

A photograph of a lush forest. Tall, slender trees with green foliage form a dense canopy. The forest floor is covered with a thick layer of brown, fallen leaves and branches. Some large, grey rocks are visible among the undergrowth. The lighting is soft, suggesting a dappled sunlight effect.

LEBANON TOWNSHIP
MUNICIPAL FOREST
STEWARDSHIP
MASTER PLAN

Lebanon Township Municipal Forest Stewardship Master Plan

Prepared by

New Jersey Audubon

Co-authored by:

Danielle Bara, Ryan Hasko, Levi Morris



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Executive Summary

Lebanon Township (Township) received a grant from the Highlands Council to create a forest stewardship master plan for all forest land owned by the Township. The purpose of this forest stewardship master plan is to assess the current conditions of the forests and provide guidance on how to steward those forests to help them continue to provide the ecological services of water quality, groundwater recharge, wildlife habitat, and passive outdoor recreation. While this plan is specific to five properties owned by the Township, the information and guidance contained in this plan are applicable to other public and private forests in the Township.

Overall, the forests within Lebanon Township contain unnatural forest structure due to lack of fire and other disturbances and are in poor condition due to a lack of regeneration from a lack of sunlight reaching the forest floor, high levels of deer browse, and/or invasive plants. Furthermore, dead or dying ash trees from the emerald ash borer have been observed on all properties, and all beech trees observed have been infested with the nematode that causes beech leaf disease. Many of these threats, in addition to potential future and unforeseen effects from new disease outbreaks, insect pests, and changes in temperature and rainfall, work synergistically in causing negative impacts to the forests in Lebanon Township.

Natural regeneration of desirable native plant species is preferred over supplemental plantings. Due to the closed canopy conditions throughout most of the forests in the Township, supplemental plantings will be limited and may need to be caged to protect them from deer browse.

The following measures are recommended to increase the overall health of the forests in Lebanon Township. Note that some activities may require permits or approved forest stewardship plans before implementation. In areas with EIFP easements or deed restrictions, prior approval from the NJDEP will be required to cut vegetation, apply herbicide, and create new trails.

- **Reduce excessive browse by white-tailed deer to allow native plants and tree seedlings to grow.** This can be accomplished through reducing the local deer herd, installing deer exclusion fencing, or a combination of the two. The installation of deer exclusion fencing needs to be extensive to adequately address deer browse which will be cost-prohibitive and not feasible in many areas in the Township. Deer fencing may be suitable in certain areas, especially within canopy gaps, though while it will protect that area from deer browse it will not resolve the problem of overabundant deer in the Township. A more cost-effective method that will help lower deer populations is through a culling program that utilizes licensed hunters to focus on the harvest of female deer. While the Township allows limited hunting on four of the five properties through a permitted deer hunting program, the number of deer harvested has not yet reduced the local deer herd to where native plants and tree seedlings can grow. NJDEP Fish & Wildlife should be consulted on the legality and effectiveness of different deer management alternatives to reduce excessive deer browse.
- **Reduce invasive plants to allow native plants and tree seedlings to grow.** Invasive plants were observed on all five properties at varying densities. Complete eradication of

invasive plants is impractical but efforts should be made to reduce these species to below 1-5% of the total ground cover. This can be accomplished through chemical treatment (herbicide) or a combination of mechanical (cutting, mowing, hand pulling) and chemical treatment. Because most invasive plants are too large or extensive for hand pulling, or will re-sprout after cutting, targeted low-volume herbicide application will be needed to reduce the density.

- **Develop trail systems and improve trail access for passive outdoor recreation such as hiking, fishing, wildlife viewing, etc.** Trail systems and parking areas that are well-marked and maintained may also increase access for deer hunting and treating invasive plants.
- **Thin forests with closed canopies and high densities of trees with low vigor to free up resources and growing space for the healthier trees.** Once deer browse and invasive plant densities are low, fell poorly formed, suppressed, and/or diseased sweet birch, red maple, and sugar maple trees. American beech and white ash trees will suffer full mortality in the near future and may also be felled if/when they pose a public safety hazard. Felling some trees will reduce competition for water, nutrients, and sunlight which will improve the health of the remaining trees and may reduce susceptibility to adverse impacts from pests and disease. If deer and invasive plant densities are able to be maintained at low levels long-term, further thinning can be done to increase the diversity of species, age classes, and structural characteristics as well as help restore oak-hickory forests and prevent the conversion of oak-hickory forests to maple-beech forests.
- **Monitor the areas where stewardship activities are being implemented to determine if the activities are achieving the goals.** Routine monitoring will also aid in identifying unforeseen threats and allow a more rapid response and appropriate mitigation.
- **Explore the possibility of using prescribed burning.** Prescribed burning can be a more cost effective way to restore oak-hickory forests and help prevent the conversion of oak-hickory forests to maple-beech forests. This action will require a burn plan and possibly a forest plan. Outreach and education to residents about prescribed burning is also recommended prior to the creation of a burn plan.

Overview of Master Plan

Introduction

In 2019, staff from the Highlands Council met with the Environmental and Open Space Commission in Lebanon Township (LTEOSC) to discuss grant opportunities for projects that support the Highlands Regional Master Plan, including but not limited to forest stewardship

plans. During that discussion, Highlands Council staff introduced the idea of creating a Forest Stewardship Master Plan for Lebanon Township to quantify the forest resources and provide science-based guidance on how to best steward those resources. In 2022, the LTEOSC solicited state-approved foresters to help draft the scope of work to obtain a grant from the Highlands Council to create this Master Plan as well as a Forest Stewardship Plan (FSP) for Anthony Preserve, and New Jersey Audubon was selected. A Highlands Council Plan Conformance Grant was awarded to the Township to create these two plans, upon which the Township entered into an official agreement with New Jersey Audubon in April of 2023 to begin work on data collection and the development of both plans.

The Municipal Forest Stewardship Master Plan was developed for five forested properties within the Township. Three of the properties are jointly owned by the Township and the New Jersey Water Supply Authority (NJWSA), and two are owned solely by the Township. The intention of this Master Plan is to 1) collect baseline data on the current health and condition of the forests found on each property, and 2) provide guidance on the stewardship of those forests based on the conditions and threats of the forests as well as the goals. The included properties of this Master Plan are formally known as: Anthony Preserve, Sun Mountain Preserve, Red Mill Race Preserve, Woodglen-Miquin Trail, and Memorial Park. All properties are located within Lebanon Township in Hunterdon County, NJ.

In general, this document follows a similar format to that found within the regulatory guidelines and framework for official Forest Stewardship Plans but is not intended for submission to a state agency for official approval. Rather, it is intended to be used as a guiding document that contains information on the general condition of the included properties which can help the Township prioritize which sites would be most beneficial to focus stewardship efforts on. It is intended to offer supporting evidence and documentation justifying the need for broad or specific stewardship practices such as deer management, herbicide treatments, and tree felling.

The overall goal in the creation of this plan is to promote activities aimed at improving forest health and resiliency, improving habitat for wildlife, improving ecosystem function to enhance groundwater quality, and providing recreational opportunities to the public to enjoy the natural resources that are available to them.

General Forestry Concepts

Much of the information contained within this document is based on the foundations established by traditional forestry methodologies for measuring and analyzing overall forest health. Silviculture, the science of managing forest ecosystems for multiple goals and objectives, has traditionally been associated with a production-driven approach to forest stewardship; mainly the focus on maximizing timber production for monetary value while minimizing inputs. However, over recent decades, application of silvicultural practices has expanded into numerous sectors, including active conservation efforts and habitat management. Forestry concepts and practices provide landowners and land managers with the necessary information and tools to manage forest systems to meet planned objectives. It has become increasingly common for foresters to

engage with both private and public landowners to manage properties with an increased emphasis on ecosystem health and resiliency rather than resource extraction. Although removal of trees in certain cases can be beneficial for forest health and have the added benefit of potentially offsetting stewardship costs through timber sales, these practices are not always recommended or feasible depending on site conditions. The emphasis of this plan is to take a holistic approach in managing the municipality's forested lands with a primary focus on overall forest health, improving ecosystem function (i.e. protecting and improving ground water quality), and improving overall wildlife habitat. Still, it is important for audiences to have some basic understanding of concepts and terminology that have been established by academics and researchers within the forestry community to facilitate more effective communication when discussing forest stewardship.

Arguably one of the most important perspectives in ecological forestry is the understanding that forests are living systems, which although appearing static at a certain moment in time, are constantly in flux; forests are ever-changing albeit at a slow and steady rate that may not necessarily be perceivable at first glance. Understanding that any action taken can have immediate *and* long-term ramifications is imperative during a decision-making process to ensure thoughtful and careful action is decided upon. Forest inventory analysis, understanding past land uses, and anticipating future conditions (changes in climate, compositional shifts, unprecedented stressors) provides important information that can help create a clear picture of how a forest established, where it is at now, and where it is projected to be going. Topography, site conditions, soil types, hydrology, and current forest cover are all relevant information that provides a basis for stewardship decisions.

Forests across the Northeast have experienced a variety of stressors and negative impacts that have caused variable rates of degradation in overall forest health. Decreased forest health has a cascading effect, reducing available resources for wildlife species and decreasing ecosystem function. Stewardship recommendations for the properties found within this document aim at an overall uplift of the natural resource, particularly through activities aimed at increasing biodiversity, and positioning the overall forest structure and composition to better withstand anticipated changes in climate and other human-induced impacts.

Long-term Stewardship Goals

The goals of the plan reflect the critical roles that forests play for people and wildlife as well as forest-related concerns impacting Township-owned forests. The eight final goals below were determined using the results of the forest inventory conducted on Township-owned forests, recommendations from foresters and biologists, peer-reviewed scientific literature, and priorities established by Township representatives. The goals were reviewed and agreed upon by the Lebanon Township Environmental and Open Space Commission, Planning Board, Township Committee, and NJ Water Supply Authority (as co-owner). External stakeholder and public feedback were then incorporated in the final language of the goals. The resulting goals are listed below, in no particular order:

- 1) Protect and improve water quality, which includes managing public forests to

- reduce erosion, runoff, and pollution into streams and wetlands.
- 2) Reduce impacts of forest pests and diseases like emerald ash borer, beech leaf disease, etc. in public forests. Any chemical treatments recommended will be investigated thoroughly and, if applied, will be applied minimally on a case-by-case basis as directed by the forester and/or licensed pesticide applicator.
 - 3) Reduce invasive plants like barberry, stiltgrass, mile-a-minute, bamboo, etc. in public forests. Any chemical treatments recommended will be investigated thoroughly and, if applied, will be applied minimally on a case-by-case basis as directed by the forester and/or licensed pesticide applicator.
 - 4) Increase the ability of water to enter the ground in our public forests and replenish the groundwater supply for drinking water.
 - 5) Increase habitat for a diversity of birds and other native wildlife in public forests.
 - 6) Develop trail access for passive outdoor recreation such as hiking, fishing, wildlife viewing, etc.
 - 7) Increase native vegetation diversity to promote local forest resiliency.
 - 8) Reduce browsing of overabundant deer in public forests, which heavily impacts forest vegetation.

Definitions and Terminology

Throughout this plan there are references to concepts, terminology, and quantified values typically used to describe forest composition and structure but may seem somewhat foreign to the unfamiliar reader. Below is a series of common forestry terms that may be used within the plan or during verbal discussions with a forester or natural resource manager.

Age – Mean age of the co-dominant trees in a forest.

All-aged or Uneven Aged Stand – A forest comprised of trees of different ages and sizes.

Aspect – Compass direction to which a slope faces.

Basal Area – The cross-sectional area of all trees in a stand measured at DBH (usually measured in square feet).

Codominant Trees – Trees of similar overall size with crowns that are not overtopped and are receiving light from above. Codominant stems collectively comprise the upper forest canopy.

Crown – Upper portion of the tree where most of the leaves are found.

DBH – Diameter at Breast Height. Tree diameter measurement taken 4.5 feet above the forest floor on the uphill side of a tree.

Dominant Trees – Trees with crowns receiving full light from above and at least partly from the sides; usually larger than the average trees in the stand. The crown extends above the others in the vicinity.

Environmental Infrastructure Financing Program (EIFP) – A program in New Jersey that provides low-cost financing to local governments and private water systems for projects that ensure the state's water infrastructure is properly constructed to state and federal standards. This includes financing for the preservation of open space to protect stream headwaters and corridors, wetlands, and aquifer recharge areas. Lands purchased through this program cannot be developed and are required to have a conservation easement, but the properties may be used for passive recreational activities such as hiking, fishing, and horseback riding.

Even Aged – Stand of trees where there are only small differences in age among the individual trees.

FSI – Forest Stand Improvement. Improving the forest quality by removing or deadening undesirable trees to achieve desired stocking and species composition.

Forest Type – Groups of tree species commonly growing in the same stand because their environmental requirements are similar.

Girdling – A physical cutting or disruption of the cambial sap flow around the entire circumference of a tree.

Group Selection – The removal of small groups of trees to regenerate shade intolerant trees in relatively small openings (usually at least $\frac{1}{4}$ acre).

Intermediate Trees – Trees receiving little direct light from above and none from the sides. Usually with small crowns that extend into the canopy of co-dominant trees.

Intolerant Species – Tree relatively incapable of developing and growing normally in the shade of other trees.

Invasive Plants – Plant species that are not native to the ecosystem and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

LCR – Live Crown Ratio, the percentage of live crown in comparison to the overall tree height

Mast – Fruits or nuts used as a food source by wildlife. Soft mast includes fruits with fleshy coverings, such as dogwood or cherries. Hard mast refers to nuts such as acorn, beech and hickory.

Mesophication – An alteration of environmental conditions from fire exclusion that causes open lands (grasslands, savannas, and woodlands) to succeed into closed-canopy forests. This alteration causes a positive feedback loop favoring conditions for shade-tolerant plant species (maple and beech trees), while deteriorating conditions for shade-intolerant, fire-adapted plant species (oak and hickory trees), resulting in the eventual replacement of fire-dependent plants by shade-tolerant, fire-sensitive vegetation. Over time the diversity of plant species will decline as numerous fire-adapted plants are replaced by a limited set of shade-tolerant, fire-sensitive plant species.

Mid-tolerant Species – A tree species that can germinate and grow under some light shade cast by other trees – although many mid-tolerant species become increasingly intolerant of shade as they mature.

Non-native Plants – Plant species that are living in areas where they do not naturally exist. "Non-native plants" and "invasive plants" cannot be used interchangeably.

Relative density is a measure of tree crowding that accounts both for the size of each tree and the amount of space typically occupied by that species. A relative density of 100 percent implies that the growing space is fully occupied, and trees must either slow their growth to survive, or some trees will be crowded out and die, making room for more vigorous ones. Crowding between trees decreases along a gradient to around 60% relative density. Below 60% there is very little if any crowding, and unoccupied growing space is available for new growth.

Site Index – A relative measure of forest productivity based on the height of co-dominant trees at base age of 50 years old.

Stocking – A description of the number of trees, basal area, or volume compared with a desired level for balanced health and growth.

Suppressed Trees – Trees with crowns receiving no direct light from above or the sides. Usually with small crowns that are entirely below the canopy of co-dominant trees.

Thinning – A tree removal practice that reduces tree density and competition between trees in a stand. Thinning concentrates growth on fewer, better quality trees.

Tolerant Species – A tree species that has the ability to grow normally in the shade of other trees.

Forest Inventory and Data Collection Methodology

Data collected through a forest inventory provides a baseline of information regarding overall forest health, species composition, tree size (diameter and height), average age, condition, and structure. Analysis of the collected data allows decision makers and land managers to assess the general health of a forest at a specific moment in time, while also forecasting potential future conditions and overall development of a forest as it continues to grow and respond to a variety of environmental conditions and stressors.

Forest inventory for all five properties was completed utilizing a variable radius point-sampling method with a 10-factor wedge prism. The point survey was conducted along a systematic grid pattern, which was predetermined for each tract prior to conducting the inventories (see attached *Cruise Point Maps* in Appendix).

