Family Forest Carbon Program

Landscape Stewardship Plan

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Introduction

"Forest stewardship is the wise care and use of forest resources to ensure their health and productivity for years to come."

Forests provide benefits that we enjoy and sometimes take for granted every day. Clean air and water, wildlife habitat, wood products and jobs are just some of the values that forests provide. Pennsylvania has an estimated 738,000 private forest owners who together make management decisions on about 11.5 million acres, or about 71% of all the state's 16.8 million acres of forestland. The decisions these landowners make concerning their forestland can positively or negatively impact forest resources. By practicing forest stewardship, landowners can meet personal goals by caring for and using the forest today while also sustaining long-term forest health and continuity. This requires both planning and action, and a Forest Management Plan serves as a guide for managing a healthy forest over the long term.

A goal of the Family Forest Carbon Program (FFCP) is to support landowners in forest stewardship and achieving their individual goals for their woods. Landowners can be stewards of their forests and achieve management goals - whether that's enhancing wildlife habitat, improving water quality, sustainable timber production, outdoor recreation, or just keeping their woods healthy overall. The best way for landowners to meet these goals is to create and follow a forest management plan.

The purpose of the Landscape Stewardship Plan is to combine property-specific recommendations provided by a natural resource professional provide with overall guidance on the factors driving those recommendations. Property specific information includes the landowner's specific forest conditions and management goals, along with management recommendations and a schedule of activities to help meet those goals. Recommendations are made at both the property-level and forest stand level. A forest stand, also referred to as a management unit, is a defined area with similar habitat throughout that can be managed the same.

Supplemental information is included provide a broad overview of various forest stewardship elements. The plan contains many links to websites that provide more detailed information. Readers are encouraged to click on the links to access more information on the topics relevant to their forests and management goals. Context of the website such as organization and topic are included to aid in an internet search in case the link no longer works.

Under this plan format, landowners receive both a customized guide to forest management actions on their properties and resources for learning about the science and reasoning behind those recommendations.

Section I. Landowner and Property Information

Landowner Information

Name:

Mailing Address:

Phone Number:

Email:

Property Information

Property Address

Township, County, State:

Nearest city or town:

GPS Coordinates of primary access point:

Total Ownership Acreage: 61.63

Total Forested Acreage: 44.33

Plan Author Information

Name:

Mailing Address:

Phone Number:

Email:

Date of Original Plan Completion: 2/5/2021

Revision Dates:

Landowner's Forest Management Goals and Objectives

Forest Management Goals

The goals for the property as expressed by the Landowner are to:

1. Encourage and enhance habitat suitable for a variety of wildlife including deer, bear, squirrel, migratory birds, and turkey.
2. Establish and maintain a healthy, sustainable, and diverse forest.
3. Eliminate and control invasive plant species.
4. Prevent erosion and improve existing trails for access and recreation.

Property Maps

Management Unit Descriptions and Recommendations

Unit Name: MU I

Acres: 26.88

Current Forest Conditions:

Forest Type**:** AR22

Age**:** 65+

Species Composition: Mixed oak species, white pine, tulip poplar, and mixed hardwoods

Site Index: 70

Regeneration

There was little regeneration found during the site visit throughout the stand. Most of the seedlings or poles were birch and soft maple. Reducing competition from deer, invasive plants, and other undesirable species will help promote regeneration of the desirable native species like tulip poplar, white pine, and oaks.

Invasive Plant Species

Ailanthus, Japanese stiltgrass, honeysuckle bush, multiflora rose, and spicebush were the main species of concern in this stand. These species will take over the forest floor and shade out the AGS seedlings, preventing them from successfully growing. Herbicide would be the most effective treatment of these species.

forest stand has a dense understory of competing vegetation and invasive plants inhibit regeneration of desirable native tree species.

Forest Health Management Activities and Stand Goals

Herbicide spraying is required to eliminate the invasive plant species currently to allow desirable species such as oak and tulip poplar to regenerate. Timber stand analysis suggests a reduction in BA per acre by a timber stand improvement or TSI cut. A harvest should remove undesirable species like birch, locust, soft maple, and blackgum.

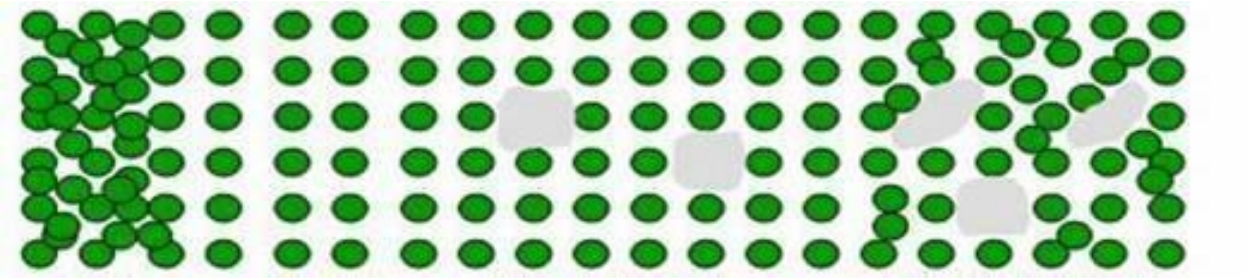
Desired Future Conditions:

Desired species to naturally regenerate: Chestnut oak, black oak, red oak, white pine, and tulip poplar.

Desired species to plant: Mixed oaks, crab apple, red bud, basswood, persimmon, white pine, Canaan fir, and tulip poplar. Tree tubes for hardwood and fencing for conifer seedlings are recommended for protection from deer browse.

Bird's-eye view of desired future stand condition

☐Wild stand	☐Evenly spaced	☐Evenly spaced with openings	☒Variable density spaced with openings



Management Recommendations:

1. Foliar herbicide treatment should be scheduled to help eliminate the woody invasive plant species that were found on the property. This foliar herbicide spraying can be accomplished with a backpack sprayer or mechanical spraying preharvest.
2. A Timber Stand Improvement (TSI) cut would help ensure regeneration of desirable native tree species. TSI involves cutting small diameter trees of poor form or species to assist in the development of new seedlings and saplings of better-quality species and value.

TSI harvest removes the undesirable trees and promotes regeneration of desired species like chestnut oak and tulip poplar.

TSI can be implemented by either commercial or non-commercial means, depending on the age and quality of the timber. In traditional non-commercial TSI, trees can be used for firewood or left to deteriorate. Decaying biomass will increase the organic and nutrient content of the soil, while also protecting regeneration from deer browse. TSI provides an excellent opportunity to channel limited forest resources into establishing quality growth of intolerant species, which are less 'tolerant' to shading by the forest canopy. Shade-intolerant species are more valuable, but they are susceptible to increased rates of mortality due to competition and over-shading; releasing them to promote increased regeneration ensures these valuable species will predominate in the mature stand. Shade-intolerant species can grow up to 2-3 times faster than shade-tolerant species, thereby yielding greater harvest frequencies. After timber harvests or disturbance, the shade-tolerant trees in the mid-story become the next stand. Removing the mid-story undesirable trees (black birch, soft maple, and black gum) permits light to reach the forest floor, allowing the less shade-tolerant, more desirable trees to germinate.

3. Japanese stiltgrass (*Microstegium vimineum*) is present on the property. This invasive annual can grow to three feet in height, forming a thick mat that inhibits the regeneration of desirable hardwood species. Stiltgrass can colonize a variety of habitats, from wetlands and fields to upland sites. This invasive plant is a prolific annual seed producer, with seeds remaining viable in the soil for over 5 years. Stiltgrass is unpalatable to deer, which encourages heavy browsing and elimination of desirable native plant species. A grass specific foliar spray application of quizalofop or Oust XP in spring or early summer is recommended to limit damage to woody seedlings post-harvest.

Unit Name: MU II

Acres: 17.45

Current Forest Conditions:

Forest Type**:** AR22

Age**: 5**5+

Species Composition: Mixed oak species, black birch, soft maple, and mixed hardwoods

Site Index: 70

Regeneration

There was little regeneration found during the site visit throughout the stand. Most of the seedlings or poles were birch and soft maple, with some red and chestnut oak stems. A high-grade harvest was conducted approximately 25-30 years ago based on the oak stumps found during the site visit.

has evidence of past logging activity that concentrated on the removal of oak sawlogs. Note there are oak pole sized stems that would benefit from a crop tree release cut.

Invasive Plant Species

Ailanthus, Paulownia tree, and some Japanese stiltgrass are the main species of concern in this stand. Herbicide would be the most effective treatment of these species.

