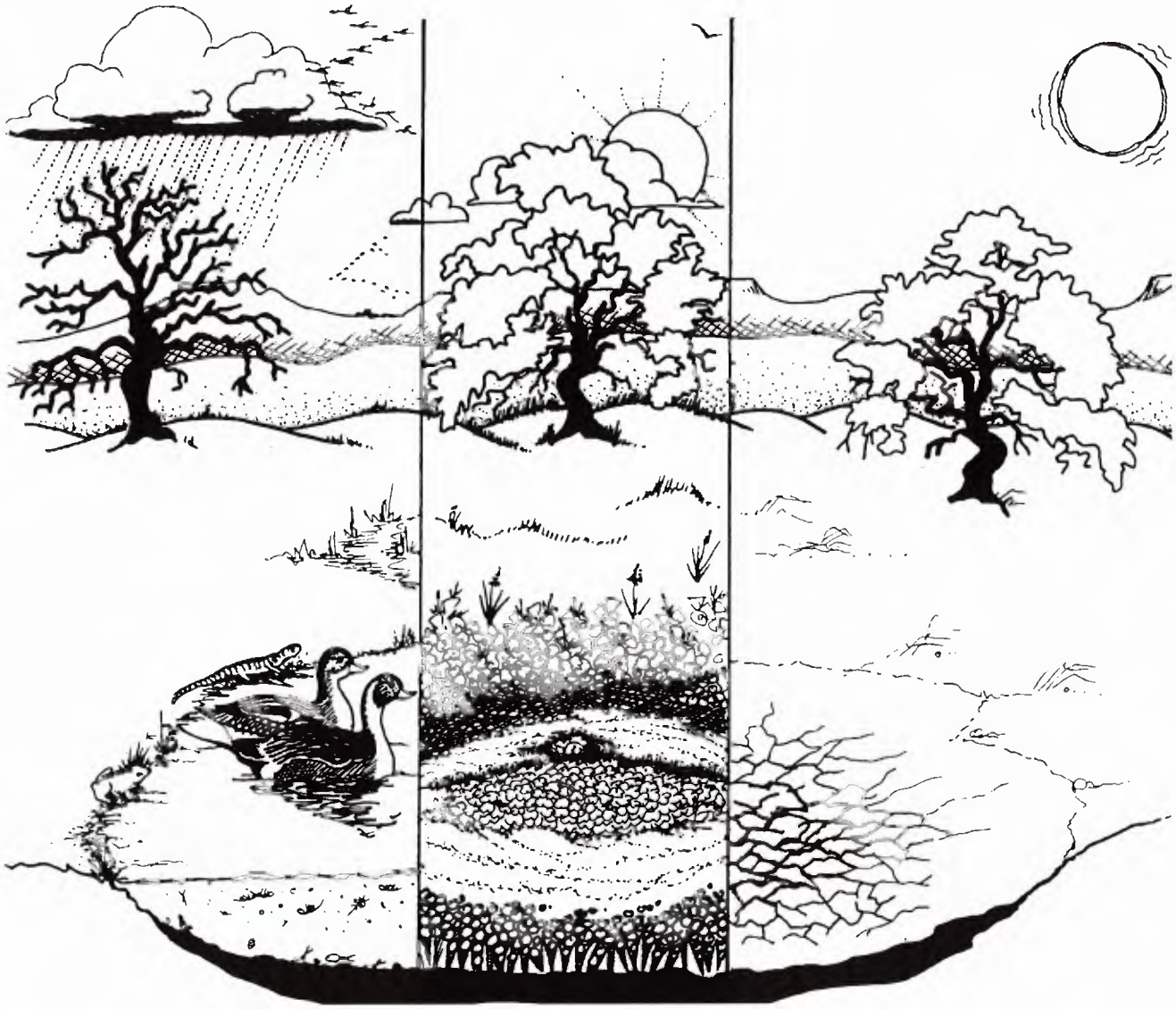


20'	60'	15'		15'	60'	20'	
CROPLAND	**ZONE 3 RUNOFF CONTROL**	**ZONE 2 MANAGED FOREST**	**ZONE 1 UNDISTURBED FOREST**	**STREAM BOTTOM**	**ZONE 1 UNDISTURBED FOREST**	**ZONE 2 MANAGED FOREST**	**ZONE 3 RUNOFF CONTROL**	**PASTURE**
Sediment, fertilizer and pesticides are carefully managed.	Concentrated flows are converted to dispersed flows by water bars or spreaders, facilitating ground contact and infiltration.	Filtration, deposition, plant uptake, anaerobic denitrification and other natural processes remove sediment and nutrients from runoff and subsurface flows.	Maturing trees provide detritus to the stream and help maintain lower water temperature vital to fish habitat.	Debris dams hold de - t ritus for processing by aquatic fauna and provide cover and cooling shade for fish dwellers. and other stream	Tree removal is generally not permitted in this zone.	Periodic harvesting is necessary in Zone 2 to remove nutrients sequestered in tree stems and branches and to maintain nutrient uptake through vigorous tree growth.	Controlled grazing or haying can be permitted in Zone 3 under certain conditions.	Watering facilities and livestock are kept out of the Riparian Zone insofar as practicable.

Seasons and Vernal Pools



Winter

Invertebrates hatch and spadefoot toads mate as rain fills the pool. Egrets, ducks, hawks, and amphibians dine on the bugs.

Spring

Tiny wildflowers bloom as the pool recedes. Invertebreate eggs settle into the mud. Baby toads stock up on bugs, then burrow themselves deep until the next rainy season.

Summer

The pools are dry. Eggs, cysts, and seeds lie dormant until winter returns.

WILDLIFE IN CONNECTICUT

WILDLIFE HABITAT SERIES

Snags for Wildlife

What Is a Snag?

A snag is any dead or dying standing tree. For wildlife purposes, snags should be at least three inches in diameter at breast height (dbh) and at least six feet tall.

Snags may develop cavities which either occur naturally or are excavated by birds and mammals.

Why Snag Management?

Over 85 species of North American birds,35 of which occur in the Northeast, use cavities in dead or deteriorating trees. Snags also provide essential habitat requirements for cavity-using amphibians, reptiles and mammals. Snags are used for nesting, shelter and feeding sites.

The removal of snags can negatively impact wildlife populations that are dependent on them as essential habitat components. Cavity nesters evolved in unmanaged forest stands where snags developed naturally. Snag and den trees are becoming short in supply as forests are being intensively managed, whether through cordwood cutting, timber management or land clearing. These activities tend to accelerate the removal of existing snags and diminish the probability of trees ever becoming large enough to serve as possible snag or den trees.

One Very Important Benefit

Insectivorous birds such as woodpeckers and nuthatches depend heavily on snags as a source of food. These birds, in addition to being an integral part of our natural ecosystem, are very beneficial in helping to control unwanted insect pests. The importance and benefits derived from insectivorous birds as biological control agents are receiving more attention.

How Many Snags?

Each forest community has different requirements in terms of the number, species and size of snags necessary to support all the cavity users associated with that community.

The number and size of available snags affects not only the presence or absence of snag-dependent wildlife but also wildlife population levels. Generally, the value of a snag tree increases as its size increases. To assure that the minimum requirements of most wildlife species are being met, three snags of 12 inches dbh or greater should be available per acre. All snags should remain in clearcuts, in wildlife openings and within 100 feet of wetland or riparian areas. Since cavity-nesting birds such as woodpeckers usually have large territories, snags should be well distributed.