Roughly speaking, properties under 20 acres were inventoried at a rate of one cruise point per acre, and properties over 20 acres at a rate of one cruise point per 1.5 acres. This method of sampling “captures” various sized trees at differing intensities (i.e. variable radius) at each plot, which allows for more efficient data collection across larger acreage. Since measuring every individual tree within a large



Image 1: NJA staff conducting forest inventory at Memorial Park

forest block is impractical and costly, a systematic sampling methodology of this nature allows for more efficient data collection while still providing statistically sound data with an acceptable margin of error. Most data collected for the properties within this plan are at a 90% confidence interval within 20% of the mean or less. Overstory tree data was collected for trees greater than 3”dbh and included species, dbh, estimated height, quality (healthy/live, poor health/declining, or dead), and overall form/condition (known as “grade” within the raw data).

In addition to overstory data collection, two fixed-radius plot samples were taken at each cruise point. One plot sample recorded estimated percent cover of understory plants (herbaceous, woody shrubs, vines, and understory trees) and a second, smaller radius plot sample, recorded stem counts of tree seedlings to quantify the amount of natural tree regeneration occurring in each forest. Groundcover estimates were completed using a 1/20 acre plot (or 26.3’ radius from plot center). All non-native and invasive plants were identified within the sample plot and estimated in overall percent cover to the nearest 5% and all notable and relatively abundant native plant species were recorded in the same manner. Estimation of vegetative groundcover

conducted in this manner is not meant to be fully comprehensive but provides a general description of understory composition and structure. Of particular importance is the estimated percent cover of invasive plant species, which is excessive across all properties and will be addressed later in this plan.

Data collected within regeneration plots identified and measured tree seedlings within a 1/400 acre plot (or 5.9' radius from plot center). Tree seedlings under 2" in diameter were recorded by species and then further into height categories of <12", 1'>3', 3'>5', and >5'. Although a straight stem count was utilized to estimate total tree seedlings per acre during data analysis (which did not directly incorporate seedling height), recording overall seedling heights provides a good indication of the absence/presence of advanced tree regeneration. Advanced tree regeneration is usually hindered by excessive deer browse, over competition with invasive plants, and/or low light, closed canopy conditions which restrict seedling establishment.



In addition to the systematic data collection described above, supplemental qualitative data was collected during the forest inventory on all properties. Images of general forest conditions were taken at inventory plot centers, along with written observations, which help to capture unique aspects or non-quantifiable characteristics of forests that may otherwise be missed. Evidence of past land use (old cut stumps, fencing, stone walls, structures, etc.) can be identified in the field, further solidifying our understanding of how a forest came to be in its current state, and how past conditions are influencing the current trajectory of a forest's development. Additionally, plants identified outside of inventory plots were noted, providing a record of species that otherwise would not have been captured during data collection.

General Property Information

Properties

As described earlier, five public properties were selected by the Township to be included in this master plan and are listed below with parcel data and acreage for reference. Two properties are preserved with Green Acres funding and three are preserved with a combination of Green Acres and EIFP funding. All of the properties are open to the public for passive recreational or conservation uses. Most properties are accessible via parking areas or by direct access from a public road, but accessibility may be somewhat hindered on a number of properties which is addressed later in this plan.

The property boundaries are well marked in general (see *Image 2*) but it is good practice to ensure all property boundaries are visibly marked with posted signs prior to the commencement of any stewardship activities. This is particularly important for boundaries bordering private properties where active stewardship that removes or alters vegetative communities may occur.

Table 1. List of Properties

Property	Block	Lot	Acreage	Total Acreage	Ownership
Anthony Preserve	49	4.02	56.95	113.74	Lebanon Township and NJ Water Supply Authority
	49	89.01	41.63		
	49	89.02	15.16		
Sun Mountain Preserve	24	2.01	67.25	67.25	Lebanon Township and NJ Water Supply Authority
Woodglen-Miquin Trail	36	18.04	25.08	27.08	Lebanon Township and NJ Water Supply Authority
	36	17.03	2.00		
Red Mill Race Preserve	35	88	7.60	7.60	Lebanon Township
Memorial Park	29	32.03	37.31	37.31	Lebanon Township

General Property Characteristics

All five properties lie within the Highlands Physiographic Region of northern New Jersey which is characterized by rolling hills and valleys, steep-sloped ridges, and rocky outcroppings.

Image 2: Property boundary sign

Many portions of the properties within this plan reflect the topographic variations of the region, with low-lying forested wetlands in some areas and moderately sloped mountainsides and rocky outcroppings in others. These variations provide pockets of differing vegetative cover and forest composition which can provide a variety of habitat types for a suite of wildlife species. Overall, the forest types found on these properties are mixed hardwood systems containing a variety of tree species, with oak, maple, beech, birch, and yellow poplar being the most common codominant canopy trees in the forests. The forest conditions found across all properties are relatively ubiquitous for the region, particularly reflecting past multi-use land and an absence of active forest stewardship. These conditions include forest overstories that are primarily even-aged and understory conditions that are in decline having been negatively affected by excessive deer browse and invasive plant pressure.

Hunterdon County, in which all these properties reside, has a rich land-use history of agriculture and woodland production. Much of the land within this region still reflects that history, with many farms, forest woodlots, and residential developments dotting the landscape. Much of the forested acreage existing today is the remnant of past agricultural fields being abandoned and reverting to forestland or historically forested tracts that were non-tillable and most likely used for wooded pasture, farm woodlots, or were inaccessible due to steep slopes or excessively wet soils. As will be discussed in each property's individual section later in this document, past land

use has had differing impacts on certain properties, including negative effects that have positioned some forests to be in a less-than ideal state. Since these properties are situated within a mosaic of landcover, human influences have had various impacts on all properties which can be attributed to the general fragmentation of the landscape and the above mentioned historical land use.

Wildlife and Ecology

All properties in this plan are primarily dominated by mature forest cover with a few properties such as Anthony Preserve and Sun Mountain containing some small acreage canopy openings, fields, and shrubby areas. However, many of these open areas are dominated by invasive plant species which do not provide the benefits of their native equivalents in terms of wildlife value (such as cover, forage, nesting opportunity, etc). The habitats identified on these properties have ecological value for many common species including small mammals, songbirds, waterfowl, fish, reptiles, amphibians, and insect populations, but due to historical and ongoing impacts to forest health and habitat quality their ability to support rare and specialist species may be reduced.

Sections of the properties that contain a drier, upland component with an abundance of oak/hickory trees in the canopy are providing important mast for many types of common wildlife like turkeys, bear and squirrels. Of equal importance, oaks also support a variety of insects that are the nutritional food foundation for many breeding songbirds. In more mesic areas, where tree species such as yellow poplar and maple are more abundant in the co-dominant class, ecological value is gained from those particular trees through nectar production for pollinators. Maple buds break earlier in the spring than many other trees, providing one of the first sources of pollen and nectar; and tulip poplar is well-known to be an important source of nectar for bees.

Sun Mountain Preserve includes several small open canopy areas that are dominated by herbaceous plants and woody shrubs. Although these areas are heavily dominated by invasive plant species, they do offer some degree of structural complexity for wildlife in the form of cover or limited nesting opportunities. Efforts that target the reduction of invasive plants and establish desirable native plants species could improve the wildlife value for these areas.

In general, the forest types, age, and structure found throughout most of the properties in this plan are common to the region and show signs of decreasing overall health from an ecological perspective. Aside from current threats described later in this plan, the forests themselves are relatively stable for the short-term but will ultimately face stressors in the future that could potentially expedite their overall decline. By considering the stewardship options outlined later, the Township has an opportunity to improve overall forest health which will ultimately have benefits for a wider suite of wildlife species.

Carbon Sequestration and Storage

With the advancement of science and an improved understanding of forests role in the carbon cycle as it pertains to increased carbon dioxide in the atmosphere, carbon sequestration and

storage is often considered during the decision making process for forest stewardship. It is important to note though, that the quantification of carbon sequestration and storage in forests (which are two separate processes that are often erroneously considered the same) is complicated because of the many variables involved. One part of carbon science that is clear is that the best way to *sequester* atmospheric carbon is to have relatively young forests that are fully occupied by fast growing trees to rapidly pull carbon in as they grow. As a fully stocked forest begins to mature, growing space becomes increasingly limited and the sequestration rate in a forest begins to slow in reaction to competition for resources. Concurrently, as natural mortality begins to increase in response to crowding, carbon is emitted during decomposition, which begins to balance some of the carbon gains vs. losses. However, if the remaining trees continue to grow and increase biomass, carbon *storage* in the forest continues to grow at a net increase, especially in the soil component of a forest. Understanding where a forest currently sits on this spectrum can help guide stewardship to either maximize sequestration or storage, depending on landowner objectives. It is also important to consider how stewardship (both passive and active management) may affect the long-term *stability* of a forest carbon pool. It is imperative that land managers consider tradeoffs between maximizing short-term carbon storage and increasing the forest's vulnerability to future large-scale mortality events when making decisions that seek to incorporate carbon storage.

Most of the forests on these properties have reached the middle-mature transition stage where sequestration is slowing, and storage is increasing. Stewardship recommendations suggested throughout this document promote a balanced approach that aims to defend the existing carbon pool by keeping healthy trees vigorous and resilient while accepting some amount of short-term carbon storage decline to accomplish this. This approach will provide for a relatively stable carbon pool over the long-term.

Additional reports regarding recorded baseline carbon storage, biomass calculations, and climate risk reports can be found in the Appendix of this plan.

Regulated Features and Hydrology

All five properties in this Master Plan are within the Highlands Preservation Area which are regulated under the Highlands Water Protection and Planning Act (NJSA 13:20-1 et seq.) to protect drinking water and preserve open space. Anything considered a “major Highlands development” is therefore regulated under N.J.A.C. 7:38 as a result of this Act and in addition to the regulations outlined below.

All surface waters in the state of New Jersey are classified and regulated under the *Surface Water Quality Standards* (SWQS) NJAC 7:9B, and most open waters are also regulated under the *Flood Hazard Area Control Act* (FHACA) NJAC 58:16A. The regulated areas surrounding water bodies (as they pertain to forest stewardship) are called *Riparian Zones*, and the width of the zone depends on the classification of the waterbody in question. Even an intermittent or seasonally dry streambed may be a regulated waterway, as long as it has a discernable “bed and bank” that defines the channel when water is present. Under state law, unclassified tributaries assume the designation of the classified water they feed. The highest classification (carrying the

widest regulated area) is Category 1 (C1) water, which carries a 300' Riparian Zone from either edge of the bank. Most other non-C1 waters have a 150' Riparian Zone from either edge of the bank, and those with the lowest classification have a 50' Riparian Zone.

In New Jersey, freshwater wetlands and their associated transition buffers are regulated under the *Freshwater Wetlands Protection Act* (FWPA) NJAC 13:9B, and unauthorized forestry activities are considered a regulated activity in these areas. The size of the transition buffer varies according to the resource classification of the wetland. *Exceptional Resource Value* wetlands receive a 150' buffer and are defined as being adjacent to FW1 - FW2 trout production water or are documented habitat for certain threatened or endangered species. *Ordinary Resource Value* wetlands include ditches, swales, detention basins and isolated pockets surrounded by at least 50% development, which do not receive a buffer. *Intermediate Resource Value* wetlands receive a 50' buffer and include all other wetlands.

Anthony Preserve (tract 1), Sun Mountain, and Red Mill Race contain regulated features as defined above (see attached *Regulated Features* maps). The Anthony Preserve Forest Stewardship Plan, once approved, will allow for stewardship activities within the regulated areas as long as all Best Management Practices are followed as outlined within the FSP. Activities in regulated areas that are not part of a Forest Stewardship Plan may be achievable if the proper wetlands permitting is obtained prior to commencement of activities. Typically, a general wetlands permit (GP4 or GP16) is sufficient to permit activities suggested within this document. Exemptions do exist to allow for activities such as invasive plant removal in regulated areas but it is recommended to verify with the appropriate regulatory office before commencing activities.

Disturbance, Fire History and Prescribed Burning

Through research examining soil charcoal and fire scars on trees throughout the eastern hardwood biome, scientists have determined that wildfire has been part of the upland hardwood ecosystem since the last ice age. In northern New Jersey, mixed central hardwood stand types are among the ecological communities that were influenced by fire. A synthesis of fire science literature was produced in 2014 by the US Forest Service's Northern Research Station. That review covers a long-term analysis in the region that suggests a Mean Fire Interval (MFI) of 13 years (meaning that fire passed through a site on average every 13 years), although that figure is perceived to be conservative because lower severity fires may not have left much scarring evidence, or scarring evidence may have been lost as trees died and decayed. The literature shows that in association with human settlement of the east, the MFI increased to every 7 years, suggesting a strong human influence, although regional variations in frequency imply that climate also had an influence.

Through pollen records and other historical data, we know that the current forest types of northern New Jersey are similar to those that dominated the region prior to European settlement (pre-settlement), although by comparison, the structure of today's forests are over-simplified and highly un-natural. Farm abandonment, similar to what occurred on a number of properties within this plan, and exploitive tree harvesting over the last ~200 years allowed large areas to collectively regenerate, creating even-aged homogenous forests instead of the multi-aged

complexes with interspersed patches of young and older forests that might be present under a more natural disturbance regime. The heterogeneity found in pre-settlement forests can be attributed to relatively frequent fire disturbance which created regeneration opportunities for different plant communities. This mosaic created a gradient of growing conditions across geographic features to maintain forest types and habitats for a variety of species. In comparison to the New Jersey of today, human development patterns have necessitated the control of wildfire and thereby eliminated much of the randomness of how natural disturbance regimes affect forests. Places that were naturally pre-disposed to higher disturbance frequencies now have buildings on them, and elsewhere, fires are quickly suppressed before affecting much area. As today's homogenous forests mature in the absence of significant disturbance large enough regenerate shade-intolerant and fire-adapted plants, they are collectively undergoing mesophication that favors shade-tolerant ingrowth of mostly singular species like red maple and beech, or in some instances, invasive plant invasions. As this trend continues, flora and fauna that co-evolved with disturbance dependent forest types will effectively disappear from the region. Additionally, large homogenous areas will eventually become susceptible to host-specific stressors and potentially be impacted all at once – like we are seeing with emerald ash borer and ash forests. Restoring some of this imbalance can be accomplished by using prescribed burning in forests. An added benefit is that prescribed burning can be a more cost effective and environmentally friendly option over the herbicides and heavy equipment needed to accomplish the same goals.

Although fire is part of the history of the landscape, returning fire to the properties in Lebanon Township using prescribed burning as a stewardship tool may be restrictive due to topography, fuel loads, and access. Overall efficacy of using prescribed burning to meet stewardship goals may be highly variable across the properties; fire may not carry well along the forest floor on certain properties, due in part to a lack of leaf litter and sparse understory vegetation. In these areas, thinning the forest canopy may be needed in order to create conditions conducive for prescribed burning. Areas that may benefit from prescribed fire without prior treatment include those with a dense understory of invasive plants or where blow downs and mortality from the emerald ash borer have increased the coarse woody debris available as fuel on the forest floor. From a wildfire risk perspective, according to the NJ Forest Fire Service Wildfire Risk Explorer mapping tool, the properties are at moderate risk of wildfire. Opportunity for utilizing prescribed burning is minimal and further restricted due to the timing-window for when prescribed fire is allowed along with the availability of the New Jersey Forest Fire Service or private contractors to conduct the work.

Cultural and Historic Resources

The historical significance of properties discussed in this plan were assessed by comparing boundaries with the NJDEP GIS layers for historic properties and historic districts. As illustrated on the attached Historic Resources maps, the northern half of Memorial Park falls within the Woodglen historic district and is near several historic properties. The remaining properties do not lie within a historic district and are ½ - 1 mile away from the nearest historic property or district.

Any recommended stewardship activities for these sites will not have an adverse impact to these resources if implemented.

Easements and Conservation Restrictions

The properties contained within this Master Plan were purchased through Green Acres funding and/or the Environmental Infrastructure Financing Program (EIFP) and contain easements or deed restrictions. Parcels funded through Green Acres must be used for recreation or conservation purposes, whereas areas purchased through EIFP have deed restrictions that limit trail creation and prohibit the cutting/removal of vegetation and the application of herbicides. As shown on the attached *Easement and Restrictions* maps in the Appendix of this plan, portions of Anthony Preserve, Sun Mountain Preserve, and Woodglen-Miquin Trail are encumbered by EIFP restrictions. Should the Township or NJ Water Supply Authority desire to create trails, treat invasive plant species, and/or fell or remove vegetation, including diseased or dying trees in the EIFP restricted areas, prior written consent would be needed from NJDEP.