Forest Health Management Activities and Stand Goals

The Crop Tree Release cut is recommended with focus on trees whose stem is 4" to 12" DBH and trees with crowns in the canopy or just below the canopy. The goal is to maintain the best trees for timber and/or wildlife, and to remove trees of less desirable form and/or species from around them. A general rule is to release between one or two sides of the canopy. Tulip poplar, black walnut, hickory, and oaks are good crop tree choices. Tree species diversity should also be considered, leaving some stems of non-commercial species (dogwood, ironwood, serviceberry) for stand diversity. Consider leaving potential den trees or creating snags for wildlife by herbicide treatment or double-girdling undesirable stems. Approximately 5 snags per acre on average will maximize wildlife benefit.

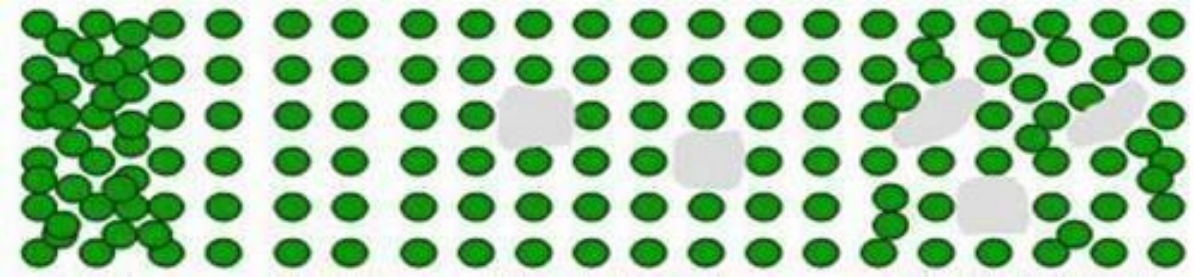
Desired Future Conditions:

Desired species to naturally regenerate: Chestnut oak, black oak, red oak, white pine, and tulip poplar.

Desired species to plant: Mixed oaks, red bud, dogwood, persimmon, white pine, Canaan fir, and tulip poplar. Tree tubes for hardwood and fencing for conifer seedlings are recommended for protection from deer browse.

Bird's-eye view of desired future stand condition

☐Wild stand	☐Evenly spaced	☐Evenly spaced with openings	☒Variable density spaced with openings



10 – Year Activity Schedule

10 Year Management Activity Schedule Tracker

Stand	Unit (Acres)	NRCS Code	Activity	Planned	Completed	Incentive Program
MU I	20	314, 315	Herbicide Spray for Woody Invasive Plants	Summer 2022	Fall 2022	EQIP & CREP
MUI	20	666	TSI (Timber Stand Improvement)	Spring 2023	Winter 2024	EQIP
MU I	20	314, 315	Herbicide Spray for Herbaceous Invasive Plants	Spring 2024	Early Summer 2024	EQIP
MU II	7	666	Crop Tree Release	Spring 2025	Fall 2025	EQIP
MU I	20	666	Review TSI Cut	Spring 2025	Summer 2025	EQIP
MU I	5	645/612	Plant Conifer & Soft Mast Trees	Spring 2025	Fall 2025	EQIP
			Audit Regeneration & Invasive Species	Spring 2025	Fall 2025	
MU I	10	314, 315	Light Spray for Herbaceous Invasive Plants If Needed	Spring 2026	Early Summer 2026	EQIP
MU II	7	666	Crop Tree Release	Spring 2027	Fall 2027	EQIP
MU II	7	666	Review Crop Tree Release	Spring 2029	Fall 2029	EQIP
MU II	7		Audit Regeneration & Invasive Species	Spring 2029	Fall 2029	
MU II	7	666	Review Crop Tree Release	Spring 2030	Fall 2030	EQIP
MU II	7		Audit Regeneration & Invasive Species	Spring 2030	Fall 2030	

Section II. Supplemental Forest Stewardship Information

Historical and Current Conditions of Pennsylvania's Forests

History of Penn's Woods

Current forest conditions are likely very different from the historical conditions, a result of extensive human influence since European colonization. Pennsylvania was approximately 90% forested at the time of European colonization, consisting of vast forests of mixed hardwoods, white pine, and eastern hemlock. Natural disturbances ranged from canopy gaps created by the loss of an individual overstory tree and small patch blowdowns (fractions of acres to a few acres in size) to large scale events such as wildfires, ice storms and pest outbreaks which covered hundreds or even thousands of acres with varying degrees of intensity. Native Americans also

frequently burned the forest to regenerate preferred food species and improve conditions for game animals and hunting. This combination of small and large-scale disturbances created a more uneven-aged and complex forest structures with a variety of age classes, tree sizes, and species composition.

These historic disturbance regimes changed drastically during the 1800's when extensive logging and land clearing occurred. Common wood products during this time included charcoal to power the iron industry, props for coal mines, tannic acid from hemlock for use in the leather-making process, ship masts from tall white pine and hemlock, and railroad ties.

Much of Pennsylvania was deforested by the early 1900's because of the extensive logging. Wildfires were also common at this time, many of them started by sparks created by the locomotives that were increasingly used in the timber transportation process. At the same time, the white-tailed deer herd was nearly non-existent because of unregulated hunting. As a result, in the early 1900's there were millions of acres of regenerating forestland that were approximately the same age, were not exposed to deer browsing, but were subjected to frequent fires. These combined factors helped contribute to the similar aged, oak-dominated forests the cover most of Pennsylvania's mountains today.

Human impacts continued to influence forests throughout the 1900's. Fire suppression became a primary forest management goal, leading to a rise in fire intolerant tree species such as red maple and black birch. Deer populations rebounded, so much so that the deer populations far exceeded what the forest could sustainably support. Overbrowsing from deer became rampant, and preferred browse species such as oaks, sugar maple, and wildflowers became scarce wherever deer could reach them. Timber harvesting continued throughout the 1900's and presently, but instead of vast clearcuts the most popular method became and still is a "select cut" in which the largest, most valuable trees were harvested while the other trees remain. Considering the forests are roughly the same age, many of these harvests are unsustainable "high-grade" harvests because they removed the largest, most productive trees and leave behind the slower growing, poorer quality trees to continue reproducing.

International trade and transport became common during the 1900's, and as goods and people crossed the oceans they sometimes intentionally or inadvertently brought plants, pests, and pathogens from other ecosystems that have devastating effects on North America's native forests. The most significant non-native impact on Pennsylvania's forests is the chestnut blight. First discovered at the Bronx Zoo in 1904 and Pennsylvania in 1908, the disease spread rapidly and by the 1940's had killed almost all chestnut trees or reduced the trees to sprouts that rarely grow larger than a few inches in diameter. Gypsy moths are another non-native forest pest that caused significant oak mortality in the 1970's and 1980's and still today will cause mortality during periodic outbreaks. Hemlock woolly adelgid is causing widespread decline and mortality

of eastern hemlock trees, and emerald ash borer quickly decimated white ash populations following its discovery in Pennsylvania in 2007. Non-native invasive plants such as tree-of-heaven, Japanese stiltgrass, mile-a-minute, and multi-flora rose are rapidly spreading throughout Pennsylvania's forests and often out-compete native plants for growing space and resources.

For more information, a video of the history of Pennsylvania's forests is available online from Penn State University and Explorepahistory.com has a great article on the history of Penn's Woods. The last two centuries have significantly changed Pennsylvania's forests and introduced multiple threats that must be assessed as part of a forest management strategy. Those threats are described in more detail throughout this plan along with general recommendations for addressing threats.

Current Forest Conditions

The tree species composition of forests vary across Pennsylvania and are influenced by a variety of factors such as soils, hydrology, aspect, and disturbance history. The most common forest types in Pennsylvania are the Northern Hardwood Forest and Oak – Hickory Forest. Northern Hardwood Forests are most common in northern Pennsylvania and along the high elevation Allegheny Front as well as cooler microclimates such as north-facing slopes and cool, moist ravines. Common tree species in Northern Hardwood forests include sugar maple, American beech, and black cherry. Oak – hickory forests are most common in the southern two-thirds of Pennsylvania. Red oak, white oak, chestnut oak, and black oak are all common tree species. Historically these forests used to also contain American Chestnut before the species was severely impacted by the chestnut blight in the early 20th century. Other minor forest types found in western Pennsylvania include Great Lakes – Beech – Maple Forest and Mesophytic Forest.