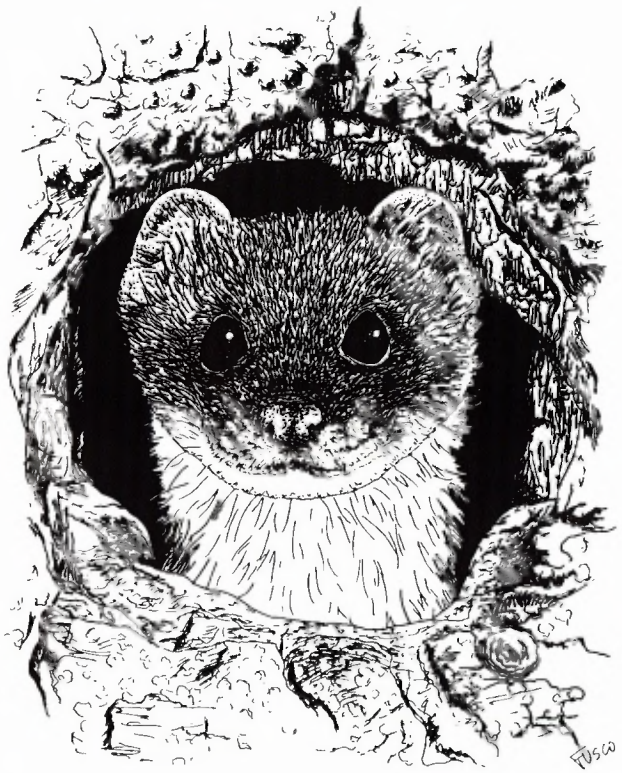
A minimum of one 15-inch dbh or greater diameter den tree should also remain per acre. Den trees are trees that are living or partially living and

possess a cavity large enough to serve as shelter or as a site for birds and mammals to give birth and raise young. In time, they will also serve as future snag trees.

Management Recommendations

Landowners and land managers who have forested land that does not meet the minimum acceptable levels of snag and den trees can follow the recommendations listed below:

- *Girdle trees (preferably cull trees).*
- *Provide artificial nest cavities (nest boxes).*
- *Set aside a percentage of the acreage to remain unmanaged (managed naturally).*
- *Bore holes in suitable-sized trees where cavity availability is limited.*
- *Consider leaving permanent uncut buffer strips on both sides of streams.*
- *Discontinue removal of dead, dying and decayed trees for use as firewood in areas where nest cavity sites are limited.*



Glossary

Buffer strip *a strip of vegetation that is left or managed to reduce the impact of a treatment or action of one area on another.*

Cull *trees, logs, or lumber which have been rejected because they do not meet certain specifications.*

Den tree *a tree having the trunk or large limbs hollowed out by rotting, with an opening to the outside. This includes some snags, but den trees are usually alive and often produce mast (dry fruit).*

Diameter at breast height (dbh) *the standard diameter measurement for standing trees, including bark, taken at four and one-half feet above ground.*

Insectivorous *feeding on insects.*

Riparian *an area identified by the presence of vegetation that requires free or unbound water or conditions more moist than normally found in the area.*

Rotation age *the age of the forest stand when the final harvest cut is made.*

References and Further Reading

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Illustrated by Paul Fusco

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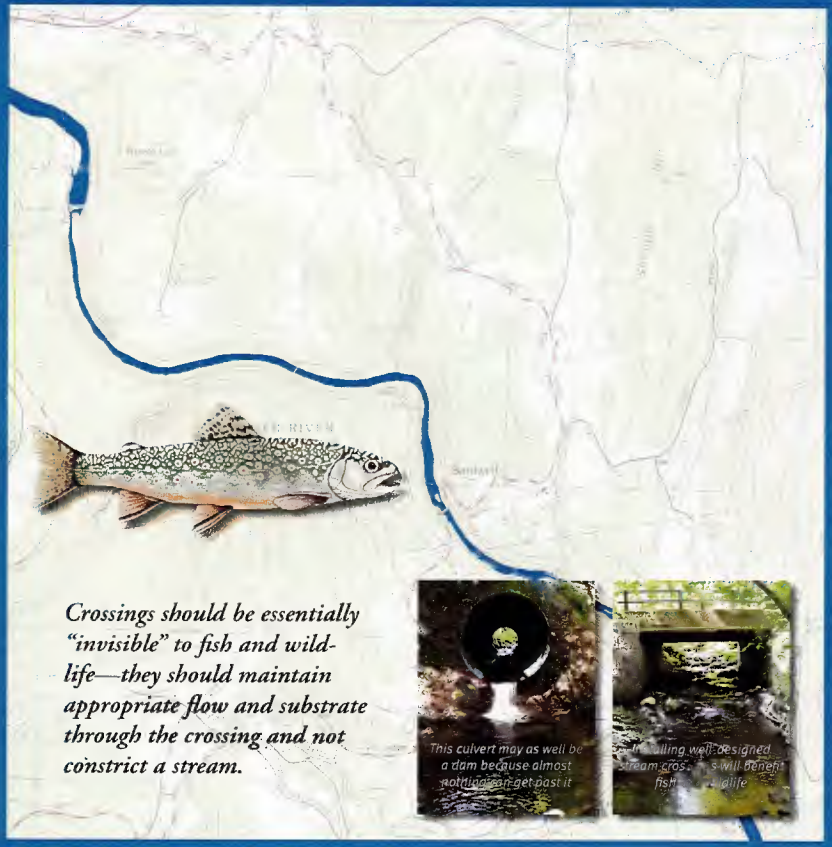
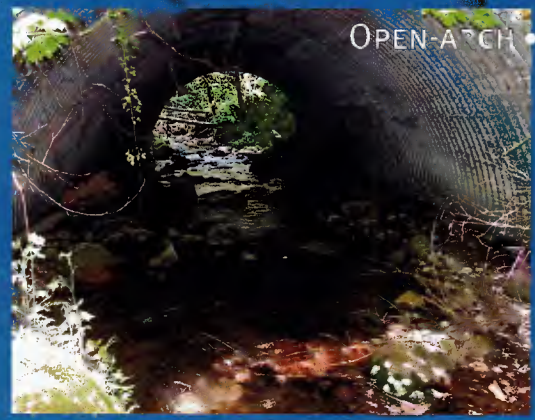


Crossings should be essentially "invisible" to fish and wildlife—they should maintain appropriate flow and substrate through the crossing and not constrict a stream.

This culvert may as well be a dam because almost nothing can get past it

A well-designed stream crossing will benefit fish and wildlife

BRIDGE



OPEN-ARCH

DESIGNED CROSSINGS

(fish friendly)

- Large sizes suitable for handling flood flows
- Bridges and open-arch designs considered optimum under most conditions
- Crossings are wide and high relative to their length
- Greater than 1.2x stream width maintains dry banks for wildlife passage
- Water depth and velocity match conditions upstream and downstream
- Natural substrates create good conditions for stream wildlife

EFFECTIVE CROSSINGS INCLUDE...

- Bridges
- Open bottom arches
- Culverts that span, and are sunk into, the streambed

STREAM CROSSING PROBLEMS...