Anthony Preserve

Property Overview

There are two distinct tracts that together make up what is referred to as the Anthony Preserve. The larger tract is roughly 99 acres in size, comprised of Block 49 Lots 89.01 and 4.02. The southern portion of the tract, Block 49 Lot 89.01 was acquired by Lebanon Township in 2007, and the adjacent northern parcel, Block 49 Lot 4.02, was acquired in 2011. Together these parcels comprise the main portion of the Anthony Preserve, for which a separate Forest Stewardship Plan has been prepared. Stewardship planning for these parcels should follow the prescriptions outlined within the approved Forest Stewardship Plan for the 10-year plan timeframe. The smaller tract, which is just over 15 acres, is comprised of Block 49 Lot 89.02 and lies to the east of the main tract. Although there has been no formal forest management in recent years for the property, the Nicholson property (Block 49 Lot 89 - prior to subdivision) was managed under formal Forest Management Plans from 1987-2007. Physical evidence was observed where some trees were felled within the northern portion of what is currently Block 49 Lot 89.01. The most recent management plan for that parcel ('97-'07) contained prescriptions for forest stand improvement and thinning activities but it is unknown to what degree the landowner carried out any of the recommended prescriptions during that time period. The forest cover is mixed hardwoods, with forested wetlands. Portions of the property were in agriculture until the 1980s when they were left fallow and slowly converted back to wooded land. Some areas have been farmed since at least the 1930s as seen on historic aerial imagery. The remainder of the property has been largely intact forest since that time.

The primary access point for the main tract is 51-55 Anthony Road in Glen Gardner, NJ 08826. The property can also be accessed by the cul-de-sac on the eastern side of Flintlock Place. The smaller tract can be accessed by Shady Lane.

History and Ownership

The Anthony Preserve as it exists today came into co-ownership by Lebanon Township and the NJ Water Supply Authority through the NJ Green Acres program. The southern portion of the larger tract, Block 49 Lot 89.01, was previously purchased as open space by Steven Nicholson in 2005 and encumbered by Green Acres in 2007. Nicholson still owns the adjoining Block 49 Lot 89, which includes a 1.221-acre easement connecting to Block 49 Lot 89.02. The northern portion of the property, Block 49 Lot 4.02, was previously purchased by Ronald K. Fisher and encumbered by Green Acres in 2011. There is a 0.049-acre bridge maintenance easement in this section of the property. There is no prior, formal forest management plan for the property, although physical evidence suggests that some trees were felled within the northern portion of Block 49 Lot 89.01.

Sections of the property contain easements and deed restrictions that prohibit certain activities. As shown on the attached *Conservation Restrictions* map in the Appendix of this plan, acreage in the northeast, central, and southern tip of the main tract are encumbered by these restrictions. Since the property was purchased through the Environmental Infrastructure

Financing Program (EIFP), the restrictions that are in place limit trail creation and prohibit the cutting/removal of vegetation and the application of herbicides. Should the Township or NJ Water Supply Authority desire to create trails, treat invasive plant species, and/or fell or remove vegetation, including diseased or dying trees in the EIFP restricted areas, prior written consent would be needed from NJDEP.

Historic aerial imagery suggests that the majority of the preserve has remained in forest cover since before the 1930s. Portions of the central, western, and northern sections of the main tract were in agriculture from at least the 1930s up until the 1970s and 1980s. Within the smaller tract, the majority of the site was in farmland in the 1930s, with the exception of the southernmost corner and a roughly 200ft strip along the northwestern boundary which have been in continuous forest cover since before that time. Over time, the farmland slowly converted back into forest cover starting around the 1950s, which is now evidenced by the presence of smaller tree size classes on the site and more significant impacts from invasive plants. At present, the upland areas consist of mixed northern hardwoods, primarily oak, poplar, hickory, and maple, and the lowlands include red maple and ash dominated deciduous wetland forests. Forest health threats at this site include emerald ash borer, beech bark disease, beech leaf disease, invasive plant species, and pressure from deer browse.

Soils and Topography

The main tract of Anthony Preserve ranges from a high point of about 1000ft in the southern portion to a low point of about 760ft in elevation along Spruce Run in the north. The majority of the site has mild to moderate slopes, with the exception of the rocky outcrops in the southern section which experience 15-40% slopes.

Nearly half of the tract is comprised of Califon gravelly loam or Califon loam. These soil types are characterized as moderately well drained with a depth to water table of 6-30 inches. The site index for black oak and northern red oak is 80 with 57 cubic feet per acre per year of productivity.

Parker cobbly loam is found across 35% of the site. This soil type is characterized as somewhat excessively drained with a depth to water table of over 80 inches. The site index for black oak is 80 with 57 cubic feet per acre per year of productivity.

Gladstone gravelly loam and Gladstone and Parker soils together comprise about 14% of the site. These soil types are characterized as somewhat excessively drained with a depth to water table of over 80 inches. The site index for black oak is 80-90 with 57 cubic feet per acre per year of productivity.

Cokesbury loam comprises less than 4% of the site. This soil type is characterized as poorly drained with a depth to water table of 0-12 inches. The site index for pin oak is 70 with 57 cubic feet per acre per year of productivity.

The smaller tract of Anthony Preserve ranges from about 940 to 1000 feet in elevation, with the highest point in elevation running along the northeastern boundary of the property. Most of the property is gently sloped, with the exception of the northwestern boundary of the property which contains slopes ranging from 18-40%.

Parker cobbly loam comprises the vast majority of the site. This soil type is characterized as somewhat excessively drained with a depth to water table of over 80 inches. The site index for black oak is 80 with 57 cubic feet per acre per year of productivity.

Gladstone and parker soils comprise less than 4% of the site, found along the southeastern border. The soil type is characterized as well drained with a depth to water table of over 80 inches. The site index for black oak is 80 with 57 cubic feet per acre per year of productivity.

As a whole, the soils on this property are beneficial for forestland productivity.

See the Natural Resources Conservation Service Soils Report for this property in the attachments for further information.

Hydrology

Tract 1 (Block 49 Lots 4.02 and 89.01)

Does the property have wetlands mapped by NJDEP?	Yes ☒	No ☐
Are there possibly wetlands present that are not mapped by NJDEP?	Yes ☒	No ☐
Does the property have wetlands transition areas?	Yes ☒	No ☐
Does the property have surface water?	Yes ☒	No ☐
Does the property have Riparian Zones?	Yes ☒	No ☐

The Spruce Run and one of its tributaries flow through the northern section of the property. Both the main stem and its tributaries are classified as FW2-TPC1 under the Surface Water Quality Classifications (FW2 = fresh water influenced by man-made discharges, TP = trout production, C1 = Category 1). Under the *Flood Hazard Area Control Act* (FHACA) rules N.J.A.C. 7:13, this designation is afforded a 300' regulated Riparian Zone extending from the bank.



Image 3: Spruce Run at Anthony Preserve

Wetlands are found throughout the northern and central portions of the

site. Freshwater wetlands and their associated transition buffers are regulated in New Jersey under the *Freshwater Wetlands Protection Act* (FWPA) rules N.J.A.C. 7:7A. The mapped wetlands are surrounded by a 150' transition buffer in accordance with the wetland classification of *Exceptional Resource Value* since they are associated with a Category 1 waterbody.

Refer to the approved Forest Stewardship Plan for this property for guidance on stewardship activities within regulated areas, which must adhere to the Best Management Practices outlined in the *NJ Forestry and Wetlands Best Management Practices Manual, 1995*.

Tract 2 (Block 49 Lot 89.02)

Does the property have wetlands mapped by NJDEP?	Yes ☐	No ☒
Are there possibly wetlands present that are not mapped by NJDEP?	Yes ☐	No ☒
Does the property have wetlands transition areas?	Yes ☐	No ☒
Does the property have surface water?	Yes ☐	No ☒
Does the property have Riparian Zones?	Yes ☐	No ☒

There are no mapped streams, waterbodies, or wetlands on this property. The nearest stream is the Little Brook Tributary found ¼ mile to the southeast and the nearest mapped wetlands lie 400ft from the western property boundary. Therefore, this section of the property is not within range of potential wetland or riparian buffers.

Ecology and Biodiversity

During the inventory, over 80 species of plants were observed, including 23 tree species. The species lists provided are not intended to be comprehensive but rather capture the more common and notable species present on the property as recorded in the inventory sampling data and otherwise observed while visiting the property. Those denoted with an asterisk (*) indicate an invasive species.

Tree Species List:

American beech	American elm	American holly
American sycamore	basswood	black cherry
blackgum	black oak	bigtooth aspen
chestnut oak	hickory	northern red oak
pin oak	princess tree*	red maple
sassafras	sweet birch	sugar maple
swamp white oak	white ash	white oak
yellow birch	yellow poplar	

Shrub/Small Tree Species List:

American hornbeam	American witchhazel	apple
autumn olive*	blackberry	blackhaw
burning bush*	common winterberry	flowering dogwood
hawthorn	highbush blueberry	honeysuckle*
hophornbeam	huckleberry	Japanese barberry*
lowbush blueberry	mapleleaf viburnum	multiflora rose*

northern spicebush
wineberry*

serviceberry

sumac

Vine Species List:

American hog-peanut
Japanese honeysuckle*
Virginia creeper

eastern poison ivy
Asiatic bittersweet*
wild yam

grape
roundleaf greenbrier

Herbaceous and Groundcover Species List:

arrow arum
black cohosh
dogbane
garlic mustard*
Indian pipe
jewelweed
mugwort*
poke milkweed
sensitive fern
spotted geranium
striped prince's pine
white snakeroot
wood sorrel

beardtongue
Canada mayflower
eastern hayscented fern
goldenrod
Jack in the pulpit
mayapple
narrowleaf bittercress
rush
skunk cabbage
stinging nettle
unidentified grass
wild sarsaparilla

bedstraw
cinnamon fern
eastern teaberry
ground strawberry
Japanese stiltgrass*
meadow-rue
partridgeberry
sedge
Solomon's seal
strawberry
unidentified moss
woodfern

Forest Conditions

Being in close proximity and with comparable land use history, both tracts of the Anthony Preserve have a similar species composition and structural characteristics. A separate Forest Stewardship Plan for the main tract of the Anthony Preserve has been prepared alongside this master plan document. A high-level view of the forest within the main tract is provided below. For more detailed data and analysis, refer to the separate Forest Stewardship Plan for the property.

Tract 1 (Block 49 Lots 4.02 and 89.01)

Forest data was collected from sixty-four evenly spaced inventory plots distributed across the forest using a 10-factor prism, which translates to roughly one inventory plot for every 1.5 acres. The forest tract is further divided into 5 separate stands based on species composition, prior land use history, and soil characteristics. More information about the specific stands in Tract 1 can be found in the Forest Stewardship Plan for Lebanon Township Anthony Preserve.

Mixed upland hardwood forests are found in the higher elevations in the central and southern sections of the tract. These forests are dominated by red oak, yellow poplar, sweet birch, hickory, chestnut oak, red maple, and black oak. The remainder of the site is classified as mixed lowland hardwoods. These stands are dominated by red maple, yellow poplar, white ash, American beech, sweet birch, hickory, red oak, and black cherry. Based on the review of historic aerial photographs, most of the forest is over 100 years old, as it was intact forest cover in the 1930s

aerial imagery. Two stands on the site were in agricultural production during that time, with areas of the northern and western portions of the site in farmland up until about the 1970s. Differences in stand composition, age, and structure are reflected in current conditions and are heavily tied to these differences in land use history. More information about the forest characteristics in Tract 1 can be found in the Forest Stewardship Plan for Lebanon Township Anthony Preserve.



Image 4: Upland forest



Image 5: Lowland forested wetlands

Regeneration of trees is poor across the site. While regeneration data collected during the forest inventory indicates anywhere from nearly 400 to over 3,000 seedlings per acre on average, the vast majority of those are below 1 ft in height. This is an indicator of high levels of deer browse as well as closed canopy conditions with limited growing space for seedlings. Additionally, about half of the seedlings observed across the site were American beech or ash trees. Unfortunately, the long-term viability of these seedlings is minimal due to the presence of emerald ash borer, beech leaf disease, and beech bark disease. Even if growing conditions were improved to be made more suitable for these species, they are likely to still suffer adverse impacts due to the pests and disease, preventing them from successfully recruiting into the canopy.

The understory composition at the site is variable, with more dense cover found in areas where the canopy is more open due to dieback of mature ash trees that have succumbed to the emerald ash borer. Invasive plants are quite prevalent and problematic in some areas, particularly in areas with a more recent history of agricultural production. Some of the most widespread and abundant invasive species at the site are Japanese barberry, wineberry, and multiflora rose. Sections of the property that have been intact forest cover since before the 1930s are experiencing less pressure from invasive plants and are relatively open in the understory due to the closed canopy conditions.

Tract 2 (Block 49 Lot 89.02)

Forest data was collected from sixteen evenly spaced inventory plots distributed across the forest using a 10-factor prism, which translates to roughly one inventory plot for every acre. Using a

90% confidence interval, the resulting stand data is within +/- 15.0% of the mean basal area, and within +/- 36.6% of the mean number of stems per acre.



Image 6: Upland forest



Image 7: Upland forest with invasive understory

This is a mixed upland hardwood forest, where yellow poplar, red maple, sweet birch, red oak, aspen, and hickory together comprise 89% of the growing stock in the co-dominant crown class (~ 12-20" dbh). Beneath the co-dominant crown class is a poletimber and sapling cohort (5-11" and 1-4" dbh, respectively) that is mostly populated with suppressed yellow poplar, red maple, sassafras, sweet birch, black cherry and hickory. Other associate species found here include black oak, chestnut oak, beech, elm, sugar maple, and white ash. Factors that influence stand composition and the current concentration of certain species include prior farming practices and topography. Based on the review of historic aerial photographs, most of the stand is under 100 years old, as much of the site was in farmland production in the 1930s aerial imagery. Shortly after this time, it began to revert into forest cover. The modeled stand-wide average *effective* age, which is an estimate of different species ages based on their diameter, is 99.

Table 2. Forest characteristics of Tract 2 of Anthony Preserve

Name	Value	Name	Value
Forest Type	Mixed upland hardwoods	Stems per unit area (stems/ac)	113.7
Site Index	90 for yellow poplar	Net cord volume (cords/ac)	22.6
Medial dbh (in)	17.2	Canopy closure (% closure)	50-90%
Quadratic mean dbh (in)	12.6	Productivity	57 cu.ft/ac/yr
Size Class	Large sawtimber	Regeneration status	Poor
Age class	70-100	Coarse woody debris status	Low
Total basal area (sq.ft/ac)	98	Damage causing agents	Deer, EAB, BBD/BLD, invasive plants
Basal area in Saplings (sq.ft/ac)	1.3	Relative density (%)/vigor	50.9/moderate

Regeneration of trees on Tract 2 is poor. While regeneration data collected during the forest inventory indicates under 1,000 seedlings per acre on average, the vast majority of those are below 1 ft in height. This is an indicator of high levels of deer browse as well as closed canopy conditions with limited growing space for seedlings. Additionally, about half of the seedlings observed in the stand were American beech or ash trees. Unfortunately, the long-term viability of these seedlings is minimal due to the presence of emerald ash borer, beech leaf disease, and beech bark disease. Even if growing conditions were to be made more suitable, these species will likely suffer adverse impacts due to the pests and disease, preventing them from successfully recruiting into the canopy.

The understory composition at the site is variable, with more dense cover found in areas where the canopy is more open due to dieback of mature ash trees that have succumbed to the emerald ash borer. Likely due to the history of agricultural use across much of the site, invasive plants are quite prevalent and problematic in some areas. Some of the most widespread and abundant invasive plants at the site are Japanese barberry, wineberry, and multiflora rose. Sections of the property that have been intact forest cover since before the 1930s exhibit less pressure from invasive plants and are relatively open in the understory due to the closed canopy conditions.

Recreation and Aesthetics

Anthony Preserve is open from sunrise to sunset for passive recreation which includes activities such hiking and wildlife viewing. There are no motorized vehicles, camping, open hunting, or trapping allowed on the property, with the exception of hunting for deer by Township permit. There are remnant trails from prior land use found on the property, but there is currently no established, maintained trail system for the public to utilize which limits accessibility.