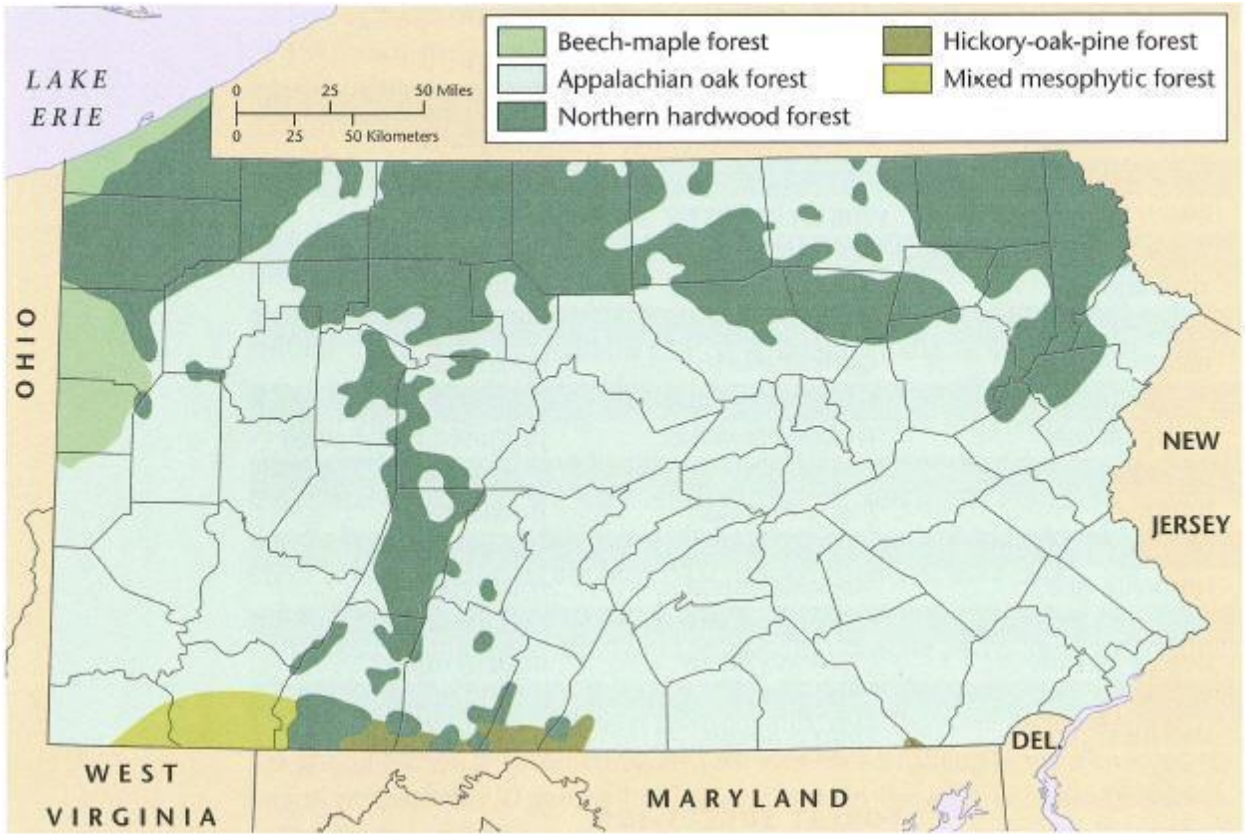


Figure 1. Distribution of major forest types in Pennsylvania. Source: Rhoads and Block 2005.

Within these Forest Types are more specifically defined Forest Communities. Forest communities are groups of plants that typically co-occur together due to shared environmental requirements. Communities are often defined by the dominant plant species, which is often the dominant tree species. In Pennsylvania, forest communities are described based in *Terrestrial and Palustrine Plant Communities of Pennsylvania 2nd Edition*.

The Penn State Center for Private Forests' article Forest Ecology: How a Forest Grows (PDF) provides great information on the various factors that influence forest development and provides a good overview of forest ecology.

Forest Health Threats and Management

Today's forests face a multitude of stressors including introduced and native insect and disease pests, deer browse impacts, and native and invasive competing vegetation. These stressors have resulted in moderately to severely degraded forest conditions in many areas of Pennsylvania and threaten long-term resilience and sustainability of nearly all Pennsylvania forests. Landowners are strongly encouraged to work with their forester to create a strategy for assessing and treating these various threats on their forestland.

Forest Pests and Pathogens

Invasive forest insects such as gypsy moth, emerald ash borer, and hemlock woolly adelgid cause widespread mortality because Pennsylvania's native trees do not have natural defense mechanisms against these non-native pests. While Pennsylvania's trees have evolved with and are adapted to living with native pests such as forest tent caterpillars and fall cankerworms, high populations of these species can lead to tree decline and mortality as well. More information on various forests pests is available online. Perry County has a list of at forest insects and pests (PDF) that is applicable to most of the state. The DCNR Forest Insects and Pests website has information on pests as well as recent monitoring results. The Pennsylvania Hardwood Council's Threats to the Forest booklet (pdf) has information on insects, plants, and diseases that threaten forest health.

Forestland should be monitored closely for non-native pests as well as high population levels of native pests. If issues are noted, various action can be taken as part of an Integrated Pest Management (IPM) strategy. IPM is a method, or process, designed to control pests while minimizing risks to humans and the environment. IPM is generally considered to have five major components that include:

- Methods for preventing pest problems
- Pest identification
- Monitoring and assessing pest numbers and damages
- Thresholds or guidelines for when management is needed
- Using a combination of, or most appropriate, management when necessary for the treatment of pests

For more information, see the American Tree Farm System's Integrated Pest Management website.

During forest management activities, simple steps like timing to minimize spread of pests, proper handling of potentially infested material, and managing site conditions (e.g. shading and moisture levels) can prevent pest spread or worsening of existing infestations. Other activities to help mitigate impacts include improving individual tree vigor by improving growing conditions, encouraging the growth of non-susceptible tree species, and targeted control methods. Individual trees that display levels of resistance to pests and pathogens should be retained or favored in management activities to promote the passing on of those genetics to the future forest.

Deer Browsing

While insects typically impact trees in the forest canopy, young trees on the forest floor are also exposed to other threats in the form of deer browsing and competing vegetation. The basis of the white-tailed deer's diet is woody browse, which consists of leaves, buds, and the new growth at the end of twigs and branches. Deer need to consume 4 to 6 pounds of food every day. This amount of chopped up twigs would nearly fill a half-bushel basket. The problem is that deer are selective browsers, preferring to eat certain seedlings while completely ignoring others. Through extensive selective browsing, deer can actually alter the plant species composition of a forest. The species that deer prefer to browse are often desired tree species such as oak and sugar maple. Furthermore, the least-preferred browse species (i.e. ferns, striped maple, and black birch) are also low-quality from both a wildlife habitat and timber standpoint. When the deer population is higher than what the forest can naturally support, extensive browsing leads to less desirable trees and more competing vegetation on the forest understory. An overview of the impacts of deer overabundance is available online from the U.S. Forest Service.

Deer Management

The vast majority of conservationists agree that the most effective and economical way to control and manage deer populations and negative deer impacts is through hunting. Landowners wishing to reduce deer browsing pressure can enroll in the Pennsylvania Game Commission's Deer Management Assistance Program (DMAP), which provides hunters more opportunities to harvest antlerless deer on the enrolled property. Hunters with a DMAP tag can harvest one antlerless deer per coupon on the specific property that coupon is assigned to. Landowners enrolling their property in DMAP do not have to allow public hunting and can select which hunters receive coupons, if desired.

In some cases, hunting alone cannot mitigate browsing pressure enough to allow for successful regeneration and deer exclosure fencing should be installed. These fences are 7.5 – 8' tall woven wire that is attached to posts to exclude deer from the area. Fencing can be expensive, so it is usually installed on an as-needed basis either before or immediately after a regeneration timber harvest to protect the seedlings from browsing. Fences normally need to remain in place for anywhere between 7-15 years depending on the success of the seedling establishment. Longer periods can increase quality and diversity of growth within the fence but are offset by increasingly problematic maintenance challenges.

Competing and Invasive Vegetation

Competing and invasive plants are those that out-compete other plants so much that they reduce plant diversity and threaten forest sustainability. Once these plants become established, they often become so dense they prevent other plants from getting established. A forest with only one or two species in the forest understory is not a sustainable forest and will likely become a severely degraded forest should the forest canopy be removed through a timber harvest or forest pest outbreak.

Hay-scented ferns are one example of a native plant species that can degrade forest quality and sustainability by creating a monoculture of one species that out-competes more desirable plants.

Ferns will grow so dense that there is no light reaching the ground, thus preventing the germination of additional species. Multiple species of non-native plants have also invaded forests and threatened forest health. Problematic species include tree-of-heaven, mile-a-minute, Japanese stiltgrass, Japanese barberry, and multi-flora rose. These species have invasive qualities in that they typically grow rapidly, their seeds spread easily, and the seed stays viable in the soil for a long time.

Vegetation Management

Management of understory vegetation is necessary to promote desirable regeneration and improve the overall resilience of the forests. The extent and method of vegetation control depends on the species, height, and density of the vegetation, as well as the management goals. Once non-native invasive plants are established, their eradication is near impossible.