UNDERSIZED CROSSINGS

Undersized crossings restrict natural stream flow, particularly during floods, causing several problems, including scouring and erosion, high flow velocity, clogging, and ponding. Crossings should be large enough to pass fish, wildlife, and floods.

SHALLOW CROSSINGS

Shallow crossings have water depths too low for many organisms to move through them and may lack appropriate bed material. Crossings should have an open bottom or should be sunk into the streambed to allow for substrate and water depths that are similar to the surrounding stream.

PERCHED CROSSINGS

Perched crossings are above the level of the stream bottom at the downstream end. Perching can result from either improper installation or from years of downstream bed erosion. Crossings should be open-bottomed or sunk in the bed to prevent perching.

...AND COMMON CONSEQUENCES

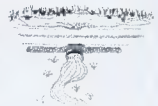
LOW FLOW
Causes: Shallow or perched crossings

UNNATURAL BED MATERIAL
Causes: Shallow or perched crossings

SCOURING AND EROSION
Causes: Undersized or perched crossings

HIGH FLOW
Causes: Undersized crossings

CLOGGING
Causes: Undersized crossings



PONDING
Causes: Undersized or perched crossings

TO LEARN MORE

This poster is a companion to the *Massachusetts Stream Crossings Handbook*, produced by the Massachusetts Riverways Program. Please consult that publication for further information on stream crossings and design standards.

The Stream Continuity website, maintained by UMass Extension, has up-to-date guidelines and crossing standards and information on crossing problems, the ecological importance of river continuity, and further resources. Staff at the Massachusetts Riverways Program are also available to provide suggestions and guidance to improve fish and wildlife movement through stream crossings. Visit these web sites for more information on stream continuity:

Stream Continuity - UMass Extension www.streamcontinuity.org
Massachusetts Riverways Program www.massriverways.org

ACKNOWLEDGEMENTS

The Massachusetts Riverways Program, a division of the Department of Fish and Game, promotes the restoration, protection, and ecological integrity of the Commonwealth's rivers, streams, and adjacent lands. The River Continuity Partnership is a collaborative effort with the Riverways Program, the University of Massachusetts Extension, The Nature Conservancy, and other nonprofit and agency partners.

RIVERWAYS PROGRAM

Writing, illustration, and design: biodrawversity (www.biodrawversity.com)

CHAPTER 15 RECREATION TRAIL DESIGN

Recreation Trail Design

Figure 15-1. *Pedestrians of all abilities enjoy the opportunity to be out in nature, which recreation trails provide.*

Recreation trails are designed to provide a recreational experience. Use of a recreation trail is a choice made by those individuals who desire the experience that the trail provides. Recreation trails should provide users with disabilities with access to the same range of trail experiences offered to other users at the site. This means that trails should be designed to reach destinations or points of interest and travel through various environments. Providing access to people with disabilities is best achieved by providing trail information in multiple formats and by minimizing grade, cross slope, barriers, and the presence of surfaces that are soft or unstable.

Any trail that is specifically designed for pedestrian use should also be designed to provide access to people with disabilities. Trails that are not designed to provide access for pedestrians, such as single-user mountain bicycling, horseback riding, or off highway vehicle trails, do not need to be designed to provide access to pedestrians with disabilities. However, these trails should be designed to provide access to people with disabilities who will be using the equipment associated with the intended trail use, such as a mounting area or platform for equestrians who use

CHAPTER 15 RECREATION TRAIL DESIGN

wheelchairs, and amenities such as parking and restrooms should also be accessible.

15.1 Background information

In the past, many "accessible" recreation trails were designed with a length less than a quarter mile, no grade or cross slope, and with a wide, paved surface that made a loop around or near the parking lot, picnic area, or nature center. Individuals looking for a short, easy stroll, such as travelers who need to stretch after driving long distances, often enjoy these trails. Although these types of trails may meet the needs of some users, they usually do not provide a complete experience of the environment or elements available at the site. Therefore, it is not desirable to design all trails to these same standards. Trails that are intended to provide access to people with disabilities should be designed to provide a range of opportunities so that all trail users can experience the various environments offered at the site.

The design recommendations presented here primarily reflect the work of the Regulatory Negotiation Committee on Accessibility Guidelines for Outdoor Developed Areas (U.S. Access Board, 1999b). These recommendations, or a slightly modified version, will form the basis of a proposed rule that will be published by the Access Board for public comment. Although no trail can provide access to all individuals, trails that meet the Committee's recommendations are considered accessible under the ADA.

It is critical that designers recognize that these specifications do not represent an exact point, beyond which the trail will be completely inaccessible to all individuals with disabilities. People with disabilities can and do use all types of trails. Some people, with and without disabilities, choose to travel on extreme trails, such as to the summit of Mt. Everest or the South Pole. Others rarely, if ever, venture off of the sidewalk, or some people have disabilities that prevent them from even going outdoors. Therefore, designers should keep in mind that some people

CHAPTER 15 RECREATION TRAIL DESIGN

with disabilities will always be able and interested in using a trail regardless of its exact design specifications. Furthermore, more people are able to enjoy different trail experiences because of advances in adaptive equipment.

Trail designers and builders should strive for maximum accessibility. However, in situations where it is not possible to fully comply with the recommended specifications for trails, designers are encouraged to comply with the recommendations to the greatest extent possible. It is essential that designers recognize the continuum of abilities among recreation trail users. The more the trail conditions vary from the recommended specifications, the larger the proportion of people who will not be able to access the trail. On trails where it is not possible to fully comply with the design recommendations, designers should ensure that the non-compliant sections are minimized in length and severity. For example:

- The trail should be free of constructed barriers, and natural barriers should be removed if feasible.
- If the steepest grade on the trail cannot be less than 20 percent, the segment should be as short as possible and the remainder of the trail should comply with the recommendations;
- If there is a segment of trail that has a 10 percent grade for more than 9.14 m (30 ft), a level rest interval should be provided as soon as possible, and the remainder of the trail should be designed according to the recommendations;
- If there is a segment of trail that has a cross slope of more than 5 percent, the segment should be as short as possible and the remainder of the trail should follow the recommended specifications; or
- If the trail travels along a cliff, and a drop-off creates a tread width less than 915 mm (36 in), the narrow

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section should be made as wide as possible and the trail on either side of the narrow section should be designed according to the recommendations.

The proposed Accessibility Guidelines for Outdoor Developed Areas would require newly designed or newly constructed and altered portions of existing trails connecting to designated trailheads or accessible trails to comply with the proposed guidelines. The guidelines recognize that the natural environment often will prevent full compliance with certain technical provisions. Departures are permitted from certain technical provisions where at least one of four conditions is present:

- Where compliance would cause substantial harm to cultural, historic, religious, or significant natural features or characteristics;
- Where compliance would substantially alter the nature of the setting or the purpose of the facility, or portion of the facility;
- Where compliance would require construction methods or materials that are prohibited by Federal, State, or local regulations or statutes; or
- Where compliance would not be feasible due to terrain or the prevailing construction practices.