Overall, the aesthetic quality of the property would be considered pleasing to most except for areas dominated by barberry in the understory. In some areas there are rocky slopes and outcrops which offer an intriguing contrast to low-lying areas of the property. There is minimal understory vegetation in some areas, which at times may offer a park-like feeling. Carpets of hay-scented fern dominate the understory in some areas, which many would find to be visually beautiful. Less appealing, however, might be the standing dead and fallen ash trees that have succumbed to the emerald ash borer in recent years. In these more open sections of the canopy, invasive plants such as Japanese barberry and princess tree have become established. The stream corridor within the northern portion of tract 1 offers a scenic and serene feature for visitors and wildlife alike to enjoy.

Due to the proximity to several residential properties, it may be worthwhile for the Township and authors of this plan to engage in public education for the surrounding community to address concerns related to subtle to moderate changes that may appear within the property if stewardship activities are undertaken. These changes may include an increase of small diameter trees on the forest floor, dieback of vegetation after herbicide treatments, and the creation of brush piles for wildlife.

Sun Mountain Preserve

Property Overview

Sun Mountain Preserve is the second largest property included within this plan at just over 67 acres, the majority of which is in forest cover. The main access point for the property is at the end of Sun Mountain Street in Califon, NJ. The property does also connect to Bunnvale Road but requires crossing a stream to reach the vast majority of the property, thereby limiting accessibility from that location. There is no prior forest management plan for this property. There is a history of agricultural use throughout much of the site. Two areas remain in open habitat with almost no canopy cover, and there is a small conifer stand that was likely planted. The remainder of the forest consists of mixed northern hardwoods.

History and Ownership

Sun Mountain Preserve is co-owned by the Township and the NJ Water Supply Authority. Previously owned by Schaaf, the property was purchased in 2005 and encumbered by Green Acres in 2006. There is no prior, formal forest management plan for this property.

Sections of the property contain deed restrictions that prohibit certain activities. As shown on the attached *Conservation Restrictions* map in the Appendix of this plan, acreage in the northwestern half of the site is encumbered by these restrictions. Since the property was purchased through the Environmental Infrastructure Financing Program (EIFP), the restrictions that are in place limit the establishment of trails and prohibit the cutting/removal of vegetation and the application of herbicides. Should the Township or NJ Water Supply Authority desire to create trails, treat invasive plant species, and/or fell or remove vegetation, including diseased or dying trees in the EIFP restricted areas, prior written consent would be needed from NJDEP.

According to historic aerial imagery, much of the site was in farmland during the 1930s, with the exceptions of a southern, central portion of the site and windbreaks between farm fields. Much of the property was allowed to revert to forest cover starting around the 1950s. Within a period between the 1940s and early 50s, a stand of conifers was planted on roughly 4 acres in the southern section of the site and a number of those trees are still present today. There are two open areas of the site that appear to have begun reverting into forest cover from about the 1930s until the 1980s when they were intentionally cleared and have remained relatively open since. Some succession has occurred on the edges of the larger field, whereas the smaller open area to the north has become overgrown with invasive shrubs.

At present, most of the site consists of mixed northern hardwoods, primarily oak, poplar, hickory, and maple, with the exception of the conifer stand and open areas. Forest health threats at this site include emerald ash borer, beech bark disease, beech leaf disease, invasive plant species, and pressure from deer browse.

Soils and Topography

Sun Mountain Preserve ranges from about 800 to 950 feet in elevation. The lowest point in elevation falls along the stream in the westernmost corner of the site. The highest point in elevation is along the eastern border of the property. Low lying areas are gently sloped, with more moderate slopes of 8 to 25% occurring throughout much of the site.

Parker cobbly loam soils comprise over 80% of the property. This soil type is characterized as somewhat excessively drained with a depth to water table of over 80 inches. The site index for black oak is 80 with 57 cubic feet per acre per year of productivity.

Gladstone gravelly loam soils are found in the northern sections of the site. This soil type is characterized as well drained with a depth to water table of over 80 inches. The site index black oak is 90 with 57 cubic feet per acre per year of productivity.

About 5% of the site contains Califon gravelly loam soils, found in the northwestern portions of the property. This soil type is characterized as moderately well drained with a depth to water table of about 6-30 inches. The site index for black oak is 80 with 57 cubic feet per acre per year of productivity.

As a whole, the soils on this property are beneficial for forestland productivity.

See the Natural Resources Conservation Service Soils Report for this property in the attachments for further information.

Hydrology

Does the property have wetlands mapped by NJDEP?	Yes ☒	No ☐
Are there possibly wetlands present that are not mapped by NJDEP?	Yes ☒	No ☐
Does the property have wetlands transition areas?	Yes ☒	No ☐
Does the property have surface water?	Yes ☒	No ☐
Does the property have Riparian Zones?	Yes ☒	No ☐

Willoughby Brook flows through the western corner of the property and is classified as FW2-TPC1 under the Surface Water Quality Classifications (FW2 = fresh water influenced by man-made discharges, TP = trout production, C1 = Category 1). Under the *Flood Hazard Area Control Act* (FHACA) rules N.J.A.C. 7:13, this designation is afforded a 300' regulated Riparian Zone extending from the bank.

Wetlands are found in the western portions of the site, in conjunction with Willoughby Brook. The mapped wetlands are afforded a 150' transition buffer in accordance with the wetland classification of *Exceptional Resource Value* since they are associated with a Category 1 waterbody.

Ecology and Biodiversity

During the inventory, over 70 species of plants were observed, including 17 tree species. The species lists provided are not intended to be comprehensive but rather capture the more common and notable species present on the property as recorded in the inventory sampling data and otherwise observed while visiting the property. Those denoted with an asterisk (*) indicate an invasive species. Note that while Norway spruce is not native, it is not considered invasive in New Jersey.

Tree Species List:

American beech	bigtooth aspen	black cherry
black oak	blackgum	eastern red cedar
eastern white pine	hickory	northern red oak
Norway spruce	red maple	sassafras
sugar maple	sweet birch	white ash
white oak	yellow poplar	

Shrub/Small Tree Species List:

American witchhazel	autumn olive*	blackberry
blackhaw	burning bush*	common winterberry
flowering dogwood	Japanese barberry*	mapleleaf viburnum
multiflora rose*	northern spicebush	privet*
southern arrowwood	wineberry*	

Herbaceous and Groundcover Species List:

bedstraw	Beggar's lice	black-eyed Susan
Canada mayflower	cinquefoil	clearweed
cohosh	common blue violet	dogbane
garlic mustard*	goldenrod	grass spp.
hayscented fern	Jack in the pulpit	Japanese stiltgrass*
meadow-rue	moss spp.	narrowleaf bittercress
northern dewberry	partridgeberry	ragwort
rattlesnake fern	sedge spp.	sensitive fern
small carp grass	Solomon's seal	striped prince's pine
unidentified species	white clover	white rattlesnake root
white snakeroot	wild basil	woodfern
wood sorrel	yarrow	

Vine Species List:

eastern poison ivy	grape spp.	hog-peanut
Japanese honeysuckle*	mile a minute vine*	Asiatic bittersweet*
roundleaf greenbrier	Virginia creeper	wild yam

Forest Conditions

Majority of Site (excluding open areas and conifer stand)

Forest data was collected from thirty-seven evenly spaced inventory plots distributed across the forest using a 10-factor prism, which translates to roughly one inventory plot for every 1.5 acres. Using a 90% confidence interval, the resulting stand data is within +/- 11.0% of the mean basal area, and within +/- 17.4% of the mean number of stems per acre.

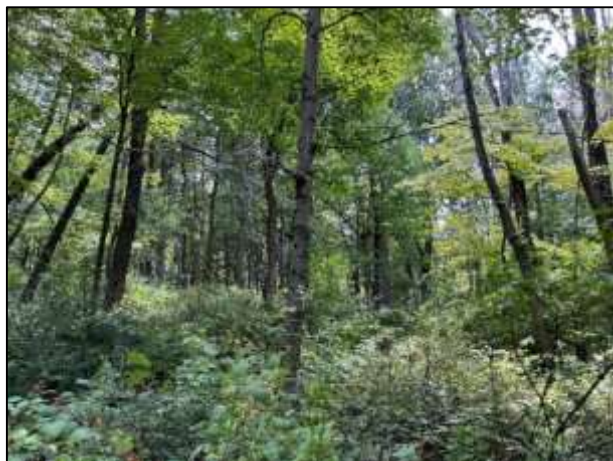


Image 8: Upland forest



Image 9: Dead and dying white ash, invasive understory

This is a mesic hardwood forest, where yellow poplar, red maple, sweet birch, red oak, hickory and white ash together comprise 90% of the growing stock in the co-dominant crown class (~ 12-20" dbh). Beneath the co-dominant crown class is a poletimber and sapling cohort (5-11" and 1-4" dbh, respectively) that is mostly populated with suppressed yellow poplar, red maple, sassafras, sweet birch, red oak and hickory. Other associate species found here include white oak, bigtooth aspen, sugar maple, black cherry, black oak, beech, blackgum, and eastern red cedar. Factors that have influenced stand composition over time, and the current concentration of certain species, include prior farming practices and general topography. Based on the review of historic aerial photographs, most of the stand is under 100 years old, as much of the site was in farmland production in the 1930s aerial imagery. Shortly after this time, it began to revert into forest cover. The modeled stand-wide average *effective* age, which is an estimate of different species ages based on their diameter, is 104.

Table 3. Forest characteristics of Sun Mountain Preserve (excluding conifer stand and openings)

Name	Value	Name	Value
Forest Type	Mixed upland hardwoods	Stems per unit area (stems/ac)	107.7
Site Index	80 for black oak	Net cord volume (cords/ac)	18.5
Medial dbh (in)	18.3	Canopy closure (% closure)	60-90%
Quadratic mean dbh (in)	11.7	Productivity	57 cu.ft/ac/yr
Size Class	Large sawtimber	Regeneration status	Poor
Age class	80-110	Coarse woody debris status	Low
Total basal area (sq.ft/ac)	81	Damage causing agents	Deer, EAB, BBD/BLD, invasive plants

Basal area in Saplings (sq.ft/ac)	2.7		Relative density (%)/vigor	41.8/moderate
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Regeneration of trees on the property is poor. While regeneration data collected during the forest inventory indicates more than 1,100 seedlings per acre on average, the vast majority of those are below 1 ft in height. This is an indicator of high levels of deer browse as well as closed canopy conditions with limited growing space and low-light conditions conducive for seedling establishment. Additionally, over half of the seedlings observed in the stand were ash trees. Unfortunately, the long-term viability of these seedlings is minimal due to the presence of emerald ash borer. Even if growing conditions were to be made more suitable, this species will likely suffer adverse impacts due to the insect pest, preventing them from successfully recruiting into the canopy.

The understory composition at the site is variable, with more dense cover found in areas where the canopy is more open due to dieback of mature ash trees that have succumbed to the emerald ash borer. Likely due to the history of agricultural use across much of the site, invasive plants are widespread across the site. Some of the most widespread and abundant invasive plants at the site are Japanese barberry, wineberry, and multiflora rose.

Conifer Stand

Within the southwestern portion of the property, there is a +/- 4.5-acre forest stand that is dominated by conifers. This stand is distinct from the rest of the site due to the species composition. Based on historic aerial imagery, it appears that this stand may have been planted sometime during the 1940s. The majority of the stand is comprised of medium sawtimber sized eastern white pine and Norway spruce trees, together comprising over 70% of the total growing stock. Sweet birch, white ash, hickory, and yellow poplar are also present, with suppressed sweet birch and hickory comprising the poletimber and sapling size classes.



Image 10: Conifer stand



Image 11: Conifer stand, down dead wood

Regeneration of trees within this stand is poor. Regeneration data indicates nearly 900 seedlings per acre on average, but the vast majority of those are below 1 ft in height. This is an indicator of high levels of deer browse as well as closed canopy conditions with limited growing space for

seedlings. Additionally, $\frac{3}{4}$ of the seedlings observed in the stand were ash trees. Unfortunately, the long-term viability of these seedlings is minimal due to the presence of emerald ash borer. Even if growing conditions were to be made more suitable, this species will likely suffer adverse impacts due to the insect pest, preventing them from successfully recruiting into the canopy.

Overall, understory vegetation is less prevalent within this area when compared to the rest of the site, but invasive plants are still present and problematic, with Japanese barberry and Japanese stiltgrass being the most abundant.

Open Areas

There are two areas on the property which have been maintained as open habitat without canopy cover. The larger of the two is over 5 acres in size and consists of an open meadow with succession occurring around the forest edge. Trees along the edge of the opening include white oak, red maple, hickory, red oak, and white ash. The smaller of the two areas is under 2 acres in size and is dominated by invasive autumn olive.



Image 12: Larger open meadow



Image 13: Smaller opening with invasive shrubs

There is minimal tree regeneration occurring within these areas. Data collected within the larger opening indicates under 200 seedlings per acre. The smaller opening shows almost 2,000 seedlings per acre. However, over $\frac{3}{4}$ of these are ash seedlings and the remaining $\frac{1}{4}$ being red maple.

The larger opening is dominated by herbaceous species within its interior. The edges of the field are experiencing encroachment of invasive shrubs such as autumn olive and Japanese barberry. The smaller opening is dominated by autumn olive. These invasive shrubs should be managed to prevent them becoming more established and widespread.

Recreation and Aesthetics

The Sun Mountain Preserve is a public nature preserve and is open from sunrise to sunset for passive recreation which includes activities such hiking and wildlife viewing. There are no motorized vehicles, camping, hunting, or trapping allowed on the property, with the exception of

hunting for deer by Township permit. There are some trails found on the property, which would benefit from regular maintenance and clear marking for ease of use by visitors. Expanding the trails network would benefit recreational users while also improving accessibility for stewardship purposes.

Overall, the aesthetic quality of the property would be considered pleasing to most except for areas dominated by invasive plants in the understory. The conifer stand and open areas offer a diversity of habitat types and structures across the site. However, the entire site would benefit from management of invasive plants both to improve aesthetics and promote healthy forest habitat. There are many ash trees on the site which have succumbed to the emerald ash borer, creating standing dead and fallen trees which can be considered hazardous due to their proximity to trails used by visitors. Areas where dying trees have created canopy gaps have increased pressure from invasive plants such as Japanese barberry in the understory.

Due to the proximity to several residential properties, it may be worthwhile for the Township and authors of this plan to engage in public education for the surrounding community to address concerns related to subtle to moderate changes that may appear within the property if stewardship activities are undertaken. These changes may include dieback of vegetation after herbicide treatments and the creation of brush piles for wildlife.

Woodglen-Miquin Trail

Property Overview

The Woodglen-Miquin Trail property encompasses more than 27 acres, the entirety of which is in forest cover. The main access point for the property is at 668-670 Woodglen Road in Glen Gardner, NJ. Parking is minimal at the point of entry, thereby limiting accessibility for more than a couple of visitors at a time without utilizing the side of the road. Nearly the entire site was in agricultural production until about the 1970s and is now dominated by young red maple wetlands. Spruce Run and one of its tributaries run along the northwestern and southern borders of the property.

History and Ownership

Woodglen-Miquin Trail is currently co-owned by the Township and the NJ Water Supply Authority. Block 36 Lot 18.04 was previously owned by Alan and Diane Goracy, until it was purchased as open space in 2004. Block 36 Lot 17.03 was owned by Vi Giaquinto and purchased as open space in 2022, serving as a connector between the Goracy property and the Miquin Woods Preserve which is owned by Hunterdon County. There is no prior, formal forest management plan for this property.

Sections of the property contain deed restrictions that prohibit certain activities. As shown on the attached *Conservation Restrictions* map in the Appendix of this plan, about 12.5 acres along the northwestern boundary are encumbered by these restrictions. Since the property was purchased through the Environmental Infrastructure Financing Program (EIFP), the restrictions that are in

place limit the creation of trails and prohibit the cutting/removal of vegetation and the application of herbicides. Should the Township or NJ Water Supply Authority desire to create trails, treat invasive plant species, and/or fell or remove vegetation, including diseased or dying trees in the EIFP restricted areas, prior consent would be needed from NJDEP.