Realistic objectives for non-native plant management are 1) maintain levels in infested areas so that the vegetation does not significantly interfere with native plant growth, and 2) prevent the spread of invasive plants to areas not currently infested. Management of native competing vegetation can be limited to areas where a regeneration timber harvest is desired but competing vegetation has become so established (typically > 30% coverage) that it hinders desirable regeneration.

Like pest and pathogen management, the control of undesirable vegetation should follow an IPM approach. Managing equipment use and movement across the property is important to prevent the spread of invasive species as mud on equipment can contain viable seeds of invasive plants. Equipment that may have been exposed to invasive plants such as logging equipment, tractors, and mowers, should be thoroughly cleaned before entering the property to prevent the unintentional spread of invasive plant seeds. Once vegetation is established, mechanical control (i.e. cutting or hand-pulling) may be acceptable on small patches of vegetation but herbicides will be the most effective practice control method in most situations. For more information, refer to Penn State Extension's guide on Integrated Vegetation Management (IVM). In most situations chemical control of undesirable vegetation is the most practical method that when done responsibly minimizes environmental harm. Penn State Extension's Herbicides and Forest Vegetation Management provides information on common forestry herbicides and application methods.

Oak Regeneration

The presence of oak seedlings on the forest floor, referred to as advanced regeneration, is a crucial component of a healthy oak forest. These seedlings will take the place of the mature trees in the event of a timber harvest or natural tree mortality. If a timber harvest or forest pest outbreak occurs before oak seedlings are established, the forest will likely convert to undesirable plants such as black birch or non-native invasive plants.

Unfortunately, establishing oak seedlings is a challenge throughout most of the Appalachians. Many of the areas that were historically oak forests are converting to red maple, black birch, or other forest types. Research across Pennsylvania indicates that red maple saplings outnumber

oak saplings 6:1. Most of this conversion is attributed to overbrowsing by deer, poor timber harvesting practices, and wildfire suppression.

Oak regeneration is a process that often spans 20 or more years. The first step is acorn production, which can be sporadic and nearly impossible to predict. Acorns must be viable, make it past the deer, mice, and other wildlife, and reach bare mineral soil before they begin to germinate. Oak seedlings spend their first several years focusing on root growth, while the above-ground portion of the seedling remains relatively short. Meanwhile, competing species such as red maple and birch focus on above ground growth and quickly overtop the oak seedlings. Deer often repeatedly browse oak seedlings, thus stunting the seedlings and causing poor growth form.

Timber harvests to regenerate oak cannot occur until there are many oak seedlings present that have established root systems and are not overbrowsed. Conducting a regeneration harvest without enough oak seedlings will likely cause the forest to convert to a maple or birch dominated habitat.

To grow a new oak forests, oak seedlings must be present before conducting a timber harvest.

Establishing oak seedlings usually requires lots of preparation such as deer fencing, thinning the midstory, herbicide applications, and prescribed fire. Timing is also crucial when regenerating oak, and a great deal of patience is needed while the seedlings become established. It is likely that a 15-year process will be necessary to regenerate oak within some stands. However, taking the necessary steps to establish oak regeneration will lead to enhanced forest health and wildlife habitat.

Landowners should plan to financially invest in management units where oak regeneration is recommended. Regenerating oak can be challenging but is very important for long-term management.

Forest Management Considerations

Sustainable forest management aims to optimize the benefits of a forest both presently and in the future. Forests are dynamic, and the ability of the forest to provide different benefits depends on both natural and human-caused factors. Current forest conditions are likely very different from the historical conditions, a result of extensive human influence since European colonization. Invasive plants and pests, suppression of wildfires, selective browsing by white-tailed deer, and poor timber harvest practices have all contributed to significant changes to Pennsylvania's forests. As such, there are often significant challenges that landowners and land managers must overcome to maintain or improve forest quality. These issues are addressed through silviculture, which is defined as the art and science of controlling the establishment, growth, composition, health, and quality of forests to meet the diverse needs and values of landowners and society on a sustainable basis

In most Pennsylvania forests, the three most important factors to manage when growing new trees are Competing Plants, Deer, and Light, which can be remembered by the acronym CDL. Recommendations for managing deer and competing vegetation are covered in the "Forest Health Threats and Management" section of this plan. Various silvicultural treatments to manage sunlight are described below. All three factors are also discussed in Penn State's document What's Getting in the Way of Your Woodland's Potential to Regenerate?

Timber harvests can sustainably regenerate a forest when competing vegetation and deer browsing are addressed and the harvest results in the correct amount of sunlight reaching the forest floor. In oak and sugar maple forests, the correct amount of sunlight depends on the density and height of established seedlings.

Timber Harvesting: Wood and Fiber Production

Pennsylvania's forests provide some of the highest quality and most valuable hardwoods in the world. Pennsylvania is the largest producer of hardwoods in the United States, with a forest products industry generating over 5 billion dollars annually and employing around 90,000 people. Depending on local markets and wood quality, trees harvested from Pennsylvania's forests can be utilized as veneer, furniture, flooring, pallets, railroad ties, paper, and a host of other products.

Through careful planning and oversight, landowners may be able to implement timber harvests that meet multiple forest management goals by improving forest health and wildlife habitat, generate revenue, and support the local economy. A successful and sustainable timber harvest requires utilizing the correct silvicultural treatment, harvest administration procedures, harvesting equipment, operators, and forest product markets.

Timber harvests should be overseen by a professional forester that represents the landowner. On average, timber sales involving a consultant offer value-added benefits that benefit the

landowner. This could be higher revenue, better resource protection, or both. The forester should ensure that the harvest is sustainable, protects the environmental resources of the property, and achieves landowner objectives. More information on Best Management Practices for Pennsylvania forests and timber harvesting is available from Penn State Extension.

Forest Harvesting Equipment

The equipment and methods used to harvest timber typically depend on the size and quantity of the trees being harvest, the timber products produced, and site access and slope. Harvesting methods employed should be appropriate to site condition, limitations, and stand characteristics. The harvesting systems and types of equipment most common to Pennsylvania are described below.

Conventional: Hand-felling and cable-skidding has been the most common harvesting technique in the region and is typically associated with the harvest of sawtimber-sized trees. This system has the advantage of being able to work on highly variable terrain and logs can be extracted from difficult or sensitive areas by cable and winch, reducing the overall footprint of trails and equipment use. Loggers cut the trees individually with a chainsaw, which increases risk to the logger and limits the number of small-diameter trees that can be removed.

Mechanized: This type of harvest method refers to a feller-buncher working in tandem with a skidder (often a grapple skidder) or forwarder. This system is generally more appropriate and cost-effective for higher intensity harvests and is suitable for harvesting a high quantity of small or low-value trees. The size of the equipment used limits the slope and residual tree density in which a mechanized harvest is feasible. It is a safer method for workers because contractors are typically always in a machine with a protective cab.

Cut-to-Length: A single mechanized felling, delimbing and cut-to-length head, mounted on a small excavator or similar carrier can be an efficient and low impact harvesting method. Logs can be cut to length in the woods, staged by road and moved to landings on a rubber-tired forwarder. These systems can work in tight areas and harvest individual trees without excessive residual damage but are uncommon in the state

Unsustainable Timber Harvests

Unfortunately, many Pennsylvania landowners unknowingly agree to poor timber harvesting practices. Unsustainable harvest methods commonly used in Pennsylvania are a diameter limit cut where all trees above a certain diameter (typically 14 inches DBH) are harvested or a “select cut” in which only the most economically valuable trees are harvested. Both harvest types can be considered “high-grade” harvests because these remove the most valuable trees but leave behind a lower-quality forest.

Both harvest types are often pursued under the wrong assumption that it is acceptable to “cut the big trees and let the little ones grow.” The problem is that much of Pennsylvania was clearcut around the start of the 20th century, so essentially most of the forest is even-aged with most of

the trees the same age. Although the trees are the same age, they are most certainly not the same size or quality. Some trees grow faster than others because of growing conditions and genetics. A high-grade timber harvest removes these superior trees without also establishing regeneration, which means the low-quality ones are left behind to pass on their inferior genetics to the next forest. Whenever conducting a timber harvest, it is essential to make sure the forester is following a science-based silvicultural treatment such as one of the methods described below in the "Silvicultural Practices" section of this plan.

Silvicultural Practices

Silviculture is defined as the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis. Silvicultural systems can be implemented through commercial timber harvests as appropriate to generate revenue or through firewood cutting and other non-commercial projects. Foresters take the science behind a silvicultural practice, combine that with data on current forest conditions, and develop a customized prescription for the project.

Silvicultural treatments generally aim to achieve one or more of the following objectives:

- Intermediate Treatments: Enhance forest health and productivity by managing growing space and species composition of the existing forest.
- Regeneration Treatments: Create a new forest with the adequate number of young trees and desirable tree species.