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Table 15-1. Firmness, Stability, and Slip Resistance for a Variety of Common Trail Surfacing Materials

Surface Material	Firmness	Stability	Slip Resistance (dry conditions)
Asphalt	firm	stable	slip resistant
Concrete	firm	stable	slip resistant*
Soil with Stabilizer	firm	stable	slip resistant
Packed Soil without Stabilizer	firm	stable	not slip resistant
Soil with High Organic Content	soft	unstable	not slip resistant
Crushed rock (3/4" minus) with Stabilizer	firm	stable	slip resistant
Crushed rock without Stabilizer	firm	stable	not slip resistant
Wood Planks	firm	stable	slip resistant
Engineered Wood Fibers that	moderately	moderately	not slip
comply with ASTM F1951	firm	stable	resistant
Grass or Vegetative Ground Cover	moderately firm	moderately stable	not slip resistant
Engineered Wood Fibers that do not comply with ASTM F1951	soft	unstable	not slip resistant
Wood Chips (bark, cedar, generic)	moderately firm to soft	moderately stable to unstable	not slip resistant
Pea Gravel or 1-1/2" Minus Aggregate	soft	unstable	not slip resistant
Sand	soft	unstable	not slip resistant

*A broom finish significantly improves the slip resistance of concrete.

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Soft trail surfaces should be avoided whenever possible. Not only do they limit the accessibility of the trail, but they generally require more maintenance and create a greater impact on the environment. Existing surfaces that are not firm and stable can be improved through the following recommendations:

- Improve the design of trail surfaces so that water quickly runs off to the side of the trail rather than being absorbed into the trail surface;
- If it is possible to excavate the natural trail surface, install a layer of drain rock under the surface material;
- Use a soil stabilizer or construct a raised rock surface, such as riprap or turnpike, to maintain the firmness and stability of wet areas;
- Construct a raised surface such as a boardwalk or puncheon; or
- If possible, avoid dry, sandy soils. As an alternative, consider maintaining vegetative ground cover or building a boardwalk over the sandy surface. If trails are located on beaches, provide a beach access route and make tide information available to users so that they can travel at lower tides and make use of the firmer surface below the high water mark (see Section 17.2).

Figure 15-6. *This recreation trail contains many tread obstacles including tree roots and rocks.*

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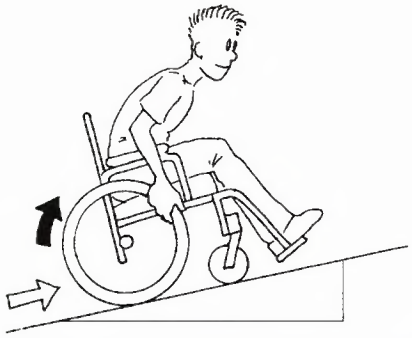

Figure 15-9. *Steep trail grades are a significant barrier to access for many pedestrians with mobility impairments.*

15.5 Trail grades and cross slopes

All individuals, with and without disabilities, must exert more energy to traverse upward on sloped surfaces than on level surfaces. For some individuals, such as those who use manual wheelchairs, the difference in energy for sloped versus level surfaces is significant. In contrast, powered wheelchair users do not exert more energy on sloped surfaces; however, they do use more battery power on steep grades and end up with reduced travel range as a result. In addition, many individuals with mobility impairments, including both powered and manual wheelchair users, are less stable on sloped surfaces.

15.5.1 Grade

People with mobility impairments have a difficult time negotiating steep grades because of the additional effort required for mobility. Manual wheelchair users may travel very rapidly on downhill pathways, but will be significantly slower on uphill segments. Steep running grades are particularly difficult for users with mobility impairments when resting opportunities are not provided. Furthermore, less severe grades that extend over longer distances may tire users as much as shorter, steeper grades.

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15.5.1.1 Recommended grade specifications

In general, running grades on recreation trails should not exceed 5 percent, and the most gradual slope possible should be used at all times. When trails must be built with steeper grades, it is essential that the lengths of the maximum grade segments are minimized to enhance accessibility and grade segments are free of other access barriers. Users should not be required to expend additional efforts to simultaneously deal with factors such as soft surfaces, steep cross slopes, narrow tread widths, or obstacles.

When it is not possible to have running grades that are 5 percent or less, the following recommended guidelines should be used for designing maximum grades over short intervals:

- 8.3 percent for a maximum of 61.0 m (200 ft);
- 10 percent for a maximum of 9.14 m (30 ft); and
- 12.5 percent for a maximum of 3.05 m (10 ft).

On recreation trails, a 14 percent maximum grade is acceptable for open drains when resting intervals are provided every 1.525 m (5 ft), and the maximum cross slope is 5 percent. Furthermore, the total running slope should not exceed 8.3 percent for 30 percent or more of the trail.

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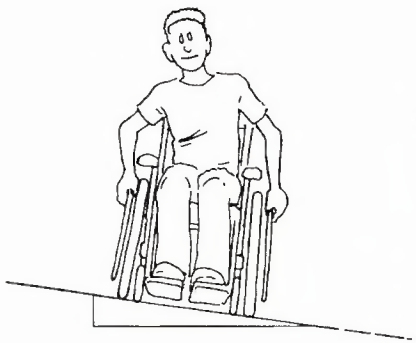

Figure 15-15. *Wheelchair users traveling on a trail with a cross slope have to use more energy to travel in a straight line to offset the force of gravity that directs them sideways.*

15.5.2 Cross slope and drainage

Severe cross slopes can make it difficult for wheelchair users and other hikers to maintain their lateral balance because they must work against the force of gravity. Cross slopes can also cause wheelchairs to veer downhill. In addition, individuals using crutches often cannot compensate for the height differential created by severe cross slopes.

15.5.2.1 Recommended cross slope specifications

Designers must balance the negative effect cross slope has on pedestrian mobility against the necessity of including cross slope to provide adequate drainage. On most paved surfaces, 2 percent is adequate for drainage. However, cross slopes up to 5 percent may be necessary for drainage on non-paved surfaces, such as crushed limestone. Particular attention should be paid to drainage in steep terrain because the velocity of the water flow will be significant and more cross slope will be required to direct the water to the side of the trail rather than down the center of the path. If water cannot be adequately routed off an unpaved trail using a 5 percent cross slope, a more significant cross slope may be needed. Cross slopes may increase to 10 percent at the bottom of an open drain if the trail path width is a minimum of 1.065 m (42 in).

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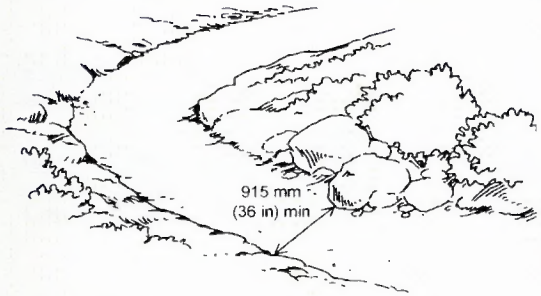

Figure 15-24. *If an object must protrude into the travel space, it must not extend past the minimum 915 mm (36 in) clear tread width.*

15.6 Trail tread width

The width of the trail tread not only affects pedestrian usability but also determines the types of users that will have access. Recreation trails designed for pedestrian use should have a minimum tread width of 915 mm (36 in). However, it is recommended that the tread width be at least 1.525 m (60 in) wide when possible. This allows space for people using assistive devices, such as a wheelchair, stroller, or walker, to easily pass one another. If a narrower passage space is unavoidable, for example between two rock beds, the trail width may be reduced to 815 mm (32 in) for short distances.