Almost the entire property was in farmland production since at least the 1930s up until the 1970s when it began to revert into forest cover. There is a small section in the southwestern corner of the property that has been in continuous forest cover since before the 1930s. Notable differences in the species composition and forest structure can be seen between this piece and the remainder of the property. The areas that were in farmland production are now dominated by young red maple stands with lots of pressure from invasive plants in the understory. The older forest section has greater species diversity in the canopy, and less pressure from invasive plants in the understory. At present, the site is dominated by young red maple in both the forested wetlands and upland areas. Forest health threats at this site include emerald ash borer, beech bark disease, beech leaf disease, spotted lanternfly, invasive plant species, and pressure from deer browse.

Soils and Topography

Woodglen-Miquin Trail ranges from about 700 feet in elevation at the westernmost corner of the property along Spruce Run, to almost 800 feet in elevation at the entrance to the property along Woodglen Road. The terrain is relatively flat across much of the property, with gentle slopes.

The majority of the soils on the property are Califon loam, which is characterized as moderately well-drained with a depth to water table of 6-30 inches. The site index for northern red oak for this soil type is 80 with 57 cubic feet per acre per year of productivity.

The Hatboro-Codorus complex is found in about 30% of the property, along the northern and western border. This soil type is characterized as a silt loam that is poorly drained with a depth to water table of 0-6 inches. The site index for red maple for this soil type is 57 with 43 cubic feet per acre per year of productivity. Overall, the Califon loam soils offer better forestland productivity than the Hatboro-Codorus complex.

Less than 2% of the property includes Califon gravelly loam and Parker cobbly loam soils.

See the Natural Resources Conservation Service Soils Report for this property in the attachments for further information.

Hydrology

Does the property have wetlands mapped by NJDEP?	Yes ☒	No ☐
Are there possibly wetlands present that are not mapped by NJDEP?	Yes ☒	No ☐
Does the property have wetlands transition areas?	Yes ☒	No ☐
Does the property have surface water?	Yes ☒	No ☐
Does the property have Riparian Zones?	Yes ☒	No ☐

The Spruce Run flows along the northwestern boundary of the property, and a tributary of the Spruce Run is found within the southern section of the site. Both the main stem and its tributaries are classified as FW2-TPC1 under the Surface Water Quality Classifications (FW2 = fresh water influenced by man-made discharges, TP = trout production, C1 = Category 1). Under the *Flood Hazard Area Control Act* (FHACA) rules N.J.A.C. 7:13, this designation is afforded a 300' regulated Riparian Zone extending from the bank.



Image 14: Spruce Run at Woodglen-Miquin Trail

Wetlands are found throughout much of the site along the streams. The mapped wetlands will be afforded a 150' transition buffer in accordance with the wetland classification of *Exceptional Resource Value* since they are associated with a Category 1 waterbody.

Ecology and Biodiversity

During the inventory, over 70 species of plants were observed, including 21 tree species. The species lists provided are not intended to be comprehensive but rather capture the more common and notable species present on the property as recorded in the inventory sampling data and otherwise observed while visiting the property. Those denoted with an asterisk (*) indicate an invasive species.

Tree Species List:

American beech	American elm	American holly
American sycamore	basswood	black cherry
blackgum	chestnut oak	eastern red cedar
eastern white pine	gray birch	hickory
northern red oak	pin oak	red maple
sugar maple	swamp white oak	sweet birch
white ash	white oak	yellow poplar

Shrub/Small Tree Species List:

alder	American hornbeam	American witchhazel
arrowwood viburnum	autumn olive*	blackberry
blackhaw viburnum	burning bush*	bush honeysuckle*
common winterberry	dogwood sp.	highbush blueberry
hophornbeam	Japanese barberry*	lowbush blueberry
mapleleaf viburnum	multiflora rose*	northern spicebush
privet*	wineberry*	

Herbaceous and Groundcover Species List:

Arrow-leaved tearthumb	bedstraw	butterfly milkweed
Canada mayflower	cinquefoil	dogbane
goldenrod	grass spp.	hayscented fern
jack in the pulpit	Japanese stiltgrass*	jewelweed
meadow-rue	moss spp.	mountain mint
narrowleaf bittercress	narrowleaf mountain mint	partridgeberry
purple milkweed	sedge spp.	sensitive fern
skunk cabbage	striped prince's pine	white snakeroot
woodfern	woodland strawberry	wood sorrel

Vine Species List:

eastern poison ivy	grape	hog-peanut
Japanese honeysuckle*	Asiatic bittersweet*	roundleaf greenbrier
Virginia creeper	wild yam	

Forest Conditions

Forest data was collected from twenty-four evenly spaced inventory plots distributed across the forest using a 10-factor prism, which translates to roughly one inventory plot for every acre. Using a 90% confidence interval, the resulting stand data is within +/- 13.4% of the mean basal area, and within +/- 24.6% of the mean number of stems per acre.



Image 15: Young red maple stand



Image 16: Opening with invasive pressure

This is a mesic hardwood forest, where red maple, elm, and yellow poplar together comprise 88% of the total growing stock. In the co-dominant crown class (~ 8-14" dbh), red maple, sugar maple, and blackgum are most abundant. Beneath the co-dominant crown class is a small poletimber and sapling cohort (5-7" and 1-4" dbh, respectively) that is mostly populated with red maple, elm, and black cherry. Other associate species found here include red oak, eastern red cedar, sweet birch, white ash, basswood, beech, sycamore, chestnut oak, hickory, and swamp white oak. Factors that influence stand composition and the current concentration of certain species include prior farming practices and topography. Based on the review of historic aerial

photographs, the majority of the site is under 100 years old, as it was in farmland production in the 1930s aerial imagery. The modeled stand-wide average *effective* age, which is an estimate of different species ages based on their diameter, is 54.

Table 4. Forest characteristics of Woodglen-Miquin Trail

Name	Value	Name	Value
Forest Type	Mesic hardwoods	Stems per unit area (stems/ac)	357.5
Site Index	80 for northern red oak	Net cord volume (cords/ac)	17.0
Medial dbh (in)	9.6	Canopy closure (% closure)	30-90%
Quadratic mean dbh (in)	7.2	Productivity	43-57 cu.ft/ac/yr
Size Class	Large poletimber	Regeneration status	Moderate
Age class	50-60	Coarse woody debris status	Low
Total basal area (sq.ft/ac)	100	Damage causing agents	Deer, EAB, SLF, BBD/BLD, invasive plants
Basal area in Saplings (sq.ft/ac)	11.7	Relative density (%)/vigor	75.7/poor-moderate

Regeneration of trees on the property is poor. While regeneration data collected during the forest inventory indicates nearly 1,500 seedlings per acre on average, the vast majority of those are below 1 ft in height. This is an indicator of high levels of deer browse as well as closed canopy conditions with limited growing space for seedlings. About half of the seedlings observed in the stand were American beech or ash trees. Unfortunately, the long-term viability of these seedlings is minimal due to the presence of emerald ash borer, beech leaf disease, and beech bark disease. Even if growing conditions were to be made more suitable, both ash and beech will likely suffer adverse impacts due to the pests and disease, preventing them from successfully recruiting into the canopy. Additional species recorded in the regeneration layer included oak species, black cherry, hickory, red maple, sugar maple, and tulip poplar. Unfortunately, all these species were recorded at low levels of abundance which makes it highly unlikely for the seedlings currently present to persist into the future and eventually establish as a new cohort of trees. For example, both black cherry and swamp white oak seedling frequency were measured at 16 stems per acre and the desired seedling density for these species to persist past the seedling stage is +/- 2,000 stems per acre.

The understory composition at the site is variable, with more dense cover found in areas where the canopy is more open. Likely due to the recent history of agricultural use across much of the site, invasive plants are quite prevalent and problematic. Some of the most widespread and abundant invasive plants at the site are Japanese stiltgrass, Japanese barberry, autumn olive and multiflora rose. Despite the prevalence of invasive plants across the site, several beneficial native herbaceous plants were found in open areas, including butterflyweed and purple milkweed. These plants are significant in that they support the life cycle of monarch butterflies, which are currently proposed for listing as a federally threatened species. Control of invasive plants, particularly in open areas where these beneficial native plants are found, is recommended.

Recreation and Aesthetics

Woodglen-Miquin Trail is a public nature preserve and is open from sunrise to sunset for passive recreation such as hiking and wildlife viewing. There are no motorized vehicles, camping, open hunting, or trapping allowed on the property, with the exception of hunting for deer by Township permit. There are some trails found on the property, which would benefit from regular maintenance and clear marking for ease of use by visitors. Expanding the trails network would benefit recreational users while also improving accessibility for stewardship purposes.

In some ways, the aesthetic quality of the property may be considered to be charming to visitors, as it is dominated by younger forest habitat which differs in age and structure from what is seen in most other nearby woodlands. However, many areas of the site are affected by invasive plants in the understory. The entire site would benefit from management of invasive plants both to improve aesthetics and to promote healthy forest habitat. The stream corridor along the property boundary offers a scenic and serene feature for visitors and wildlife alike to enjoy.

Due to the proximity to several residential properties, it may be worthwhile for the Township and authors of this plan to engage in public education for the surrounding community to address concerns related to subtle to moderate changes that may appear within the property over the course of this plan. These changes may include dieback of vegetation after herbicide treatments and the creation of brush piles for wildlife.

Red Mill Race Preserve

Property Overview

The Red Mill Race Preserve is a nearly 8-acre green acres property found along 97-101 Red Mill Road in Glen Gardner, NJ. Access to the site is challenging, as there is no designated parking area. The Spruce Run flows throughout the site, and the majority of the property has been in continuous forest cover since at least the 1930s. The current forest habitat consists of mesic hardwoods, dominated by sugar maple, yellow poplar, American sycamore, and oaks.

History and Ownership

The Red Mill Race Preserve was part of the John Dempsey estate and was purchased as open space by Lebanon Township in 2017. John J. Dempsey and his wife Gloria M. Dempsey acquired the property in 1967 and were active members of the community, with John being a historian of Lebanon Township until his passing in 2011. There is no prior, formal forest management plan for this property.

The property contains deed restrictions from Green Acres prohibiting use other than for recreation or conservation purposes. The stewardship of natural resources is not prohibited on Green Acres properties.

According to historic aerial imagery, the majority of this property has been in continuous forest cover since at least the 1930s. Small sections along the western and northeastern borders were cleared for farmland production around the 1930s but have been in forest cover since about the 1950s. At present, the site is dominated by sugar maple, yellow poplar, American sycamore, white ash, oak, and hickory. Forest health threats at this site include emerald ash borer, invasive plant species, and pressure from deer browse.

Soils and Topography

The Red Mill Race Preserve ranges from about 620 to 660 feet in elevation, with the lowest points of elevation found along Spruce Run which flows through the middle of the site. Steep slopes occur on the property to the south of Spruce Run, reaching as much as 40% slopes. Low lying areas along the stream are relatively flat with more gentle slopes.

Just over 50% of the property is comprised of Califon gravelly loam, which is found along the stream corridor and has slopes of 0-8%. This soil type is characterized as moderately well-drained with a depth to water table of about 6-30 inches. The site index for black oak is 80 with 57 cubic feet per acre per year of productivity.

Nearly 45% of the site is comprised of Parker cobbly loam, found along both the northern and southern borders of the site where the steeper slopes occur. This soil type is characterized as somewhat excessively drained with a depth to water table of over 80 inches. The site index for black oak is 80 with 57 cubic feet per acre per year of productivity.

The Hatboro-Codorus complex is found in about 5% of the site along the eastern boundary. This soil type is characterized as poorly drained with a depth to water table of about 0-6 inches. The site index for red maple is 57 with 43 cubic feet per acre per year of productivity.

The majority of the soils on the property are beneficial for forestland productivity, with the exception of the Hatboro-Codorus complex with experiences slightly lower productivity, likely due to being poorly drained.

See the Natural Resources Conservation Service Soils Report for this property in the attachments for further information.

Hydrology

Does the property have wetlands mapped by NJDEP?	Yes ☒	No ☐
Are there possibly wetlands present that are not mapped by NJDEP?	Yes ☒	No ☐
Does the property have wetlands transition areas?	Yes ☒	No ☐
Does the property have surface water?	Yes ☒	No ☐
Does the property have Riparian Zones?	Yes ☒	No ☐

The Spruce Run flows through the entirety of the property. This stream is classified as FW2-TPC1 under the Surface Water Quality Classifications (FW2 = fresh water influenced by man-made discharges, TP = trout production, C1 = Category 1). Under the *Flood Hazard Area Control Act* (FHACA) rules N.J.A.C. 7:13, this designation is afforded a 300' regulated Riparian Zone extending from the bank.

Mapped wetlands are only found in the southwestern corner of the site. The mapped wetlands are afforded a 150' transition buffer in accordance with the wetland classification of *Exceptional Resource Value* since they are associated with a Category 1 waterbody. The southeastern portion of the property contains portions of a wetland buffer for wetlands that fall outside of the property boundary, as shown in the *Regulated Features* map for the site.



Image 17: Spruce Run at Red Mill Race

Ecology and Biodiversity

During the inventory, over 50 species of plants were observed, including 10 tree species. The species lists provided are not intended to be comprehensive but rather capture the more common and notable species present on the property as recorded in the inventory sampling data and otherwise observed while visiting the property. Those denoted with an asterisk (*) indicate an invasive species.

Tree Species List:

American sycamore	blackgum	eastern hemlock
hickory	northern red oak	red maple
sassafras	sugar maple	white ash
yellow poplar		

Shrub/Small Tree Species List:

American hornbeam	American witchhazel	autumn olive*
bamboo	blackhaw viburnum	burning bush*
elderberry	Japanese barberry*	multiflora rose*
northern spicebush	wineberry*	

Herbaceous and Groundcover Species List:

arrow-leaved tearthumb	bedstraw	Canada mayflower
eastern hayscented fern	garlic mustard*	ghost plant
goldenrod	grass spp.	Jack in the pulpit
Japanese stiltgrass*	jewelweed	mayapple

meadow-rue
ramps
skunk cabbage
white snakeroot
woodfern

moss spp.
sedge spp.
stinging nettle
wild leek

narrowleaf bittercress
sensitive fern
striped prince's pine
wild yam

Vine Species List:

American hog-peanut
Japanese honeysuckle*
Virginia creeper

eastern poison ivy
Asiatic bittersweet*
wild yam

grape
roundleaf greenbrier

Forest Conditions

Forest data was collected from seven evenly spaced inventory plots distributed across the forest using a 10-factor prism, which translates to roughly one inventory plot for every acre. Using a 90% confidence interval, the resulting stand data is within +/- 29.5% of the mean basal area, and within +/- 40.1% of the mean number of stems per acre.



Image 18: Riparian corridor



Image 19: Remnant trail

This is a mesic hardwood forest, where sugar maple, yellow poplar, sycamore, and red oak together comprise 82% of the growing stock in the co-dominant crown class (~ 12-20" dbh). Beneath the co-dominant crown class is a poletimber and sapling cohort (5-11" and 1-4" dbh, respectively) that is mostly populated with suppressed sugar maple, red oak, hickory and blackgum. Other associate species found here include red maple, eastern hemlock, white ash, and sassafras. Factors that influence stand composition and the current concentration of certain species include prior farming practices and topography. Based on the review of historic aerial photographs, the stand is over 100 years old, as it was in forest cover in the 1930s aerial imagery. The modeled stand-wide average *effective* age, which is an estimate of different species ages based on their diameter, is 100.

Table 5. Forest characteristics of Red Mill Race Preserve

Name	Value	Name	Value
Forest Type	Mesic hardwoods	Stems per unit area (stems/ac)	151.7
Site Index	80 for black oak	Net cord volume (cords/ac)	21.4
Medial dbh (in)	16.3	Canopy closure (% closure)	50-80%
Quadratic mean dbh (in)	10.3	Productivity	57 cu.ft/ac/yr
Size Class	Medium sawtimber	Regeneration status	Poor
Age class	90-110	Coarse woody debris status	Low
Total basal area (sq.ft/ac)	89	Damage causing agents	Deer, EAB, invasive plants
Basal area in Saplings (sq.ft/ac)	5.7	Relative density (%)/vigor	58/moderate

Regeneration of trees on the property is poor. While regeneration data collected during the forest inventory indicates more than 1,100 seedlings per acre on average, the vast majority of those are below 1 ft in height. This is an indicator of high levels of deer browse as well as closed canopy conditions with limited growing space for seedlings. Additionally, about nearly $\frac{3}{4}$ of the seedlings observed in the stand were ash trees. Unfortunately, the long-term viability of these seedlings is minimal due to the presence of emerald ash borer. Even if growing conditions were to be made more suitable, these seedlings will likely suffer adverse impacts due to the insect pests, preventing them from successfully recruiting into the canopy.