Intermediate Treatments

The following practices are usually implemented while a forest stand continues to mature with no plans to regenerate the management unit in the near future (typically less than 20 years). The overall goal of these practices is to increase growing conditions around desirable trees by removing the undesirable trees that are competing for sunlight, water, and growing space. These practices can be implemented through both commercial timber harvests and non-commercial cutting or herbicide applications. To sustainably implement these practices through a commercial harvest, the undesirable trees must provide enough volume to attract a timber sale buyer, and the timber harvester must be able to remove the undesirable trees without causing damage to the retained desirable trees.

<u>Crop Tree Release</u>

This is typically a non-commercial project implemented early in the forest's life. Desirable trees are first identified, and any undesirable tree directly competing with that tree is removed. This increases the vigor and growth rates of the crop tree.

To implement, a target number of crop trees per acre is established and the crop trees identified. Next, the crop trees receive a crown release thinning on 3-4 sides of the crown by removing

undesirable trees adjacent to or overtopping the crop tree. There is no prescribed treatment to intermediate areas between crop trees.

A crop tree release is most effective about 10 to 20 years after a final regeneration harvest, but it can occur any time throughout the stand rotation. Where stem density is high, it may be easiest to implement a crop tree release through a selective herbicide application such as a basal bark application or "hack and squirt"/frill and spray method.

Improvement Thinning

A harvest designed to control the structure, spacing and species composition of the forest stand by removing or killing designated trees. In a commercial thinning the value of trees removed more than covers the costs of treatment, whereas in pre-commercial TSI (Timber Stand Improvement) an investment is necessary to accomplish the treatment. Foresters will determine the desired residual tree (trees left on the site) spacing and reduce stands to a condition where the retained trees adequately occupy the site with enough space to grow. Retained trees are selected based on good health and form, species, good crown condition, spacing, timber value potential, wildlife or biodiversity value, and seed tree potential.

Salvage/Sanitation Thinning

A thinning in response to tree mortality or stress where harvest decisions are based on evaluations of tree health or risk potential. Salvage harvesting is by definition reactive and not typically a predictable component of forest management planning, but it is a common strategy as more and more introduced insect and disease threats stress our forests along with natural storm damage or drought stress. Dead trees are typically removed along with stressed trees which are unlikely to survive or fulfill management objectives. For instance, an oak tree with over 50% of the crown exhibiting dieback from gypsy moth defoliation will not be able to rebuild its crown and provide adequate growth or acorn production. Along recreation areas or trails, dead trees and hazard trees might be removed to increase safety and reduce ongoing maintenance needs.

Regeneration Treatments

In most Pennsylvania forests, the three most important factors to manage when growing new trees are Competing Plants, Deer, and Light, which can be remembered by the acronym CDL. Management of competing plants and deer browsing are discussed in the "Forest Health Threats and Management" section of this plan. Regeneration silvicultural practices manage sunlight levels because light has a strong influence on which tree species will grow and how fast they will grow. The desired amount of sunlight reaching the forest floor depends on the number, quality, and species of seedlings growing there. Timber harvests can sustainably be used to regenerate a forest when the harvest results in the correct amount of sunlight reaching the forest floor. In oak forests, the correct amount of sunlight depends on the density and height of established oak seedlings, which is determined through a Regeneration Assessment. The following cutting practices are typically used in forest regeneration sequences, with the main differences being intensity of harvest and the amount of sunlight that reaches the forest floor.

Single Tree Selection

The single-tree selection method removes individually selected trees of all sizes, small and large, to create small gaps in the canopy to facilitate regeneration. This method is generally the most expensive method of harvesting and requires the greatest amount of care and skill on the part of the forester and the logger. This approach should only occur where there are established seedlings of shade-tolerant species that are known to grow well in the low-light conditions that persist even after harvest. Therefore, this approach should mostly be limited to northern hardwoods forests with adequate sugar maple regeneration. It is essential that single tree selections are based on silviculture and not financial decisions alone, as this practice can easily degrade into a high-grade that removes only the most valuable trees and not the smaller ones.

Group Selection

A patchy treatment designed to create forest openings which mimic the partial openings created naturally by blowdowns, insect mortality, etc. It is generally recommended that the harvest remove groups of trees in an area with a diameter roughly equal to 1-1.5X the height of the tallest trees at a minimum. This treatment can be adapted to react to the natural establishment of seedlings by focusing treatments around pockets of seedlings. Areas between openings can be treated by thinning or left untouched. This is not a common strategy in Pennsylvania, but can be appropriate in special circumstances to either deal with inherent patchiness, encourage regeneration without drastic harvesting in sensitive areas, or create specialized wildlife habitat conditions.

Coppice Regeneration

This treatment is restricted to species which exhibit root sprouting but can be a valuable habitat management tool in certain regions, especially where aspen management is possible. Both quaking and bigtooth aspen have a tendency to put up root sprouts when cut which can emerge 20-30 feet distant from a cut stump. Aspen is also a preferred food supply for grouse (buds and flowers), deer (twigs), rabbits, hares and beavers (bark). The regenerating thickets provide excellent habitat for grouse, woodcock, black bear and other species. Harvesting should be accomplished in winter periods when the trees' energy reserves are stored in the roots. Nearly the entire overstory should be removed to provide maximum sunlight and significant habitat features for target wildlife species. The forester should evaluate need for protective deer fencing as aspen is a preferred browse species of deer and excessive browse will kill shoots and starve the root system of needed energy, eliminating the aspen component from the future forest.

Shelterwood Sequence

The shelterwood sequence is a two or three-staged approach designed to control tree density, seed source, and sunlight to favor seedling growth under a "shelter" of partial canopy. This sequence is important for oak regeneration, as the harvest types match the changing sunlight requirements of oak seedlings as they grow. The first harvest, which is only required where there lots of shade and few established seedlings, is a thinning of small trees to favor certain seed producers, promote germination of seed stored in the ground, and slightly increase sunlight by removing most of the undesirable midstory trees. This may be referred to as a "*midstory*

removal" "*thinning from below*." Very little timber is removed during this type of harvest, making it difficult to implement as a commercial harvest.

This is followed approximately 5-15 years later by a harvest which generally takes out most of the small to medium sized trees along with a few large trees. This second harvest is generally referred to as a *shelterwood harvest* will include some sawtimber, but many of the valuable trees will remain to continue producing seed and providing the partial shade most tree seedlings prefer. Once seedlings have fully established root systems and can compete with other trees (typically > 6 ft tall), the final step in the sequence is implemented by harvesting most of the remaining overstory trees. Referred to as an "*Overstory Removal*," this harvest turns site resources over to the new forest represented by the established seedling and saplings. During overstory removals it is a good idea to leave a few scattered mature trees to enhance wildlife habitat and aesthetics.

If a forest already has abundant established seedlings, also referred to as advanced regeneration, the pace of the shelterwood progression can be shortened or stages skipped. It can also be halted if seedlings establish slowly or plagued by deer browse. The actual shelterwood harvest should retain healthy dominant and codominant trees of favored species such that suitable seed continues to be deposited into the seedbed. It is very important to match the shelterwood sequence to the desired regenerating species and to take all recommended steps. For example, going straight to the 2nd stage of a shelterwood in an oak forest with no seedlings present will likely result in an abundance of black birch and red maple regeneration. Likewise, if the final stage does not occur and the forest floor remains partially shaded, the oak seedlings will eventually die out because of the lack of sunlight and shade tolerant species (birch and maple again) will overtop them. Some species like black cherry and tulip poplar grow much faster growing species than oak and sugar maple, so the regeneration process typically can proceed faster in stands where regenerating those species is the goal. The keys to a successful shelterwood process is patience, a consulting foresters that understands silviculture and low-grade wood markets, and potentially upfront investment followed by future returns during the final harvest.

The Appalachian Mountains Joint Venture produced 360-degree videos of different forest management practices including the three stages of the shelterwood sequence. Viewers can pan around the videos by clicking and dragging the mouse if viewing on a desktop or if using a mobile device moving your device in the direction you want to look just as if you were standing in the forest. A fast internet connection is necessary for good video quality. Links to the different videos are available for Midstory Removal, Shelterwood Harvest, and Overstory Removal

Hybrid Treatment Approach

Silvicultural treatments are usually intended to apply a single prescription to an entire forest stand or project area. However, sometimes forest variability within the stand or multiple landowner goals warrant multiple prescriptions. This can also be a necessary approach in forests

that were high-grade and a more flexible approach is necessary to restore good growing conditions.

For instance, given dual landowner goals of wildlife habitat and timber value, a forester may thin out red maple in one area to free up oak crop trees, do a group selection in another area to favor regeneration, and leave other pockets untouched where improvements are not needed. In high-graded stands, foresters need to focus on providing more growing space to the best quality trees remaining, which could alternate between seedlings and overstory trees throughout the high-graded area.