In addition to providing for clear passage, designers should also consider that most pedestrians tend to avoid path edges. They chose to travel in the center of the trail to avoid drop-offs and untrimmed vegetation. The tendency of pedestrians to avoid the edges of a path increases the width required for a given path to be usable. In contrast, individuals with limited vision who use a cane for guidance tend to travel primarily along the edge of the trail surface, using the difference between the trail and the surrounding brush to provide direction. The movement patterns of other designated user groups should also be considered when designing the width of a trail. For example, cross-country skiers may use a lateral foot motion for propulsion that is wider than the stride of most pedestrians. The width required to accommodate this motion increases when skiers ascend grades or pick up speed. As a result, trails permitting these users should be wider than trails that are designated solely for pedestrians.

15.6.1 Trails with vegetation

For all trails, the section cleared on either side of the tread width should be wide enough to prevent vegetation from encroaching on the trail between periods

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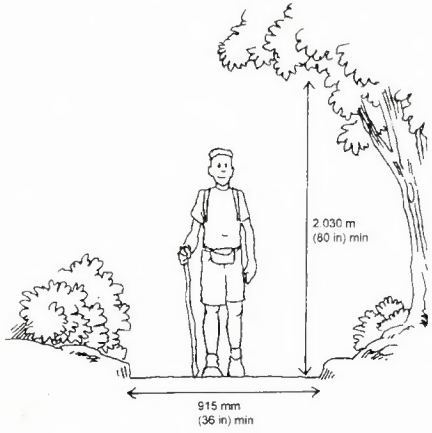


Figure 15-25. *A clear area that is wider and taller than the trail tread width should be created to prevent vegetation, such as tree limbs, from encroaching into the trail and creating protruding objects.*

of scheduled maintenance. Trails in areas with heavy vegetation require additional width on either side of the trail tread to prevent the growth of grasses or ground cover from significantly increasing the energy required to traverse the trail. Overgrowth can also hinder a user's ability to see other trail users, increasing the possibility of collisions. Overgrowth also limits a user's awareness of minor changes in the ground surface, increasing the risk of falls.

Although the extent of vegetation that must be cleared will depend on the type of vegetation, frequency of maintenance, and permitted trail user groups, the following recommendations should be considered:

- Whenever possible, the path should be cleared beyond the trail tread and above the required vertical clearance height to reduce maintenance requirements;
- At a minimum, vegetation should be cleared to the width of the beaten path and the height of the tallest user group; and
- On trails that accumulate a significant amount of snow in the winter, the clearance height should be measured from the height of the maximum snow level rather than from ground level to accommodate cross country skiers and other winter trail users.

15.6.2 Passing space

Periodic passing spaces allow trail users to pass one another and provide wheelchair users enough maneuvering room to turn around. Slower pedestrians benefit from passing spaces because faster users can travel by them with less disruption. On recreation trails that are narrower than 1.525 m (60 in), passing spaces should be at least 1.525 m x 1.525 m (60 in x 60 in) and should be provided at least every 305 m (1000 ft). Passing spaces should be provided more frequently if the terrain is challenging and there is no space to pull off of the trail to allow others to pass. Passing spaces should also be provided more frequently if the trail is

CHAPTER 15 RECREATION TRAIL DESIGN

Figure 15-26. *Objects, such as tree limbs, that protrude into the recreation trail tread more than 101 mm (4 in) should be removed.*

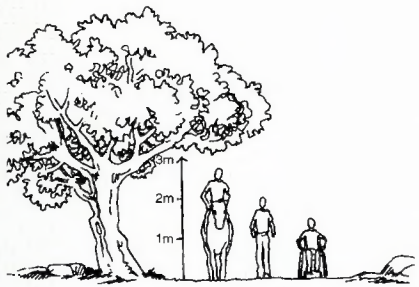


Figure 15-27. *Overhead branches should be maintained to a height that is sufficient for all expected users of a recreation trail.*

narrow and sight distances are restricted enough that a trail user may unexpectedly encounter somebody traveling in the opposite direction in an area where passing is not possible.

15.6.3 Protruding objects and vertical obstructions

Protruding objects are anything that overhangs or protrudes into the shared-use path tread, whether or not the object touches the surface. Examples of protruding objects include rock overhangs and tree limbs. People with vision impairments who use dog guides for navigation are able to avoid obstacles in the trail up to 2.030 m (80 in). Objects that protrude into a recreation trail but are higher than 2.030 m (80 in) tend to go unnoticed, because most pedestrians require less than 2.030 m (80 in) of headroom. People with vision impairments who use long white canes to navigate can easily detect objects on the trail that are below 685 mm (27 in). However, objects that protrude into the pathway between 685 mm (27 in) and 2.030 m (80 in) are more difficult to detect because the cane will not always come in contact with the object before the pedestrian comes in contact with the object.

Ideally, objects should not protrude into any portion of the clear tread width of a recreation trail. If an object must protrude into the travel space, it should not extend more than 101 mm (4 in).