The understory composition fluctuates across the site and is often densest along the stream banks of the Spruce Run. While a range of native plant species such as northern spicebush, woodferns, and jewelweed are present, offering some structural diversity, invasive plants are also present. Japanese barberry and multiflora rose occur at the highest frequency but are not as widespread and problematic as at other sites within this plan. However, control measures should still be considered to limit the spread of these plants and promote a healthy, native forest understory.

Recreation and Aesthetics

The Red Mill Race Preserve is a public nature preserve and is open from sunrise to sunset for passive recreation and include activities such hiking and wildlife viewing. There are no motorized vehicles, camping, open hunting, or trapping allowed on the property, with the exception of hunting for deer by Township permit. There is no true existing trail network for visitor use. Creating a trail network would benefit recreational users while also improving accessibility should stewardship activities be undertaken.

The aesthetic quality of the property may be considered pleasing to most visitors, primarily due to the presence of the Spruce Run throughout the site. This stream corridor offers a scenic and serene feature for visitors and wildlife alike to enjoy. However, many areas are affected by invasive plants in understory. The entire site would benefit from treatment of invasive plants both to improve aesthetics and to promote healthy forests. There are also many ash trees on the site

which have succumbed to the emerald ash borer, creating standing dead and fallen trees which may pose a hazard to visitors.

Due to the proximity to several residential properties, it may be worthwhile for the Township and authors of this plan to engage in public education for the surrounding community to address concerns related to subtle to moderate changes that may appear if stewardship activities are undertaken. These changes may include dieback of vegetation after herbicide treatments and the creation of brush piles for wildlife.

Memorial Park

Property Overview

Located near the Lebanon Township Municipal Building and the local school system, this park offers a variety of recreational opportunities for the local community. The main entrance to the park is located at 67 Bunnvale Road in Califon, NJ. The park includes amenities such as picnic areas, benches, playgrounds, volleyball courts, basketball courts, a pavilion, restrooms, paved walking trails, and ample parking. Although the property is about 37 acres in size, only around 7 acres are in forest cover. There is no prior forest management plan for this property. The forest cover primarily consists of red maple, black cherry, and sassafras trees.

History and Ownership

Memorial Park is owned by the Township and was encumbered by Green Acres in 2012. There is no prior, formal forest management plan for this property.

The entire property was in agricultural production during the 1930s. The two forest blocks on the site began reverting to forest cover in the 1950s and have remained intact since then. At present, the forest consists of mesic hardwoods dominated by red maple, black cherry, and sassafras. Forest health threats at this site include emerald ash borer, invasive plant species, and pressure from deer browse. The remainder of the property continues to be open fields and other infrastructure to support recreational activities for the public.

Soils and Topography

Memorial Park ranges from about 940 to 960 feet in elevation. The site is relatively flat in terrain.

The forest on the property is comprised of Califon loam, Gladstone gravelly loam, and Parker Cobbly loam soils. Califon loam is found in the forest section along the northern border for the property. This soil type is characterized as moderately well-drained with a depth to water table of about 6-30 inches. The site index for northern red oak is 80 with 57 cubic feet per acre per year of productivity.

The Gladstone gravelly loam soil type is found in the majority of the forest section found in the southeastern section of the property. This soil type is characterized as well-drained with a depth

to water table of over 80 inches. The site index for northern red oak is 76 with 57 cubic feet per acre per year of productivity.

Parker Cobbly loam soils are found within the southwestern corner of the forest block that is located in the southeastern section of the property. This soil type is characterizes as somewhat excessively drained with a depth to water table of over 80 inches. The site index for black oak is 80 with 57 cubic feet per acre per year of productivity.

As a whole, the soils on this property are beneficial for forestland productivity.

See the Natural Resources Conservation Service Soils Report for this property in the attachments for further information.

Hydrology

Does the property have wetlands mapped by NJDEP?	Yes ☐	No ☒
Are there possibly wetlands present that are not mapped by NJDEP?	Yes ☐	No ☒
Does the property have wetlands transition areas?	Yes ☐	No ☒
Does the property have surface water?	Yes ☐	No ☒
Does the property have Riparian Zones?	Yes ☐	No ☒

There are no mapped streams, waterbodies, or wetlands on this property. There is an artificial lake found on an adjacent parcel to the northwest of the site, which does not require a buffer zone. The nearest streams are Hickory Run Tributary to the east and Rocky Run to the southwest, both of which are over 0.3 miles from the site. Therefore, the property is not within range of potential wetland or riparian buffers.

Ecology and Biodiversity

During the inventory, over 40 species of plants were observed, including 9 tree species. The species lists provided are not intended to be comprehensive but rather capture the more common and notable species present on the property as recorded in the inventory sampling data and otherwise observed while visiting the property. Those denoted with an asterisk (*) indicate an invasive species.

Tree Species List:

American elm	black cherry	northern red oak
Norway maple*	pin oak	red maple
sassafras	white ash	shagbark hickory

Shrub/Small Tree Species List:

American hornbeam	arrowwood viburnum	autumn olive*
burning bush*	bush honeysuckle*	flowering dogwood
Japanese barberry*	multiflora rose*	privet*
wineberry*		

Herbaceous and Groundcover Species List:

arrow-leaved tearthumb	bedstraw	cinquefoil
garlic mustard*	goldenrod	grass spp.
Jack in the pulpit	Japanese stiltgrass*	jewelweed
moss spp.	mugwort*	narrowleaf bittercress
sedge spp.	sensitive fern	white snakeroot
wood sorrel		

Vine Species List:

eastern poison ivy	grape	Japanese honeysuckle*
Asiatic bittersweet*	roundleaf greenbrier	Virginia creeper

Forest Conditions

Forest data was collected from six evenly spaced inventory plots distributed across the forest using a 10-factor prism, which translates to roughly one inventory plot for every acre. Using a 90% confidence interval, the resulting stand data is within +/- 12.7% of the mean basal area, and within +/- 19.7% of the mean number of stems per acre.



Image 20: Paved trail through woodlands



Image 21: Invasive understory

This is a mixed upland hardwood forest, where red maple, black cherry, and red oak together comprise 88% of the growing stock in the co-dominant crown class (~ 12-20" dbh). Beneath the co-dominant crown class is a poletimber and sapling cohort (5-11" and 1-4" dbh, respectively) that is mostly populated with suppressed red maple, black cherry, sassafras, white ash, and elm. Other associate species found here include northern red oak, pin oak, hickory, and Norway maple. Factors that influence stand composition and the current concentration of certain species include prior farming practices and topography. Based on the review of historic aerial photographs, the stand is under 100 years old, as it was in farmland production in the 1930s aerial imagery. The modeled stand-wide average *effective* age, which is an estimate of different species ages based on their diameter, is 74.

Table 6. Forest characteristics of Memorial Park

Name	Value	Name	Value
Forest Type	Mixed upland hardwoods	Stems per unit area (stems/ac)	152.8
Site Index	80 for northern red oak	Net cord volume (cords/ac)	22.2
Medial dbh (in)	13.7	Canopy closure (% closure)	50-80%
Quadratic mean dbh (in)	11.5	Productivity	57 cu.ft/ac/yr
Size Class	Medium sawtimber	Regeneration status	Poor
Age class	70-90	Coarse woody debris status	Low
Total basal area (sq.ft/ac)	110	Damage causing agents	Deer, EAB, invasive plants
Basal area in Saplings (sq.ft/ac)	0.0	Relative density (%)/vigor	61/poor-moderate

Regeneration of trees on the property is poor. While regeneration data collected during the forest inventory indicates nearly 2,400 seedlings per acre on average, the vast majority of those are below 1 ft in height. This is an indicator of high levels of deer browse as well as closed canopy conditions with limited growing space for seedlings. Additionally, about half of the seedlings observed in the stand were ash trees. Unfortunately, the long-term viability of these seedlings is minimal due to the presence of emerald ash borer. Even if growing conditions were to be made more suitable, this species will likely suffer adverse impacts due to the pests, preventing them from successfully recruiting into the canopy.

There is a lack of healthy, native understory cover present within the forests at the site. Invasive plants are prevalent and problematic throughout. Out of the ten most dominant understory species found at the site, only two of those were native plants. These most abundant and dominant invasive understory plants include Japanese stiltgrass, Japanese barberry, multiflora rose, Asiatic bittersweet, bush honeysuckle, privet, garlic mustard, and wineberry.

Recreation and Aesthetics

Memorial Park is a public park managed by the Lebanon Township Memorial Park Committee and is open from sunrise to sunset for a variety of recreational uses. Those activities include sports fields, picnic areas, playgrounds, and paved walking trails. The property is widely accessible with ample parking for visitors.

In terms of public parks, the aesthetic quality of the property may be considered to be pleasing to most visitors as it offers a mix of infrastructure that supports recreational opportunities as well as some natural forest areas which provide shade cover and opportunities for wildlife viewing. However, the forests on site are affected by invasive plants in the understory and would benefit from treatment both to improve aesthetics and to increase forest health. There are several ash trees on the site which have succumbed to the emerald ash borer, creating standing deadwood which may pose a hazard to visitors.

Due to high levels of visitation and proximity to the local school system, it may be worthwhile for the Township and authors of this plan to engage in public education for the surrounding community to address concerns regarding subtle to moderate changes that may appear within the property if stewardship activities are undertaken. Changes may include dieback of vegetation after herbicide treatments and the creation of brush piles for wildlife.

Historical Resources

The historical significance of Memorial Park was assessed by comparing boundaries with the NJDEP GIS layers for historic properties and historic districts. As illustrated by the attached *Historic Resources* map, approximately 16 acres in the northeastern portion of the property falls within the Woodglenn historic district and is near a dozen historic properties including Twin Oak Farm, White Hill Farm, several family residences, a schoolhouse, and general store which is still in operation. Recommended stewardship activities for this site prioritize reducing invasive plant cover and will not have an adverse impact to the historical character of these resources.

Threatened and Endangered Species

Federally Listed Species

The US Fish and Wildlife Service (USFWS) was consulted to obtain an official “species list” for the five properties in this Master Plan, which was generated via their online portal and is attached for reference. According to this document, there are six federally imperiled species that may be found in the area, and no critical habitats. Below are descriptions of each species with possible conservation measures.

Northern long-eared (NLEB), Indiana bat (IB), and Tricolored bat – While the Indiana bat has been listed as endangered since the start of the Endangered Species Act in 1973, the northern long-eared bat was listed more recently as threatened in 2015 and was reclassified as endangered in 2022. The tricolored bat is currently a candidate for listing as an endangered species, as proposed in 2022. All three species may occupy the properties for foraging and summer roosting, although their numbers have dropped so precipitously due to white-nose syndrome that occupation is unlikely. Knowing that suitable habitat exists, and the properties are within the range of these bats, another resource was consulted through the USFWS NJ Field Office website (last updated in 2023) that lists municipalities with known occurrences of hibernation or maternity of NLEB and IB. This resource indicates occurrences of NLEB in Lebanon Township including hibernation habitat. Although occupation by these species is unlikely, it is recommended to follow the primary conservation measures to minimize impacts which is to avoid felling trees with exfoliating bark, such as shagbark hickory, that could be a maternity roost (bats seek shelter with their pups under loose bark) between April 1st and November 15th. Forestry treatments that favor increased opportunities for roosting and foraging can be beneficial.

According to the most current regional science synthesized in the *Forestry Habitat Conservation Plan for Bats* that was developed for the state of Pennsylvania in conjunction with the USFWS, the primary conservation measure to minimize impacts to NLEB or IB is to avoid clearcutting within ¼ mile of a hibernaculum and to avoid felling potential roost trees (e.g., those with cavities or exfoliating bark) during the period when pups are non-volant, which is between June 1st – July 15th. If NLEB or IB is eventually recorded on any properties receiving forestry prescriptions involving tree felling, following these timing guidelines will prevent adverse and irreversible effects on the species. Furthermore, the *Pennsylvania Forestry Habitat Conservation Plan for Bats* found that many forestry treatments improve roosting and foraging habitat, so forestry treatments to improve the health of this forest may be beneficial to the species recovery.

Bog turtle – The bog turtle is North America’s smallest turtle species and was listed as federally threatened in 1997 due to habitat loss from land use changes and development. In addition, natural succession of vegetation (conversion from open habitat to forested wetlands) has caused a loss of habitat as well. Bog turtles prefer open wetland habitats that often have shallow areas of standing water interspersed with tussocks of grasses and sedges. No wetlands encountered on the properties were typical of bog turtle habitat. Bog turtle habitat is characterized by wetlands with saturated soils, diverse herbaceous vegetation, and perennial hydrology. It is unlikely that bog turtles currently inhabit any of these sites, although there are occupied sites along connected waterways. Red Mill Race Preserve can be managed as a travel corridor to facilitate successful movements between bog turtle populations. The Partners in Amphibian and Reptile Conservation (PARC) outline best practices for forest stewardship that favor habitat suitability for herpetofauna in the publication *Habitat Management Guidelines for Amphibians and Reptiles of the Northeastern United States*. These practices support a complex mix of wetlands, vegetation, and woody debris that provides adequate foraging opportunities and cover for bog turtles and other herpetofauna to move across the landscape. The primary conservation measure to avoid negative impacts to bog turtles is to avoid damage to wetland vegetation during the breeding and nesting season which occurs in May and June. Habitat management that promotes open wetlands may be beneficial for this species by providing suitable conditions for basking and nesting. More detailed conservation measures can be found in the *2019 Programmatic Biological Opinion* prepared by the USFWS.

Small whorled pogonia – A small orchid typically found in upland forest habitat. Although unlikely to occur on these properties due to its rarity, Hunterdon County is part of the historic range for this species and so its occurrence in Lebanon Township is possible. Favored growing conditions for this species are gently sloped forested areas typically near a persistent canopy opening. Forestry activities that increase sunlight penetration to the forest floor would help improve conditions for this plant if it is present. Any known occurrences of this plant would be buffered from forestry activities if verified locations are known.

Monarch butterfly – The monarch butterfly was proposed for listing as a threatened species with species-specific protections and flexibilities to encourage conservation under Section 4(d) of the Endangered Species Act (ESA) in December of 2024 and is nearing the end of the 90-day

comment period during the writing of this plan. USFWS is also proposing to designate critical habitat at overwintering grounds in California. The monarch butterfly currently has no federal protections. Monarch butterflies require milkweed species to complete their lifecycle, which typically grows in open fields and meadows or emergent wetlands. During forest inventory poke milkweed (*Asclepias exaltata*) was found on the Anthony Preserve property in two areas in small amounts, and butterfly weed (*Asclepias tuberosa*) and purple milkweed (*Asclepias purpurascens*) were found in open areas of Woodglen-Miquin Trail. Stewardship activities to promote suitable habitat for these and other milkweed species will benefit monarch butterflies. Purple milkweed is one of the rarer species of milkweed in NJ and grows best in full to part sun in sandy soils of shrub thickets and dry open oak and oak/pine woodlands. It can also be seen growing in wet prairies and calcium rich sites. Forestry activities that create small canopy openings near well drained moist soils would help improve conditions for this plant to persist on suitable sites.



Image 22: Poke milkweed



Image 23: Purple milkweed



Image 24: Butterflyweed

State Listed Species

A NJDEP Natural Heritage Database report for the property was requested from the Office of Natural Lands Management (ONLM). The report, which is included in the plan attachments, lists species occurrences based on the property's position relative to known or potentially suitable habitat patches, so a listing on the report does not necessarily mean that all the species listed are present on-site of included properties even when indicated as such. The species reported by the ONLM for each property are displayed in the table below. Conservation measures to protect each species are listed (if applicable).