A hybrid treatment approach results in an "uneven" result although the outcome should always strive to improve conditions where possible. Decisions must be made on silviculture, not timber revenue, for this to be sustainable.

Forest Carbon Management

Trees play a vital role in helping slow the pace of climate change by reducing atmospheric levels of carbon dioxide (CO_2). Trees reduce carbon dioxide by removing it from the atmosphere through photosynthesis, storing some of the carbon as part of the tree. This process is referred to as carbon sequestration. Sequestered carbon is then stored in the tree until it dies or is harvested. Approximately one half of a tree's weight consists of stored carbon. Depending on the wood product a harvested tree is turned into, the carbon can be continued to be stored in that product for years or even decades.

There are three general strategies for increasing forest carbon: increasing or maintaining the amount of forestland, improved forest management that maintains or increases the amount of carbon in a forest, and substituting wood for energy intensive building materials. These strategies are considered Natural Climate Solutions. Combined with innovations in clean energy and other efforts to decarbonize the world's economies, natural climate solutions offer some of our best options in the response to climate change.

Landowners participating in FFCP agree to manage their forests in a way that increases forest carbon stocks and sequestration. To minimize emissions associated with timber harvesting, harvests should occur at sustainable levels of intensity and intervals. Through well-timed and well-managed harvests, forest carbon stocks can increase while also being balanced with other forest management goals. There are multiple forest management techniques that increase carbon storage or avoid greenhouse gas emissions. Almost any practice that increases forest growth and productivity also increases forest carbon sequestration. These include controlling competing vegetation, protecting seedlings from deer browsing, minimizing logging damage, and implementing silvicultural systems that promote growth of healthy trees.

Forest landowners should also create a balance of older and younger forests on their property as each play an important role in carbon management. Younger forests (less than 70 years old) maximize growth and therefore carbon sequestration rates, while older forests are very important for continuing to store the carbon that was sequestered. Both young and old forests are also very important for wildlife and overall biodiversity. Landowners should manage forests for carbon by

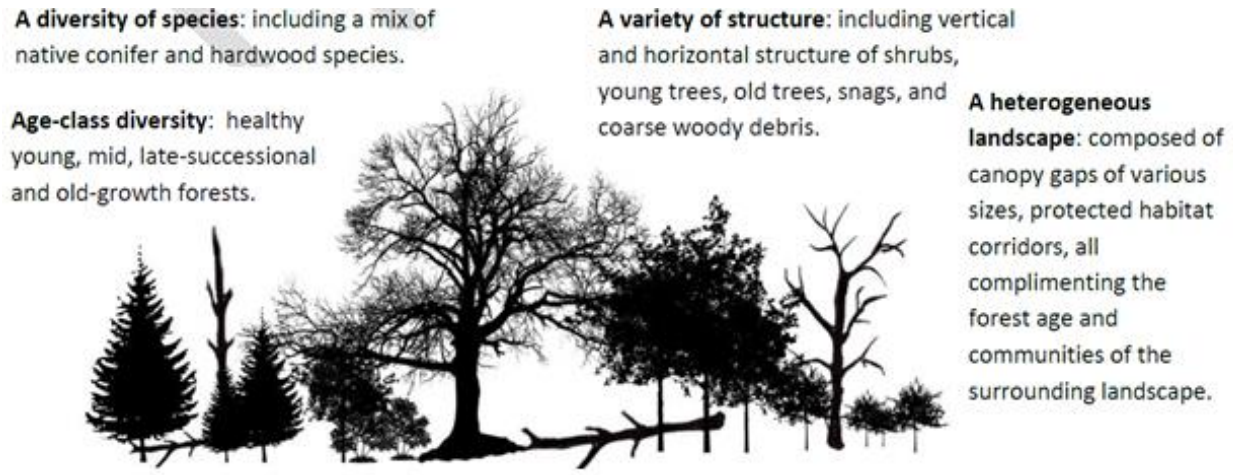
increasing both carbon sequestration and storage in ways that are compatible with management goals and priorities.

Forest Resilience

Forests are under increasing stress from a host of impacts such as invasive plants and pests, deer browsing, poor management practices, and climate change. With these increased stressors and complexities, it is essential to promote forests that are resilient to new and expanded threats. Forest management approaches that attempt to maintain and enhance forest resilience must work to increase four essential targets; 1) increase species diversity, 2) increase structural diversity, 3) increase age-class diversity, and 4) increase landscape-level diversity.

The primary opportunity for promoting species diversity is through developing and fostering forest regeneration by creating conditions suitable for a variety of plant species. Increasing structural diversity through forest management can be achieved by retaining some standing and fallen over dead trees, leaving treetops after a harvest, creating forest canopy gaps of various sizes, and creating young forest habitats.

Planning for a variety of age classes across the property requires essential long-term planning, including reserving portions of the forest to be managed for a healthy old-growth forests and identifying areas where younger forests will be featured. Increasing landscape-level diversity similarly requires long term planning to identify where and when management at the management unit level should occur. Landowners can also increase landscape-level diversity by identifying and conserving habitats on their properties that are not present in the surrounding areas. Examples could include wetlands, shrublands, or conifer forests.



A diagram of a resilient forest, demonstrating the four essential targets of managing for a resilient forest; 1) increased species diversity, 2) increased structural diversity, 3) increased age-class diversity, and 4) increased landscape-level diversity. Source: Bearer and Anderson (TNC).

Fire

Prescribed fire—often referred to as controlled burns—can be a valuable forest management tool for creating favorable conditions for regeneration of desirable species such as oak and pine, controlling competing vegetation, enhancing biological diversity, improving wildlife habitat, and a variety of other management objectives. Many of Pennsylvania's current oak forests were likely shaped by widespread fires in the early 1900's. Both mature and young oaks have adaptations that allow them to survive light-intensity surface fires that were prevalent in historic oak forests. The thick bark of a mature oak tree protects it from the flames, and young oaks have a well-established root system that allows them to sprout back rapidly following a fire.

Prescribed fire is increasingly being utilized in Pennsylvania as a forest management and wildlife habitat management tool. The following types of prescribed fires are implemented to meet certain silvicultural objectives.

Site Preparation Burn: This type of prescribed fire creates receptive seedbeds and prepares an oak stand for eventual oak seedling establishment after a future acorn crop. The objective is to reduce dense understory shade and the amount of leaves on the forest floor so that a larger proportion of an acorn crop successfully germinates and becomes seedlings. Burning can be done in the dormant season (fall or early spring) or growing season (late spring) and at any intensity. Occasionally, unwanted species such as hay-scented fern or invasive plants may flourish in the aftermath of a fire, especially where an elevated deer herd is drawn to the site to feed on the succulent regrowth and eliminate desired vegetation.

Release Burn: Prescribed fire can change species composition by freeing fire-tolerant species like oak from competing fire intolerant species such as birch and maple. Release burns typically occur from mid-April to mid-May where there are competitive oak seedlings and saplings. The fire will kill the top of an oak seedling, but the oak will sprout back aggressively following the fire because of the established root system. Intolerant species do not have an established root system and sprout minimally or not at all. Release burns can be particularly useful in combination with silvicultural treatments such as shelterwood systems.

Ecological Restoration: Certain vegetative communities are adapted to the presence of fire, such as barrens habitats, scrub oak and pitch pine. Many of these communities and the unique plants they contain are disappearing because of fire suppression. When burning to restore these communities, a prescribed burn is designed to consume much of the vegetation and stimulate sprouting, seed germination, and recycling of nutrients to reestablish a new plant community adapted to the presence of fire. This can have benefits in maintaining critical habitats necessary for plants and animals adapted to these ecosystems.

More information on the ecological benefits of prescribed burning is available from the U.S. Forest Service. Another benefit of prescribed fire not related to silviculture or ecological management is the removal of fuel build-up and de creased risk of more catastrophic fires during severe droughts or excessive winds when control is very difficult. By maintaining firebreaks and burning excessive fuel buildup in blocks within the landscape, wildland firefighting has better options to attack wildfires when they do occur.

Natural Resources Management

Soils

The soils underneath the forest strongly influence the vegetation above it. Tree species, health, and height can all be influenced by soils quality. Soil structure also can impact tree windthrow potential, suitability for heavy equipment use, and soil erosion. Landowners and land managers can learn more about the types and features of their property's soils from the Web Soil Survey

The best way to protect forest soils is to keep heavy equipment (skidders, tractors, skid-steers) off them when they are wet. Operating heavy equipment on saturated soils causes soil compaction and ruts, destroys groundcover, and leads to erosion and sedimentation problems. Compacted soils contain less air and water for roots, which severely slows tree growth and can even cause tree mortality. Check soil wetness before any equipment use. If the soils appear soft, use equipment only when necessary. In general, do not use equipment during the spring when the ground is thawing. Instead, wait until the summer or winter when the ground is dry or frozen. Additionally, minimize equipment use during late March and April's freeze-thaw cycle, as significant soil damage can occur during this period.