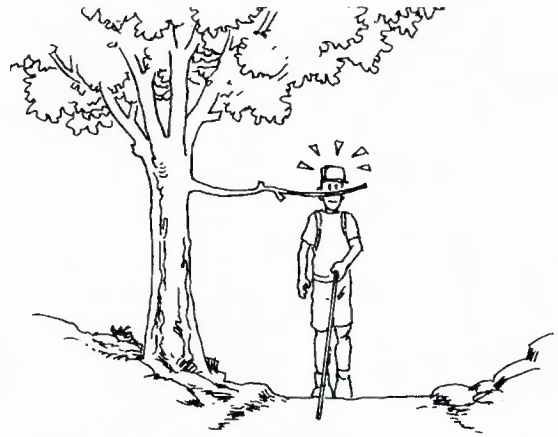
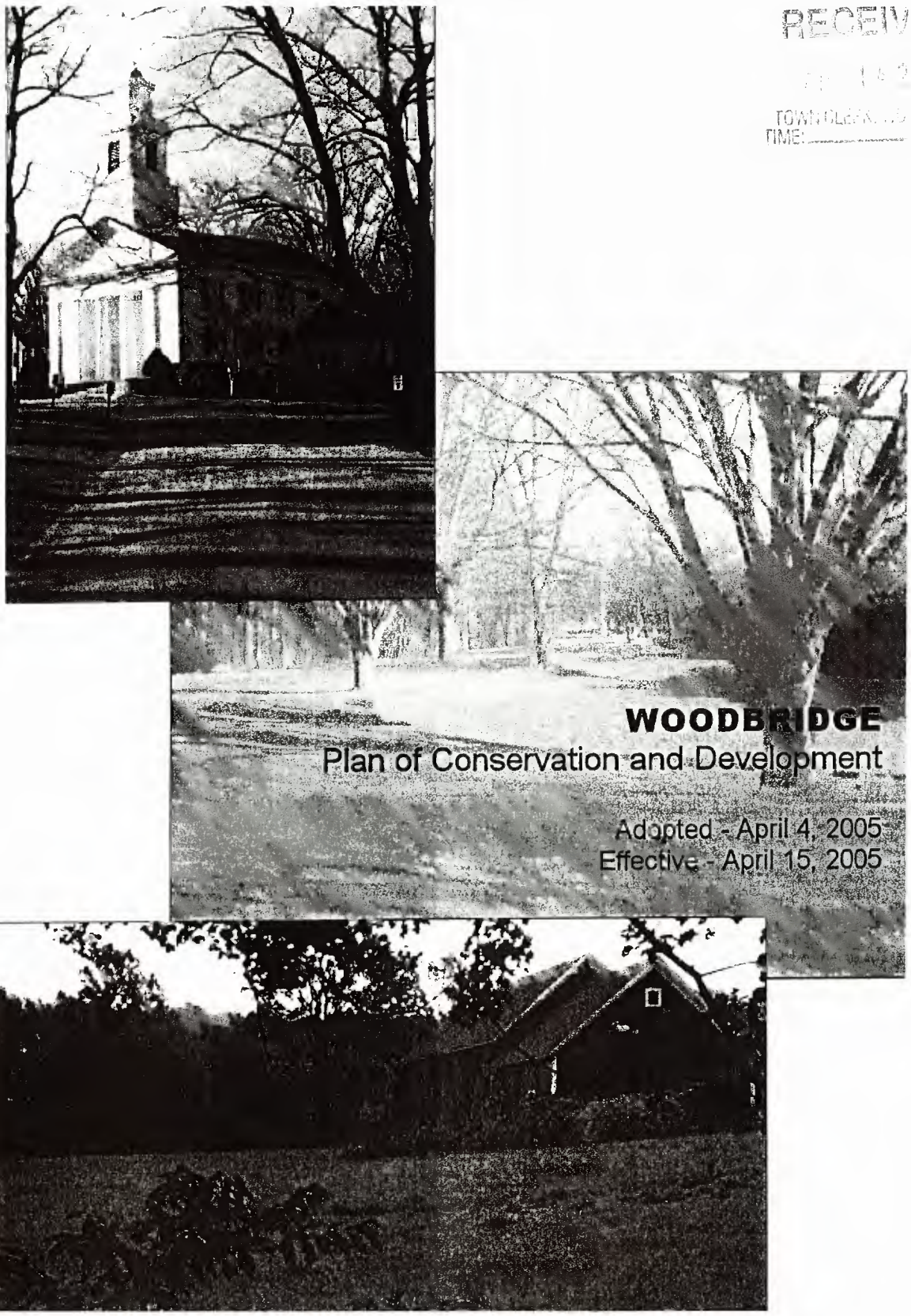


Figure 15-28. *Objects that protrude into the pathway at a height greater than 685 mm (27 in) are difficult for pedestrians who use long white canes to detect.*



Much of this district is already developed. The district has been developed with bio-technology facilities, office buildings, indoor recreation facilities, light manufacturing, warehouses and other commercial enterprises. Opportunities to attract new businesses to this area remain.

8.2 Vision for Development District 2

Development District 2 has significant potential to increase the tax base of the Town. This plan recommends that this opportunity be leveraged by marketing this area with concerted efforts to attract new business ventures. Continuing with observed trends, Development District 2 is well served by technology and bio-technology enterprises as a welcome addition to the mix of currently existing businesses. New development and continued renovation should draw on the natural setting, complementing it with landscaping to further its aesthetics. This would reinforce the natural buffers between the businesses and adjacent residential properties. With this approach, Development District 2 can continue as a desirable thriving area.

9. Open Spaces

Woodbridge has a variety of natural features and environmental resources, including trap rock ridges, streams and rivers, lakes and ponds, wetlands, meadows, and upland forests. Figure 9-1 Greenway depicts the natural water resources in the Town. Along its easterly boundary, Woodbridge borders West Rock Ridge State Park, which offers hiking opportunities and scenic vistas of the greater New Haven area. This ridge is a part of the trap rock ridge that runs from Long Island Sound north to Massachusetts and New Hampshire. Trap rock ridges are unique to Connecticut and western Massachusetts. Because of their unique status, Connecticut specifically allows municipalities to restrict development within ridgeline setback areas, as set forth in Connecticut General Statutes, Section 9-1 a.

Two public water supply watersheds cross the Town and the South Central Connecticut Regional Water Authority and Birmingham Utilities own significant land holdings in the Town. Although situated next to coastal towns, the land in Woodbridge is generally hilly and not suitable to the intensive development prevalent in adjoining New Haven, Orange, and other neighboring towns. The State of Connecticut 1998-2003 Plan of Conservation and Development recognizes these geographic features and recommends that Woodbridge remain a rural community with significant conservation areas and preserved open space lands. Table 9-1 Open Space in Woodbridge identifies the composition of the open space lands in Woodbridge.

ıssessor's Office

DBRIDGE
ERVATION AND DEVELOPMENT

0 2000 4000 6000 Feet

1 : 4,000

Figure 9-1 Greenway

- Utility Right-of-Way
- Protected Paths
- Need Right-of-Way
- Public / Institutional
- Private / Recreational
- Water Agency
- Protected Open Space
- Water

Table 9-1 Open Space in Woodbridge

Preserved Open Space / Land Encumbered by Open Space Restrictions		
Town Land	650	Acres (approximately)
Non-Profit Organizations	265	
	Total: 915	(7.5% of total acreage in Town)
Undeveloped Land without Restrictions		
State Land	125	Acres
Town Land	240	
Water Companies	2,030	
Golf Courses	375	
Farms, forests and undeveloped residential land	750	
	Total: 3,520	(28%)
Land with Open Space Qualities		
Cemeteries	15	Acres
Churches	80	
Large Lots (8+ acres)	980	
Power Company	130	
	Total: 1,205	(9.6%)
	Grand Total: 5,640	**(45.1%)**

The September 2002 Town Survey results indicate that residents are concerned about the environment and would like to see the designation of additional open space. Sixty-seven percent of returned surveys indicated that Woodbridge should have more open space lands. Also interesting to note, 51% of the returned surveys revealed that residents were unwilling to increase taxes to pay for the acquisition of additional land.

9.1 State of Connecticut Open Space Guidelines

Connecticut General Statutes (CGS) Section 12-107b defines open space as:

"any area of land, including forest land, land designated as wetland under Section 22a-30, and not excluding farmland, the preservation or restriction of the use of which would 1) maintain and enhance the conservation of natural or scenic resources, 2) protect natural streams or water supply, 3) promote conservation of soils, wetlands, beaches, or tidal marshes, 4) enhance the value to the public of abutting or neighboring parks, forests, wildlife preserves, nature reservations or sanctuaries or other open spaces, 5) enhance public recreation opportunities, 6) preserve historic sites, or 7) promote orderly urban or suburban development."

ticut originally established a goal to preserve 10% of its land as open space. This vas increased in 1999 with the passage of Public Act 99-173, which called for unicipalities to acquire and hold an additional 11% as open space. Public Act 99- osequently established 21% as the goal for preserving State lands. Legislation in 1998 stipulated annual goals for the acquisition of open space land. It proposed uisition of 4,000 acres per year for 2001 and 2002 and 5,000 acres for 2002. ridge has made a concerted effort to establish its open space network and to iently protect its remaining open spaces and natural resources. Slightly less than ts land is deed restricted. The Woodbridge Conservation Commission has d a Town-wide open space plan that identifies additional lands that should be d for open space protection.

en Space Plan discussed below, borrows heavily from the 2003 Woodbridge Open Plan.