Table 7. Presence of state listed species based on Natural Heritage Data report.

Species	Property				
	Anthony Preserve	Red Mill Race	Sun Mountain Preserve	Woodglen-Miquin Trail	Memorial Park
New Jersey Chorus Frog	x	x	x	x	
Barred Owl	x	x	x	x	
Brown Thrasher	x	x	x	x	

Red-shouldered Hawk	X	X	X		X
Sharp-shinned Hawk	X	X	X	X	
Savannah sparrow					X
Veery	X	X	X	X	
Wood Thrush	X	X	X	X	
Bobcat	X	X	X	X	
Eastern Red Bat	X	X	X	X	
Bog Turtle		X			
Spotted Turtle	X	X	X		
Wood Turtle	X	X	X	X	
Woodland Box Turtle	X	X	X	X*	

* Although not included in the Natural Heritage Data report, NJA staff encountered a box turtle during forest inventory at the Woodglen-Miquin Trail property

New Jersey Chorus Frog (special concern) - New Jersey chorus frogs can be found throughout most of NJ and are an adaptable species that use various moist habitats, including grassy floodplains, shallow water wetlands (marshes, ditches, swamps, or vernal pools). Adults utilize herbaceous and scrub shrub wetlands with abundant sedges and grasses for breeding. Breeding begins in late winter and is completed in late spring. Adults then disperse across the landscape into swamps, and forested wetlands and are no longer congregated near the shallow water breeding areas. To avoid impacts to the population, limit vehicle traffic near potential breeding sites to dry periods or months outside the breeding season (February – June). Maintain forested buffer zones 450' from isolated wetlands (vernal pools) and limit vehicle use in this zone. Silvicultural prescriptions that promote understory development and small canopy openings within wetlands may promote suitable breeding habitat for this species.

Barred owl (state threatened) - Barred owls begin breeding around March each year in expansive (i.e., core) forests, with a preference for wetland and riparian woodlands that are generally more than 1,000' from humans. They typically utilize large cavity trees > 18" dbh for nesting but may use stick nests constructed by other birds when cavities are unavailable. Nesting is normally completed by the end of June, so the primary best management practice to mitigate adverse and irreversible impacts to barred owls is to avoid disturbances within 1,000' of suspected nest trees during the breeding and nesting season. Sun Mountain Preserve has several features that represent diverse and suitable barred owl habitat with variable structure of the forest understory, fields, wetlands, and a conifer stand. Activities that increase the number of larger diameter cavity trees may improve nesting success, and forestry treatments that improve plant biodiversity and small rodent populations may be beneficial for the conservation of this species.

Brown thrasher (special concern) – Brown thrashers nest in dense understory cover within deciduous forests, typically low to the ground or occasionally directly on the ground. Brown thrashers may find suitable understory structure for nesting on some of these sites as several areas of dense scrub/shrub growth were identified. However, these areas are dominated by invasive plants which offer marginal foraging opportunities. Managing invasive plant species and promoting understory development of native shrub communities can improve habitat and increase foraging opportunities for this species.

Red-shouldered hawk (non-breeding sighting; special concern) – Red-shouldered hawks have been documented in the non-breeding season at all sites except for Woodglen-Miquin Trail. During migration and winter, they prefer hardwood swamps and riparian forests as well as pastures, fallow fields, and open-canopy forests. Forestry treatments that improve plant biodiversity and small rodent populations may be beneficial for the conservation of this species during the non-breeding season.

Red-shouldered hawks are listed as state endangered during the breeding season. While the properties do not have documented records of breeding red-shouldered hawks, red-shouldered hawks were confirmed nesting within two miles of one of the properties. Like the barred owl, red-shouldered hawks prefer to nest in expansive, mature forests away from human activity, though they are becoming more common in wooded residential areas. They tend to prefer hardwood swamps and riparian forests, selecting large diameter deciduous (sometimes coniferous) trees for nesting. Nesting is normally completed by the end of July, so the primary best management practice to mitigate adverse and irreversible impacts to red-shouldered hawks is to avoid disturbances within 1,000' of suspected nest trees during the breeding and nesting season. Activities that increase the number of larger diameter cavity trees may improve nesting success, and forestry treatments that improve plant biodiversity and small rodent populations may be beneficial for the conservation of this species.

Savannah sparrow (state threatened) – Savannah sparrows utilize open habitats, nesting in fields, grasslands, pastures, and meadows. They prefer a mix of tall and short grasses with dense ground vegetation and a thick litter layer and will use fields undergoing vegetative succession that include young woody vegetation such as shrubs and saplings. This species historically benefitted from the prevalence of farmlands in the state and has experienced habitat loss as farmlands have been converted into development or left fallow to succeed into closed canopy forests. Memorial Park is identified as a breeding site for the species, likely due to the presence of open habitat on the property. Forest stewardship activities that promote a healthy understory of native vegetation and a mosaic of forest structure including young forest can benefit the species.

Sharp-shinned hawk (special concern) – Sharp-shinned hawks can be found throughout the state year-round. They prefer to breed in coniferous forests near openings and deciduous woodlands. The limited coniferous component of forests on these sites makes them an unlikely location for nesting sharp-shinned hawks. Stewardship activities that increase structural diversity and understory vegetation will likely increase foraging opportunities for this species.

Veery (special concern) – Veeries are small songbirds that favor dense, damp, and mostly deciduous woodlands typically located near rivers, streams, and swampy areas. They thrive in wooded areas with dense understory vegetation that provides adequate nesting cover as well as foraging areas. It is possible that veery are nesting on these properties, but a lack of dense, native understory vegetation may limit their ability to nest and rear young successfully.

Silvicultural prescriptions that will promote native tree regeneration and understory development may increase foraging opportunity and quality for this species.

Wood thrush (special concern) – Wood thrush breed in mature deciduous forests with a healthy native understory, as they nest and forage in dense cover close to the ground. Due to the lack of consistent, native understory cover, it is unlikely wood thrush are nesting on these properties. Managing invasive plants and promoting understory development and diversity can create better habitat and may increase foraging opportunities for this species.

Bobcat (state endangered) - Bobcats are elusive mammals that often den in rocky outcrops within closed canopy forests but prefer hunting small prey in the dense vegetation of shrubby, young forest habitat. They have home ranges that are larger than these properties and move about frequently. Since they are highly mobile and evasive, they will quickly move away from human activity, so occasional forest stewardship activities are not considered to adversely affect bobcats. Forestry treatments that improve plant biodiversity and small rodent populations may be beneficial for the conservation of this species. The creation of brush piles may also provide shelter for bobcats and their kittens.

Eastern red bat (special concern) – The eastern red bat is a common, tree-dwelling species whose summer range includes forests throughout the state. They roost among a variety of vegetation (deciduous and coniferous trees, shrubs, and vines) favoring open tree canopies. While they typically migrate south in the winter, some individuals may hibernate in NJ by utilizing hollow trees or burying within leaf litter on the forest floor. To minimize impacts to roosting bats, it is best to avoid felling trees during the summer months, especially those with exfoliating bark, such as shagbark hickory, between April 1st and November 15th.

Spotted turtle (special concern) - Spotted turtles are primarily aquatic and have significant habitat overlap with bog and wood turtles. They utilize various slow-moving still water wetlands, including shallow ephemeral pools, wet meadows, swamps, streams, and drainage ditches. Spotted turtles use small waterways to travel between wetlands as they seek suitable conditions for foraging, nesting, and overwintering. It is not likely that spotted turtles are nesting or overwintering on these properties as no areas with suitable hydrology and vegetation were identified. The properties may serve as travel corridors and foraging areas between several ponds, vernal pools, and herbaceous wetlands along the Spruce Run and its tributaries. Stewardship activities will not have adverse impacts to this species.

Woodland box turtle (special concern) - Although this turtle is abundant, it is declining throughout much of its range. Woodland box turtles are primarily terrestrial and found throughout NJ in various habitats including fields, mature forests, wetlands, and riparian areas. They benefit from diverse plant communities, with cool moist microclimates utilizing dense shrub cover, downed trees, ephemeral wetlands, and clumps of thick vegetation to avoid harsh weather and predators. Woodland box turtles are dormant (brumate) anytime from late October to April. In contrast to many reptiles, box turtles do not brumate below the frost line, instead

relying on dense layers of vegetation to insulate a shallowly excavated hole. This puts them at risk of being crushed by large equipment even during winter months. To reduce the risk of mortality, use of heavy equipment should be restricted to winter months (November – March) during dry periods or when snow cover is present. They may resurface during bouts of warm weather near the onset of winter and spring. Woodland box turtles are known to occur on every property included in this plan except Memorial Park, and all properties have potential as box turtle habitat. These turtles are likely to benefit from stewardship activities that increase vegetation density, woody debris, and small canopy openings which provide them places to forage, bask, and nest.

Wood turtle (state threatened) – Wood turtles are associated with upland, early successional plant communities, and forested wetlands near unpolluted streams with deep pools for brumation and overwintering. Streams that are too shallow, lacking deep pools and soft substrates sufficient for brumation are unlikely to support wood turtles. This is likely the case for the portion of Spruce Run that passes through Woodglen-Miquin Trail, although the property has potential as seasonal foraging and nesting habitat. Red Mill Race Preserve has more suitable stream conditions and may support wood turtles overwintering on site as well as throughout the breeding and nesting season. The primary conservation measure is to avoid using heavy equipment within 300' of streams during the spring and fall periods (depending on weather) when turtles are concentrated near streambank brumation sites and are most susceptible to being encountered. It is recommended to avoid activities that alter potential nesting sites such as traversing with heavy equipment or piling woody debris and treetops in these areas. Nesting sites are characterized as having sandy or gravelly substrates, less than 20% vegetative cover, exposure to sunlight, and elevation three feet above the water level. An additional stewardship recommendation for this species is to establish filter strips as no-cut zones that extend at least 25' from the stream bank to maintain microclimate and provide a future source of large woody debris.

Threats to Forest Health and Sustainability

Several threats to the sustainability of this forest have been identified and discussed in this document, including excessive deer herbivory, invasive plants, and insect pests. These and other threats are discussed in further detail below:

Deer

White-tailed deer, although a native wildlife species, can have severe negative impacts in forest ecosystems when found in high numbers due to excessive browse on desirable vegetation. Evidence of over browse by deer includes a visible browse line, which is a lack of vegetation within the space that deer can reach, and noticeable browse on unpalatable vegetation such as beech trees or invasive plants. Extensive deer browse was notable at all properties. For example, at the Anthony Preserve, deer browse was visible on beech sprouts, indicating that the local deer herd has a lack of available food to support the population. Lebanon Township has allowed deer hunting through a permitted hunting program since 2021 on the following properties: Anthony Preserve B49 L4.02, 89.01, 89.02; Woodglen-Miquin Trail B36 L18.04, 17.03; Sun Mountain Preserve B24 L2.01; and Red Mill Race Preserve B35



Image 25: Deer browse on vegetation

L88. It is recommended to continue to allow hunting access on the current properties and explore ways to increase hunting participation with the goal of increased harvest numbers to decrease the local deer herd. However, it is unlikely that hunting activities alone will mitigate the overall issue due to the tendency of deer to move across a landscape and seek refuge in neighboring, non-huntible properties when pressured. Forestry and conservation activities should consider the impacts of deer and may require fencing or caging to protect regeneration and any supplemental plantings.

Pests and Diseases

Emerald ash borer (EAB) has become widespread in the state since its initial detection in 2014. This non-native and invasive pest lays eggs in the bark of ash trees, and the larvae feed on the cambium layer which cuts off the flow of nutrients within the tree. Indicators of EAB infestation include D-shaped exit holes, blonding of the bark as woodpeckers feed on the larvae, branch dieback, and ultimately dead mature ash trees. Ash trees are present on all properties, with many already suffering mortality, and all have been negatively impacted by EAB infestations. There are some mature ash trees on the property that are still alive but showing signs of stress from EAB and will likely succumb in the next few years. Some of the seedlings observed during inventory were ash trees, and it is likely that the EAB will eventually affect any seedlings that successfully recruit into the overstory. Due to the widespread damage and mortality caused to ash trees throughout the region, there are currently no treatment or mitigation recommendations for EAB at the site. Dead and dying ash trees should be considered a hazard along trails.



Image 2626: EAB larval galleries



Image 2727: EAB exit holes

Beech Bark Disease (BBD) has been present in the United States since at least the late 1890's and in New Jersey since the 1970's. The disease begins with the infestation of beech scale insect (*Cryptococcus fagisuga*) which establishes on rough areas of the normally smooth beech bark. Any deformity, damage, or break in the bark allows beech scale to establish and feed on sap by using specialized mouth parts to pierce the bark. The feeding activity creates small fissures and breaks in the bark that allow species of *Nectria* fungi to infect the tree, which then kills portions of woody tissue. When heavily infested, the fungi can girdle the tree by stopping the flow of sap, ultimately leading to mortality after several years. Older trees with abundant abnormalities are more susceptible to beech scale infestations than young, smooth-barked trees. The first sign of beech scale activity is congregations of white specks that give the bark a wooly appearance. This is a result of waxy exudates that beech scales use to protect themselves while feeding. As *Nectria* fungi infect the tree, cankers begin to form. When the fungi reproduce, they produce red fruiting structures that contrast with the grey beech bark. Another sign of fungal infection is "tarry spots," discolored spots of dead wood on the tree oozing a brown fluid. In the late stages of BBD, the tree is weakened, and damage from wood boring insects, woodpeckers, and sapsuckers will be evident. Diseased trees are prone to snapping in windstorms and should be considered hazards near trails. To minimize the spread of BBD avoid transporting infested beech wood from midsummer through early winter when beech scales are likely to be mobile.

Beech leaf disease (BLD) is a new threat in forests of the United States. BLD was first identified in Ohio in 2012 and has spread eastward, reaching the northeast in 2019. BLD is a nematode induced necrosis of interveinal leaf tissue that affects all species of beech trees including American beech. The nematode (*Litylenchus crenatae* ssp. *mccannii*) establishes on beech buds from June through October, persisting throughout the winter within buds where it feeds on tissues. Evidence of BLD includes dark green colored bands between leaf veins, curling of leaves, thickened leaf tissues with a leathery texture, early abscission of leaves, and eventual

dieback of branches leading to tree mortality over a period of 3-7 years depending on tree maturity and vigor. BLD was observed in most of the beech trees on the property. Foliar nematicide spray and systemic nematicide injections have varied results in treating BLD, and these methods are considered cost prohibitive for widescale forest stewardship. There are no known cultural practices that reduce the spread of BLD.



Image 2828: Beech bark disease



Image 2929: Beech leaf disease

Spotted lanternfly (SLF) were first detected in NJ in 2018 and have now spread to every county in the state. NJA staff observed SLF nymphs during forest inventory at the Woodglen-Miquin Trail property. SLF are an annual species, emerging in the spring (May – June) from egg masses. After molting several times adult SLF can be seen starting in July. The adults will breed and lay eggs masses before dying off after the first hard frosts of the year (October – December). The eggs persist through the winter and the cycle repeats the following year. Evidence of SLF infestations include gray to brown clay-like egg masses, honeydew, black sooty mold, molted exoskeletons of nymphal stages, and mass congregations of SLF on trees. SLF nymphs feed on herbaceous plants, green woody shoots, and new growth. Once mature, they feed directly on larger trees, piercing the bark with specialized mouth parts to feed on sap. As SLF feed they excrete honeydew, a sticky sugar rich liquid waste that coats vegetation in heavily infested areas. Bees, hornets, and other insects are known to then congregate to feed on honeydew. SLF are not known to cause direct mortality to mature trees but can cause branch dieback, sapling mortality, and impact the overall vigor of trees making them susceptible to other pests and diseases. The black sooty mold that establishes on honeydew coated vegetation reduces light availability for

affected plants and may cause dieback of understory plants in areas around heavily infested trees. SLF are a major threat to vineyards and orchards, as they significantly reduce production and plant vigor of grapevines and fruit trees. As adults they preferentially feed on tree-of-heaven, often congregating by the hundreds or thousands and forming dense masses along the trunk. There are contact and systemic insecticides available that are effective against SLF, but are primarily used for mitigating damage to vineyards, orchards, and shade trees. Although SLF can complete its lifecycle without feeding on tree-of-heaven, it is extremely attractive to the adults. Tree-of-heaven was not encountered during forest inventory, but if it is discovered, removing it can reduce the likelihood of SLF migrating to and establishing a robust population on a property. Tree-of-heaven typically responds to cutting with aggressive root suckering, so it is recommended that trees be treated with a systemic herbicide via a basal bark treatment and cut only after trees are dead.