Erosion is a major threat to water quality and causes a loss of soil. Any new ground disturbance related to forest management, such as skid trails and log landings, will need to follow the guidelines outlined in Pennsylvania's Erosion and Sedimentation Plan for Timber harvesting.

Water and Fisheries Conservation

Pennsylvania has more than 86,000 miles of rivers and streams, making protection of water resources is a critical component of forest management planning in the state. Water sources typically found within forestland include *intermittent* (not flowing continuously throughout the year and perennial (continuous flow) streams, wetlands, spring seeps, and vernal pools. Vernal pools, also called ephemeral pools, are important habitats for amphibians because they are wet at only portions of the year and therefore lack fish. When planning forest management activities, it is crucial to identify, mark, and buffer any water resources.

Special attention to water resources is essential during forestry activities, especially when heavy equipment and earth moving are involved. Soil can enter streams through erosion and travel for miles. When sediment, pollutants, and certain nutrients enter the water they can adversely affect

fish habitat, stream vegetation, and human uses far downstream. Water sources must be protected during forest management activities by implementing the guidelines outlined in Pennsylvania's Erosion and Sedimentation Plan for Timber harvesting. When applying herbicides near water, use only those that are approved for aquatic use based on the chemical's label. Use selective application methods that minimize spray drift into water sources.

Vegetation adjacent to streams is important for stabilizing the streambank and reducing erosion, and the shade from streamside trees is important for keeping water temperatures cool. Where trees are absent from streambanks, planting a "Riparian Forest Buffer" is a great way to improve water quality while also creating wildlife habitat. Riparian forests act as filters for the sediments and pollutants from farm fields, residential lawns, and roadways to help keep them from reaching the water. The state of Pennsylvania has a goal of planting 95,000 acres of riparian forest buffers by 2025. More information on Pennsylvania's goals is available through the Department of Conservation and Natural Resources (DCNR). Resources include a description of riparian buffers and their importance a description of riparian buffers and their importance (PDF) as well as funding opportunities for planting buffers (PDF). The Penn State Center for Private Forests also has a website dedicated to riparian buffers for private lands. Landowners should also contact their local DCNR Service Forester or Conservation District for more information.

Wetlands

Wetlands are one of Pennsylvania's most important habitats. Wetlands store and slowly release floodwaters, improve water quality by filtering pollutants and sediment, and provide habitat for many wildlife species. Wetlands have at least one of three characteristics:

- The presence of water at or near the surface for a portion of the year,
- Plants that are adapted to wet conditions, and
- Soils that result from wet conditions

Many wetlands dry up at certain times of the year, so plant and soil characteristics typically the best indicators of a wetland site. Before conducting forest management activities, evaluate the project area and mark any areas that may be considered a wetland. Extra care must be taken when conducting forestry operations around wetlands because of their vulnerability to soil compaction and erosion and disturbance of their water systems. Management should be done with regard to season, soil type, soil moisture, and type of equipment used.

Pennsylvania's wetlands are regulated at the Federal, State and, in some cases, municipal levels. Best Management Practices for Wetlands are available from Penn State Extension. The National Wetlands Inventory (NWI) is a database of known wetlands that is accompanied by the NWI mapping tool available through the U.S. Fish and Wildlife Service.

Wildlife Habitat

The key to wildlife management is habitat diversity. Each wildlife species has different food and cover needs. To maximize wildlife diversity on the property, an assortment of habitats must be available. The property already contains a diverse mix of forest types and sizes, and following the recommendations described in this plan will enhance habitat diversity.

There are general habitat management techniques that will benefit a wide array of wildlife species. A good overview of these techniques is provided by Penn State Extension's Wildlife and Forest Stewardship document. In addition to these general recommendations, more targeted management can occur to benefit specific species of conservation concern such as those outlined in the Pennsylvania Wildlife Action Plan.

The Pennsylvania Wildlife Action Plan Conservation Opportunity Area Tool was utilized for the property to assist with the prioritization of conservation activities. This is a spatial analysis tool that is linked to the 2015 – 2025 Pennsylvania Wildlife Action Plan. The tool supports conservation planning and guides conservation actions in accordance with the goals, objectives, strategies and conservation actions of the Pennsylvania Wildlife Action Plan.

Regional Wildlife Diversity Biologists with the Pennsylvania Game Commission are available to assist with conservation planning through the Private Landowner Assistance Program and funding for these conservation actions may be available through the Voluntary Public Access and Habitat Incentives Program for properties open to public hunting. Audubon Pennsylvania offers information through their Forestry for the Birds program including a Guide to 18 Priority Bird Species (PDF) and Habitat Assessment Guide (PDF).

Special Sites

Biological Diversity

Biological diversity, also referred to as biodiversity, refers to the richness or variety of animal, plant, and other life in a given area. It is useful to think of biodiversity on three interconnected levels:

- Genetic diversity--each individual organism is unique, even among their own species. A diverse gene pool increases a species' ability to adapt to changing environmental conditions.
- Species diversity--the variety of different species.
- Ecosystem diversity--the variety of physical environments and biotic communities over a landscape.

One strategy for protecting biodiversity is providing and protecting a variety of habitat types, especially those that are rare. Many of these unique habitat types have been identified by the Pennsylvania Natural Heritage Program along with information on rare species. These areas, along with other natural resource information, are mapped in the Conservation Explorer online tool and described in the various Natural Heritage Inventories by county.

Many of the forest management recommendations outlined in this plan also promote biodiversity. These include controlling invasive plants, managing deer browsing pressure, conducting sustainable timber harvests, and promoting forest resilience. More recommendations for enhancing forest biodiversity are available through Penn State Extension.

Rare, Threatened, and Endangered Species

Sustainable forest management activities can benefit multiple wildlife species, but it is important to consider those that may be negatively impacted, especially rare or at-risk species. The Pennsylvania Natural Diversity Index (PNDI) lists known locations for threatened, endangered or rare plants, animals, natural communities, and geologic features throughout Pennsylvania. The PNDI search is an online environmental review where one can find out if any of these are located on or near a property. Landowners and land managers can see if there are likely threatened or endangered species plus species of concern on their property by selecting the various checkboxes under the “Environmental Review” section of the Conservation Explorer online tool. Note that this will likely just show if a species is likely to be present but not what particular species it is. The full list of species that can be filtered by county or watershed is available online, along with factsheets for many of the species. Fact sheets for most of Pennsylvania’s threatened and endangered birds and mammals are available from the Pennsylvania Game Commission.

Forests of Recognized Importance

Forests of Recognized Importance (FORI) are defined by the American Tree Farm System as "globally, regionally and nationally significant large landscape areas of exceptional ecological, social, cultural or biological values." FORIs occur at the landscape level, not the individual management unit or parcel level. FORIs may include but are not limited to landscapes with exceptionally high concentrations of one or more of the following:

- protected, rare, sensitive or representative forest ecosystems such as riparian areas and wetlands
- areas containing critical habitats of multiple threatened or endangered plant and animal species
- recognized large - scale cultural or archeological sites including sites of human habitation, cities, burial grounds and artifacts
- areas containing identified and protected water resources upon which large metropolitan populations are dependent
- areas containing identified unique or geologic features including geysers, waterfalls, lava beds, caves or craters

Landowners can use various online tools such as the Conservation Opportunity Area Tool, Conservation Explorer, and Cultural Resources Geographic Information System to help determine if their property is within a significant landscape.

Most FORIs in the U.S. that are globally, nationally or regionally significant have already been identified and protected by state or federal government or have been put under a conservation easement by an environmental nonprofit organization. Therefore, landowners are more likely to be near a Forest of Recognized Importance than to have one. Landowners that are within or near a FORI should be mindful of the landscape-level goals and issues when managing their own land. This could include creating habitat for wildlife species of concern or placing buffers around historical features.

Archeological, Cultural, and Historic Sites

The Pennsylvania State Historic Preservation Office (SHPO) administers the state's historic preservation program. The presence of the most significant cultural and historic sites can be determined by using the Pennsylvania Cultural Resources Geographic Information System (CRGIS).

Most properties have pieces of the past still evident today. This can include old barbed wire fences or stonewalls, building foundations, railroad grades, and charcoal hearths. Landowners should take note of these old features as the history of the property greatly influences the current conditions.

Other Stewardship Considerations

Recreation

Most landowners use their property for various types of outdoor recreation such as hiking, hunting, birdwatching, and camping. For many landowners, their property becomes an area to escape the busyness of life and to reconnect with nature. Landowners should ensure that their consulting forester is aware of the various types of recreation conducted on the property so that the quality of these experiences can be maintained or enhanced through forest management.