Open Space Plan

ridge first prepared an Open Space Plan in 1965. Since then, it has been updated , 1999, and most recently, 2003. As described in the plan:

lan is guided by the belief that human activity must be in harmony with the ts of nature: air, water, land, and other natural resources that are finite and s. The Town needs to protect and actively manage its natural resources. Open elps to preserve the livability found within Woodbridge. The focus is to preserve ll-town atmosphere of our Town, to plan for its physical landscape, to protect the wildlife, vegetation, environment, and quality of life for our citizens and for the "

en Space Plan identifies the following objectives:

Protect surface water, ground water (aquifers), wetlands, water quality, and water company lands

Protect steep slopes to control erosion and water runoff and to maintain scenic views

Enlarge existing open space areas and create open space corridors and greenways to provide linkages

Protect flora and fauna, particularly critical and threatened species and habitats listed on Connecticut's Natural Diversity Database and Endangered Species List

Protect the community's unique and natural features, including wetlands, flood plains, prime agricultural soils, productive forestland, scenic vistas, trap rock ridges, glacial formations, and archaeological and historic sites

Preserve areas that shape community design and character, such as buffer strips, street trees, stonewalls, and roadsides

- Provide sites for both active and passive recreation
- Use subdivision and zoning regulations to identify and protect meaningful open space lands to complement proposed development

The two principal purposes identified in the Open Space Plan are to identify the characteristics that make specific parcels of land worthy of open space preservation and to make specific recommendations for the acquisition of the lands that have the greatest value as open space. Woodbridge must focus on the areas that conform to the definitions of open space as outlined by the State and the Open Space Plan. The Conservation Commission has set a goal of acquiring 15% of all Town land as permanent open space. The Conservation Commission hopes to reach that goal through the continued purchase of open space parcels, future donations of land by landowners and mandatory set asides in future subdivisions.

The overriding theme of the Open Space Plan is the acquisition, preservation and extension of the Woodbridge Greenway. The Greenway received State recognition in 2002. The Open Space Plan recommends that farmland, wildlife habitats, and other land with important natural features, be preserved and linked with open space parcels in order to enhance the Woodbridge Greenway.

Greenway planning calls for a holistic view of the topographical and natural systems of the area, rather than a parcel-by-parcel approach that ignores impacts outside the property lines. The interrelationships of highlands, lowlands, wetlands, and settlement patterns need to be considered when planning for greenways.

A successful greenway is established through a partnership between private, nonprofit, and public agencies. The Conservation Commission has worked with these groups to develop a successful greenway plan.

9.2.1 Woodbridge Greenway

This description of the Woodbridge Greenway is taken from the 2003 Woodbridge Open Space Plan:

The greenway "begins" at the top of West Rock Ridge State Park and traverses the South Central Connecticut Regional Water Authority's (SCCRWA) lands to the Town-owned Thomas Darling House and the Bishop Estate. From the Bishop Estate, the greenway travels north to Dillon Road into the SCCRWA's land and up to the utility easement. The trail follows the utility easement westward across Newton Road to the Russell Estate, which includes an extraordinary trail and boardwalk through diverse wetlands of the Bladens River watershed. From here, the greenway will go to the Elderslie Preserve to the Lodge. The greenway the leaves the Lodge and crosses Milford Meadows and into Wepawaug Falls. From the falls, the greenway connects with Alice Newton Street Memorial Park, the Town Hall, and across Center Street to the Fitzgerald Tract. The trail travels easterly across the Bussman Property and the Alegi Property to the East Side Burial Ground. From the cemetery, the greenway crosses the Jewish Community Center and heads south into the United Illuminating Company Parcel. The trail heads down to Park Lane Road and the Priest Property.

)pen space worthy of preservation

:ion to the greenway, there are significant land holdings in Town that have
ding historic, environmental and/or recreational significance worthy of
ation. The following is a list of open space sites worthy of preservation. The
ee sites constitute important open space parcels that currently are most threatened
:lopmental forces. Open space planning is a continuous process, and therefore sites
added to or deleted from this list as times and needs change.

'd Farms /Schulz Estate

Steep slopes facing West Rock Ridge Park

Wooded ravines

Old cement quarry

Old cement kiln

Quartz schist studied by geology classes

Greenway Trail runs through it

Magnificent laurel and dogwood

s for acquisition:

: of the last remaining undeveloped areas in Woodbridge (117 acres).

des Shepard Farm, the last working farm in Woodbridge.

Scout camp is adjacent to the area and connected to the Green way.

imity to West Rock Ridge State Park adds to its value.

/ide a natural year-round shelter for many forms of wildlife.

ect an historic trail that is a critical link in Woodbridge's Greenway.

acent to lands owned by the Town and the Woodbridge Land Trust.

Kelsey and Kozak Properties -

Adjacent to Town-owned land

Various sized potholes with shrubby shelter for birds

Land forms a natural amphitheater above potholes

Slope of amphitheater has wide variety of vegetation, with wild azalea, pink lady slippers, viburnum, club mosses, blueberries, oak, beech, spruce, and pine

Stream and swampy area

s for acquisition:

To provide an area for nature study.

To maintain existing cover for small animals and birds.

The contours of the land make development of an outdoor theater feasible.

Ideal for a wildlife park.

Possible recreation area.

Potential Bridge to Ansonia-Derby Water Company Property.

Haight Property

This is an important piece of open space that is contiguous with the Wallace Estate open space to the east of Peck Hill Road. It contains both woodlands and meadows. Acquisition of this parcel will extend the large area of protected open space created by Wallace and the Woodbridge Land Trust properties, and maximize the benefits of that area for wildlife and the public.

Hubbell Farm 424 Amity Rd / Woodbine Rd

There are approximately 40 acres east of North Pease Road that were part of the old Hubbell Farm property and that provide views of West Rock Ridge, New Haven Harbor, and Long Island Sound and that contain interesting wetlands.

902 Baldwin Road

This property is about a 70-acre farm with about 10 acres in Woodbridge. This is a critical parcel, with a developer presently exploring options.

Fellows Hillside Farm 145 Beecher Road

It is a 12-acre horse farm in the center of Town, with frontage on a state road. It faces the Fitzgerald cornfields and Town trail (originally part of the farm). Despite its relatively small size, its setting and collection of New England barns and outbuildings is a huge presence in Town, helping define its rural character.

1010 Racebrook Road

This property is a 42-acre parcel that is surrounded by South Central Regional Water Authority-land. Part of the property is a private golf course which has the Wepawaug River running through it. The site would be valuable to the Town's Greenway trail system, and it could serve as a Town golf course.

Racebrook Road, 1130 Racebrook Road, and 25 Northrup Properties

An opportunity exists to extend the Greenway from the Racebrook Tract on the south to the Town owned Massaro Property on Ford Road on the Town's southwestern border. The key linkages are the South Central Regional Water Authority's Wepawaug River lands between Greenway Road and Ansonia Road (permission for a trail would have to obtained from The SCCRWA), and the three parcels totaling 73 acres between Racebrook Road and Northrup Road known as 1156 Racebrook, 1130 Racebrook, and 25 Northrup. This is an important watershed area that if protected would also link the Town's Greenway system to the 600 plus acres of open space owned by Birmingham Utilities in Derby, Ansonia, and Seymour. Such a linkage would allow the public to circle back into Woodbridge Greenway via the Birmingham Class 1 lands adjoining the Elderslie Preserve on Peck Hill Road.