Image 30: SLF egg masses



Image 31: Adult SLF

Invasive Plants

During the forest inventory, at least a dozen invasive plant species were observed. Invasive plants pose a threat to native ecosystems because characteristics such as fast growth rates, prolific seed production, and lack of natural predators allow them to spread quickly and outcompete native species for resources. This competition can severely limit natural regeneration of native plant species and ultimately reduce the biodiversity of a forest or other habitats. In addition, the compounding effects of deer browse on native plants while they are being outcompeted by invasive plants can be a major threat to the long-term health and resiliency of a native forest ecosystem. Addressing these invasive plants on the property is crucial in allowing for the success of natural regeneration and maintaining or increasing biodiversity. This is of particular importance when it comes to supporting wildlife species such as migrating and

breeding songbirds. Invasive plants do not support the diversity of insects that these birds rely on to feed their young during the nesting season and beyond. Invasive plants should be managed through physical removal and through targeted chemical treatments made by a licensed pesticide applicator as appropriate.



Image 32: Invasive Japanese barberry and Japanese stiltgrass in the understory with dead and dying ash trees in the canopy at Anthony Preserve

Climate Change

The effects of climate change are already being seen across the region, such as rising sea levels and warmer average temperatures. These changes have the potential to impact the long-term health of the forests in Lebanon Township. Most of the properties connect to the Spruce Run, making the low-lying land on the properties susceptible to flooding during severe storm events. Additionally, changes in precipitation events may cause more frequent occurrence of periods of drought, or heavy rainfall leading to flooding of low-lying areas, both of which may lead to tree mortality and difficulty of seedling establishment. Severe storms can also cause wind throw which would topple mature trees and open the canopy, making it more susceptible to invasive plants unless actively treated. In addition to threats from severe storms, climate change brings a shift in mean annual temperatures that has occurred across the region in recent years which has implications for the habitat suitability for current plant species that may not be adapted to warmer growing conditions. The Plant Hardiness Zone maps, which are determined based on the average

annual extreme minimum winter temperature, were updated in 2023 indicating a shift in ranges. While Lebanon Township is still considered to be zone 6b (-5° to 0° F) as it was in the 2012 update, it is now close to the border of zone 7a (0° to 5° F) according to the most recent climate data. These ongoing shifts in climate should be considered when planning restoration activities, particularly in selecting native species for planting. Broadly speaking, suitable habitat for some species will likely be shifting northward in the coming decades, so species whose native range lies south of the property may be able to survive and even thrive in the projected future conditions. Conversely, species that are currently present but are lying at the southernmost extent of their range (such as sugar maple) may be less adaptable to future climate conditions as the entire species “migrate” northward. The most up-to-date resources and modeling data should be utilized in species selection for any planting efforts at the site.

Summary

Many of these threats, in addition to potential future and unforeseen effects from disease outbreaks, new insect pests, and changes in climate, work synergistically in causing negative impacts to general forest health and sustainability. Proactive measures can be taken to increase overall forest health and resiliency, thereby reducing the risk of severe negative impacts due to current and unforeseen threats. For example, removing some trees to reduce competition and improve individual tree health and vigor may reduce susceptibility to adverse impacts from pests and disease. Also, increasing the diversity of species, age classes, and structural characteristics present will improve overall resiliency in the event that a pest or disease outbreak adversely affects a specific species as seen with the chestnut blight, emerald ash borer, and beech leaf disease. To achieve this, steps must be taken to address invasive plant species and excessive deer browse in the understory to ensure that any future silvicultural activities and restoration plantings will allow for adequate tree regeneration and a healthy native understory. Consistent monitoring of the site throughout any management period is key to determining if activities are achieving these goals, and to identify unforeseen threats as they arise and allow appropriate mitigation efforts to be taken.

Stewardship Recommendations

In order to achieve the goals set forth by Lebanon Township for the stewardship of the properties included within this Master Plan, there are several activities recommended for implementation. These include control of invasive plants, reduction of the local deer herd, improved accessibility and establishment of trail systems, and incorporation of educational opportunities for the public. In areas with EIFP easements or deed restrictions, however, prior approval from the NJDEP will be required to cut vegetation, apply herbicide, and create new trails.

Stewardship recommendations, as well as suggestions for property prioritization, are discussed in more detail below.

Invasive Plant Treatment

As discussed throughout this plan, invasive plant species are a significant threat to forest health. Each of the properties is impacted by these species to varying degrees of severity. Addressing invasive plants often requires intensive, consistent, and long-term treatments and monitoring.

In some cases, mechanical control methods such as hand pulling, cutting, or mowing may be feasible. This will be dependent on the severity of the infestation and the particular species being addressed. Hand pulling of smaller infestations of herbaceous invasive plants such as garlic mustard can provide opportunity for hands on community engagement through volunteer events. However, this is not the most time or cost-effective means of control at larger scales. Additionally, mechanical control by cutting invasive plants is effective for reducing biomass, but many plants will resprout shortly after being mechanically treated in this manner. In most cases, the most effective means of long-term control for widespread and persistent infestations will be through the use of herbicide.

Careful use of herbicides, overseen by a licensed applicator, is the most cost-effective means of controlling most invasive plant species. In many situations, mechanical control is the preferred first step needed to make a site accessible for chemical treatments, or to reduce the use of chemicals and make the application more targeted. A general approach for controlling invasive plants for these properties is to treat herbaceous plants and shrubs below 4' tall with a foliar application of a non-selective chemical like glyphosate or triclopyr, which are labeled as low toxicity products that have limited soil mobility. This can usually be done with low chance of affecting non-target plants when timed appropriately using a backpack sprayer or other low-volume application methods. Larger shrubs (>4' tall) and trees can either be treated using a basal bark or cut stump method if the density is low enough, or in high density populations, forestry mowing can be completed first to reduce biomass and then foliar treat the resprouts. The precise methods and chemicals will need to be altered when applying near wetlands and water resources based on the product label requirements.

Additional Best Management Practices are to be adhered to for herbicide treatments in wetlands, wetland buffers, and Riparian Zones as outlined in Section VII of the NJ Forestry and Wetlands

Best Management Practices Manual which is included in the appendix of this plan. Vegetative management is allowed within regulated areas if activities are outlined for specific properties that are being managed under the guidance of a state approved Forest Stewardship Plan (such as Anthony Preserve). If stewardship activities are desired for other properties, it is recommended that formal management plans are put in place for each additional property aside from Anthony Preserve. Activities in regulated areas that are not part of a Forest Stewardship Plan may be achievable if the proper wetlands permitting is obtained prior to commencement of activities. Typically, a general wetlands permit (GP4 or GP16) is sufficient to permit activities suggested within this document.

Deer Management

Another forest health threat that is prevalent across all properties is overabundant deer populations. A meaningful deer control program that reduces the local population to a level where native plants and tree seedlings can grow without excessive browse inhibiting establishment will be important to the success of the land management goals that are aimed at improving forest health and diversity. While Lebanon Township allows limited hunting at Anthony Preserve, Red Mill Race Preserve, Woodglen-Miquin Trail, and Sun Mountain Preserve through a permitted deer hunting program, there is still notable browse and indicators of deer overabundance which pose a threat to forest health. Not only is an excessive deer herd problematic to vegetation and wildlife habitats, but a deer herd that continues to grow unchecked will also eventually begin to decline in overall health of individuals as resources become limited and starvation and disease becomes commonplace. Different deer management programs have been used on public properties with varying degrees of success, but to date, the only cost-effective means for accomplishing this elsewhere has been through a culling program that utilizes licensed hunters to focus on removal of female deer. Among the different program models, traditional hunting clubs that have exclusive permission to hunt a property are typically *ineffective* at achieving significant population reductions to an ecologically appropriate level. This is probably because their intention is recreational rather than stewardship driven. Popular strategies among local government units that implement deer programs include restricting the number of hunters on a property and limiting the number of hunting days, which is usually based on perceived safety concerns. However, these measures reduce the number of deer that can be taken, and the most effective population control occurs where unrestricted hunting access is permitted following state regulations without additional barriers. Despite the perception, there is no demonstrated increased risk to the non-hunting public that uses properties where unrestricted hunting occurs, like on state wildlife management areas and forests.

It may be helpful to seek assistance from the NJDEP Fish & Wildlife on this issue as the professionals in the agency are best positioned to advise the township on the legality and effectiveness of different deer management alternatives. This process will probably also require some stakeholder engagement to address a variety of issues and concerns that residents may have. Since the process could take several years to develop, it would be prudent to begin it immediately while concurrently initiating other stewardship activities.

Trails and Accessibility

Sufficient parking and trail systems are important components to consider for the implementation of stewardship activities as well as access by the public for recreational opportunities. Traversing

the properties by foot is mostly feasible, although somewhat difficult in some areas due to invasive plants in the understory and a lack of maintained trails. Treatment and reduction of invasive plants will inherently provide easier accessibility as overall cover is reduced. Ideally, the stewardship activities will result in a more robust native understory and structural diversity to promote wildlife habitat which may include down dead wood. These characteristics, while improving forest health and sustainability, may in turn create barriers to access for stewardship and recreation. Therefore, it is recommended to develop and incorporate a maintained trail system alongside stewardship activities. A trail system that allows for public access to various parts of the properties while also improving access to actively steward the forests is ideal. Where feasible, improved parking areas would be beneficial as well, particularly at access points where the only current option is limited roadside parking. Most of the sites would benefit exceedingly from these improvements, with the exception of Memorial Park which already has ample parking and adequate accessibility to forested areas.

Thinning

Once deer browse and invasive plant densities are low, evaluate properties with high “fully-stocked” or “over-stocked” conditions which will benefit from select thinning practices. Although it may seem counterintuitive, felling some trees will reduce competition for water, nutrients, and sunlight which will improve the health of the remaining trees and may reduce susceptibility to adverse impacts from pests and disease. Thinning practices aiming to improve overall forest health and vigor typically aim to remove (via girdling or felling) poorly formed, diseased, stunted, or undesirable trees as identified and marked by a consulting forester. If deer and invasive plant densities can be maintained at low levels long-term, further thinning can be considered to increase the diversity of species, age classes, and structural characteristics. American beech and white ash trees will suffer full mortality in the near future and may also be felled if/when they pose a public safety hazard. If any forested block experiences a significant reduction in canopy (relative density reduced below 65%) due to excessive storm damage, disease/pest outbreak, or other disturbance(s), the forest should be reevaluated and prescriptions adjusted to take into account loss of codominant stems in the overstory.

Prescribed Burning

Explore the possibility of using prescribed burning on some of the properties as a more cost effective way to manage invasive plants and aim to restore oak-hickory and mixed hardwood characteristics to the forests. Prescribed fire is one technique among a set of tools and practices land managers can use to steward forests, but is not guaranteed to solely produce intended results. This action will require a burn plan and possibly additional silvicultural activities via forest stewardship plans. The creation of fire breaks and improved vehicular access to safely implement a controlled burn will most likely be required. Depending on the intensity of fire needed to achieve stewardship goals, thinning of midstory or canopy trees may be needed to carry a hot enough burn to achieve the desired outcome. Outreach and education to residents about the use of prescribed burns and what to expect is also recommended prior to implementing a prescribed burn.

Conservation Deed Restrictions and Easements

The EIFP deed restrictions on some sections of the properties prohibit certain activities that are necessary to meet the goals and objectives of this plan. It is recommended that the appropriate municipal representatives and NJWSA seek discretionary consent from the NJDEP to allow for conservation-focused, forest stewardship. Successful implementation of the practices outlined in this plan, such as invasive plant control, may be hindered if permission to conduct herbicide and vegetation removal is not granted in the EIFP portions of the properties. Forest stewardship is most successful when a holistic, property-wide approach can be taken to ensure goals and objectives are being met.

Education

A proactive strategy of public education about relevant issues like deer management and invasive plant control is essential for gaining public buy-in to stewardship activities, and to increase visitor tolerance for temporary inconveniences or changes from the status quo that may be necessary to sustain forest health. Educational signage in key locations can be used to explain stewardship project objectives. In addition, formal educational programs and workshops geared towards environmental education could be integrated with forest stewardship awareness through the plan implementation.

Property Prioritization

Being that there are five properties included within this plan, it is recommended that the Township decide on site prioritization to begin planning and implementing stewardship activities. Since funding and resources dedicated towards stewardship may be limited initially, it is advisable to prioritize work on properties where the most significant benefit can be achieved for a relatively reasonable amount of input. Trying to work across all of the properties at once would likely dwindle resources without achieving meaningful positive impacts. Some goals may be able to be achieved as a collective, such as a deer management program implemented across most of the sites at once. Others, namely invasive plant management, must involve focused efforts within a manageable footprint to be successful rather than spreading resources too thin. Since invasive plant management on neglected or degraded forests requires regular monitoring and follow-up, it is recommended that a manageable amount of acreage be identified to begin conservation efforts on and expand from over time. With these considerations in mind, it is recommended to generally prioritize the properties for stewardship as follows:

Anthony Preserve, tract 1 – A separate Forest Stewardship Plan has been developed for this property, which includes an in-depth assessment of the forest and a subsequent list of stewardship activities to be achieved over the course of the 10-year period. Priority should be given to this site during the 10-year period at minimum to ensure that the goals and prescription targets outlined within the plan are achieved. If the targets within this plan are being achieved with additional time and funding available to contribute towards other sites, only then is it recommended to begin planning for other properties.

Anthony Preserve, tract 2 - Should funding and resources allow, this site would be the second priority for stewardship activities. This is due to its proximity and connectivity to the main tract of the Anthony Preserve.

Sun Mountain Preserve - Should funding and resources allow, this site would be the third priority for stewardship activities. This is the second-largest property within the scope of this plan, and a significant amount of funding and resources would be necessary to adequately address forest health threats and increase accessibility. This property contains habitat types not found on the other properties of this Master Plan which makes it a higher priority property. Specifically, the areas currently in early successional stages can be rehabilitated to create pollinator/meadow habitat and/or shrubby habitat. These efforts may be costly, however, and would require a higher level of site-preparation and maintenance than some of the forested areas. This property would benefit from having its own Forest Stewardship Plan, similar to the Anthony Preserve.

Woodglen-Miquin Trail – This site would be the fourth priority for stewardship activities. Although one of the most problematic sites in terms of invasive plants, the site's proximity to the Anthony Preserve and its current level of accessibility by the public make this a higher priority than other sites within this Master Plan.

Red Mill Race Preserve – This site would be the second to last priority for stewardship activities. Limited accessibility at this site is both a major barrier to visitation by the public and for implementation of stewardship activities. Focus should first be placed on improving accessibility.

Memorial Park – Although this is a small site in terms of the actual acreage of forest, there may be justification to work on this site due to high visitation from the public which affords more direct educational opportunities than some of the previous properties. The area does contribute to the headwaters of the Rocky Run which provides value from a water quality standpoint. Overall though, the low priority of the property is primarily related to the quality of the site and context within the larger landscape. As compared to other properties within this plan, the forests at Memorial Park are of a lower quality due to the small size and being situated among a highly fragmented landscape. Therefore, the forest resource is less of a priority to invest in than other forests owned by the Township.

Monitoring

The use of permanent fixed radius plots is an effective tool for monitoring progress towards stewardship goals over long periods. It is recommended that prior to commencing activities, about one plot be established for every five acres of ground being treated that year. Plot centers would be staked and relocated using a GPS from year to year. Photographs from cardinal directions at the plot center are good visual evidence of change over time, and the measured conditions within a set radius represent a corresponding portion of an acre for extrapolation purposes like invasive plant management.

Attachments/Appendices List

- Property Maps
- NRCS Web Soil Survey Soil Reports
- USFWS – Trust Resources List (Federal Threatened and Endangered Species List)
- NJDEP Natural Heritage Database Report (State Threatened and Endangered Species List)
- Forest Inventory Data
- Carbon and Biomass reports
- NJ Forestry and Wetlands Best Management Practices Manual

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