Central Regional Water Authority Land

Key South Central Regional Water Authority parcels, should they come on the market, would be an asset to the Town. See the more explicit detailed Conservation Commission's Ford foundation funded report on this topic and recent state legislation enabling the acquisition of water company lands by towns and land trusts for open space and recreational purposes. When possible, the Town of Woodbridge is interested in pursuing joint efforts with the SCCRWA to acquire lands as open space that have an effect on the RWA's watershed. In particular, the 181 acre Racebrook Tract must be acquired so as to extend the 230 acres being protected by the Town of Orange into a total of 411 open space acres. Those 181 acres in Woodbridge contain Race Brook and Coldrum Brook, and offers a variety of passive open space recreational activities. It is the largest parcel of open space held in private hands within the Town of Woodbridge and must be preserved.

ia-Derby Water Company (Birmingham Utilities) Property

This is the site of some of the most valuable open space in Woodbridge with contiguous parcels in Seymour. Ansonia, and Derby. The BU land extending from the west side of Peck Hill Road to Beaver Reservoir is Class 1 watershed land, and should be protected by acquisition of adjacent open space properties. This land can be linked up to the Woodbridge Greenway trail from the Wallace Estate on Peck Hill Road. The Town should obtain permission for BU for hiking on the existing trails on the BU property.

Farm

Closely tied in to establishing a Greenway at the western perimeter of Woodbridge is the Zwick farm. It occupies land on Acorn Hill Road and Seymour

Road west to the border with the Town of Seymour. The Town has purchased 20.33 acres of the farm to provide a vital connector in any North-South Regional Open Space Greenway involving the Birmingham Utility lands. The Woodbridge Land Trust owns land between Seymour Road and Bladens Brook linking directly to lands in Bethany owned by the Bethany Land Trust. The Woodbridge Land Trust has been given a piece of the farm that extends out to Hallsey Lane.

West Rock Ridge State Park

West Rock Ridge State Park should remain as open space. The whole area is ideally located for recreation, bird watching/wildlife study, hiking and picnicking. The Conservation Commission recommends continued acquisition of in-holdings within West Rock State Park, including the Nugent Property along the West River and by Konolds Pond. A trail from the Town's "Bishops East and Thomas Darling property going up to the Ridge top has been installed and links the Woodbridge Greenway to the Regicide Trail (a Connecticut Forest and Park Association Blue Trail that connects to Sleeping Giant State Park and Naugatuck State Forest via the Quinnipiac Trail).

Developing of Trails Through Existing Golf Courses

Rights for trails through golf courses could be an important addition to our pathways, extending the Greenway beyond Fountain Street to the southernmost section of Town, and should be explored.

Landfill Behind Town Hall and Rice Pond

This area is an important adjunct to the Alice Newton Street Park and the Town owned Rice Pond Property. The Conservation Commission recommends the reclamation of the Landfill for recreational purposes and the reconstruction of Rice Pond for bird watching and ice skating, especially given the recent construction of a pavilion on the banks of the former pond. Such a reclamation of the old land fill and Rice's Pond, in conjunction with Center Field and the construction of four tennis courts to the south of Town Hall, will go a long way to integrating the Town Center as a recreational focal point for the community.

9.4 Other properties

There are many properties that would make excellent open space areas for Woodbridge residents as identified in Appendix C – Land Worthy of Preservation as Open Space as identified by the Conservation Commission. Many remaining undeveloped parcels provide habitat and shelter to wildlife. Often these undeveloped parcels have environmentally sensitive lands, such as wetlands or steep slopes on which unique,

and important plant species grow. Some of these parcels abut existing open space which make them attractive candidates for acquisition. Other parcels offer scenic of Long Island Sound, which also makes them attractive candidates for acquisition.

Proposals for Open Space

pace and greenways are instrumental in the preservation of the environment of ridge, its rural character and its quality of life. Therefore, this Plan recommends lowing:

Continuing the acquisition and protection of open space lands, consistent with the goals and objectives of the 2003 Open Space Plan, to produce an inventory of 15% of all Town land. Future acquisitions should target land that enlarges existing open space areas, provides open space connections, and preserves historic properties, important scenic views, and farmland.

There are several privately owned properties that would make excellent open space. Many undeveloped parcels in Woodbridge provide habitat and shelter to wildlife. Often these undeveloped parcels have environmentally sensitive lands, such as wetlands and steep slopes. They host unique or important plant and animal species. Some of these parcels are adjacent to existing open space areas and are therefore desirable for acquisition in order to expand current holdings. Other parcels offer scenic views of Long Island Sound. Consideration should be granted for properties with these characteristics. Additional consideration should be given if:

- The Town Greenway passes through the land
- The land is adjacent to existing Town land or open space areas
- The land lies within a public water supply watershed
- The land provides scenic views, including those of Long Island Sound;
- The land consists of at least 35 acres;
- The land is of historic value.

Enhancing the Greenway by minimizing travel along roads, guaranteeing access and ensuring its continuity. The use of restrictions and easements should be investigated for the purposes of achieving this objective.

Acquiring South Central Connecticut Regional Water Authority and Ansonia-Derby Water Company (Birmingham Utilities) properties. In addition, this recommends the future acquisition of properties that have one or more of the following open space qualities and characteristics:

Developing Open Space connections. Pedestrian and bicycle access to open spaces should be created in those areas where human access is encouraged. In areas where human access is not to be encouraged, linkages between open spaces and Greenways should be created for environmental continuity. Connectivity is a critical component of this plan.

- Seeking grant money and alternative funding sources for the acquisition of new lands. Acquire additional open space parcels through purchases, gifts, easements and other strategies. The Town could budget for additional open space acquisition and maintenance. It should consider open space uses which could yield revenue (for instance, renting fields to farmers). This separate revenue could be applied to maintenance, education, research, or future acquisitions.

10. Education, culture, arts and libraries

Woodbridge residents are highly educated and have diverse interests and backgrounds. Historically, the community has placed a very high value on quality education and intellectual pursuits. Year after year, this priority is evidenced by dedicated budgetary allocations to the Amity Regional and Woodbridge School Districts, which comprise approximately two-thirds of the annual Town budget. This cultural and educational emphasis is even more significant when the Woodbridge Public Library and other civic organizations are considered. It is noteworthy that in addition to the Woodbridge Public Library, there are extensive collections at Amity Regional High School and Beecher Road School libraries.

10.1 Woodbridge School District

The Woodbridge School District, Grades Pre-Kindergarten through Grade 6, is served by one facility, Beecher Road School. Beecher Road School North houses the Primary grades (pre K through second grade) and Beecher Road School South houses the intermediate grades (grades three through six). This division separates the distinct needs of the two age groups although common facilities are shared between the two. These include the cafeteria, library, gymnasium with locker facilities, music room, and Olympic size pool.

The class size goals, as identified by the Woodbridge Board of Education, are as follows:

- Kindergarten through second grade – 17-19 students
- Third grade through sixth grade: 19-21 students

The most recent demographics as depicted in Table 10-1 Elementary School Enrollment Projected to the Year 2003 predict a declining enrollment in the coming years. Thus, no future school expansion is anticipated at this time.

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