Agroforestry and Range

Agroforestry is the intentional integration of trees and shrubs into crop and animal farming systems to enhance productivity. The four key characteristics of Agroforestry are intentional, intensive, interactive, and integrated. Agroforestry is not common in Pennsylvania, but it can be very useful to both farmers and forest owners. More information is available from the National Agroforestry Center or the Association for Temperate Agroforestry at Association for Temperate Agroforestry.

There are five common agroforestry systems in temperate climates.

1. Alley Cropping: growing crops between rows of trees
2. Silvopasture: grazing animals among trees planted on improved pastures
3. Wind Breaks: planting rows of trees to reduce wind
4. Riparian Forest Buffer: planting trees near streams and lakes to reduce soil erosion
5. Forest Farming: growing specialty crops like mushrooms or ginseng in the woods

Range is open land that is used for grazing animals and may include open forests with widely spaced trees that still provide enough grass for grazing animals. Range is not a common land use in Pennsylvania nor is it recommended because cows, sheep and goats may damage roots and limit regeneration of desired tree species. The exception would be using goats or other animals to control non-native invasive plants.

Aesthetics

Aesthetics is an important consideration because most landowners are concerned about the appearance of their property and public opinion of forest management activities is often driven by appearance. Forest management should promote a healthy and visually pleasing forest. Some forest management activities, especially recent timber harvests, can be visually unappealing for

both the landowner and neighbors. Through good management, disturbances can be minimized and temporary as forest growth responds positively to good silviculture.

There are several ways landowners and land managers can enhance aesthetics during forest management. These include the use of forested buffers, residual tree retention, and maintenance of additional forest buffers around ridgetops or other prominent features. More options are available from A Guide to Logging Aesthetics. During timber harvests, a lot of attention is drawn to the log landing where the cut trees are stacked and loaded onto trucks because this is usually the largest cleared area. However, this also presents an opportunity to plant wildflowers for both aesthetics and pollinator habitat or a wildlife food plot after the harvest.

Forest Economics

The costs of land ownership and management can be problematic for many forest landowners. Many landowners look for opportunities to reduce the costs of land ownership and generate revenue from their properties.

Sources of Revenue

There are many ways a landowner could generate revenue from their forestland. Conducting timber harvests is the most common approach. Landowners are also increasingly looking at monetizing non-timber forest products such as mushrooms, ginseng, and maple syrup. Another option is leasing the property's hunting rights.

Through the carbon programs such as the Family Forest Carbon Program (FFCP), landowners can generate revenue by managing their forests in a sustainable manner that also increases the amount of stored carbon. Many companies will pay for the "carbon credits" generated from the FFCP and other carbon programs and use those to help meet voluntary or regulatory environmental goals. In the future there may be additional markets for other forest management co-benefits such as clean water or improved wildlife habitat.

Taxes

Profits from timber sales are taxed as capital gains, rather than ordinary income, if the landowner owns the timber for more than twelve months. Expenses, including the cost of a management plan or a consulting forester's fees for a timber sale, can be deducted from profits. There are many great tax related resources available on www.TimberTax.org, including the most recent edition of the annual "Tax Tips for Forest Landowners."

Donating conservation easement is one way for landowners to lower their tax burden through income tax deductions. Placing an easement on the property could possibly also result in property tax savings. Another consideration for reducing property taxes is Pennsylvania's Clean and Green Program. Landowners should consult with a financial advisor and/or attorney understand the tax implications of an easement for their particular situation.

Financial Assistance

The cost of sustainable forest management can be expensive as the cost of competing vegetation control, deer fencing, and non-commercial forest stand improvement can cost hundreds of dollars per acre. Fortunately, there are opportunities for landowners to receive money to help offset these costs.

The USDA Natural Resources Conservation Service (NRCS) provides money and advice to forest landowners to fix "resource concerns" with "conservation practices." Resource Concerns are environmental problems noted on a property such as water degradation, soil erosion, plant health, plant productivity, degraded fish or wildlife habitat and invasive plants. Forestry based Conservation Practices in Pennsylvania typically include installing erosion control measures, controlling competing vegetation, improving wildlife habitat, installing deer exclosures, and planting trees. Landowners interested obtaining NRCS financial assistance should contact their local NRCS Service Center and complete the necessary eligibility forms. If funding is available, NRCS will offer a landowner a contract that specifies the Conservation Practices to implement and the corresponding the financial assistance payments.

State Agencies such as the Pennsylvania Game Commission (PGC) and Department of Conservation and Natural Resources (DCNR) occasionally offer financial assistance as well for various programs. Landowners should talk to their local PGC Diversity Biologists and DCNR Service Foresters (PDF) to see if financial assistance programs are currently available.

Financial assistance is never guaranteed, and the amount of funding available from both NRCS and state agencies changes annually. NRCS utilizes a "ranking" system to determine which landowners have the greatest resource concerns and warrant financial assistance. Landowners may receive financial assistance immediately or may have to wait multiple years depending on the amount of available funding and the number of eligible landowners.

Legacy and Estate Planning

"*Stewardship challenges us to look beyond our immediate personal needs so we can leave a lasting forest legacy for future generations*"

Most forest landowners would like to pass their woods to their children or other heirs. At least 80% of Pennsylvania forest landowners intend to leave their forestland as a legacy to the next generation, but only 40% of discussed a legacy plan and fewer still have a plan in place. Transferring land from one generation to another is challenging and complex with many legal and family issues to discuss and resolve.

Forests are most at risk of poor forest management when land transfer takes place. Landowners may feel forced into developing, subdividing, or selling the land to pay large state taxes. Landowners often harvest timber to help pay estate taxes, but many times these unplanned harvests are high-grades that maximize revenue but degrade forest and wildlife habitat quality.

Landowners should seek legal advice regarding wills, trusts and other estate planning mechanisms to transfer land. Parents should talk with their children to communicate their desires for their land while there is still time. A great starting resource is the Penn State Center for Private Forests' Legacy Planning website

Conservation easements are a tool to help landowners ensure that their forest management goals are carried into future generations. Conservation easements are voluntary agreements by landowners to give up certain rights like parcelization, land use change or development. More information on conservation easements is available from Western Pennsylvania Conservancy. Landowners interested in a conservation easement should contact their local land trust. A map of land trusts is available online at www.findalandtrust.org.

Technical Assistance

Landowners are strongly encouraged to work with various natural resource professionals to implement the recommendations in this plan. A consulting forester is an essential resource when conducting a timber harvest and can assist with non-commercial activities as well. Currently anyone can legally claim to be a consulting forester in Pennsylvania regardless of training, certifications, or experience. Additionally, unsustainable timber harvests are still very common in Pennsylvania. As such it is important for landowners to thoroughly research which consulting forester best is best suited for meeting their needs and management goals. The Pennsylvania Forestry Association offers some advice on selecting a forester to help manage your forest. The Department of Conservation and Natural Resources has Service Foresters available that can conduct site visits and provide forest management guidance for free. Regional Wildlife Diversity Biologists with the PA Game Commission are available to help landowners enhance wildlife habitat. The Penn State Center for Private Forests and Penn State Extension are both great resources for guidance on multiple topics from legacy planning to wildlife management to herbicide applications. The PA Forests Web Seminar Center has recorded webinars on a wide range of topics relevant to good forest stewardship. The Center for Private Forests can also be reached by calling 1-800-235-9473.

Connecting with other Landowners

One of the best ways to learn about forest stewardship is by talking to landowners already practicing it. There are many experienced forest stewards that are happy to share their personal successes, challenges, and discoveries of forest management. Connecting with other landowners is also a great way to receive and provide honest reviews of consulting foresters, financial assistance programs, and other opportunities or decisions that landowners are presented with. There are multiple Woodland Owners Associations across Pennsylvania which provide educational opportunities for members. Most use meetings, field demonstrations, tours, seminars, and newsletters to provide information about forests and sound forest management to their members and people in the local communities. Every two years there is a Forest Landowners Conference that focuses on the conservation and management of healthy forests

with the intent of bringing together people who want to demonstrate a commitment to forest sustainability.

Talk to your neighbors about their forest management goals and plans and look for opportunities to coordinate planned activities. This can be especially useful for smaller landowners who may have limited opportunities because of property size. Timber harvests, especially sustainable ones like a shelterwood, usually require a minimum acreage to be feasible. By working together, neighbors may be able to attract more interest and better prices for their timber by collaborating to create a larger timber sale. If wildlife is a goal, neighbors can work together to see which types of habitat their individual properties provide and how the various needs of wildlife can be met by across multiple properties. For deer hunters, one option may be working with neighbors to form a Quality Deer Management co-op.

Monitoring

Successful forest stewardship requires frequent monitoring to identify current conditions of the forest. Landowners, or their forester, should walk their entire forest at least annually to inspect the forest for changes and to evaluate the success of earlier management activities. Monitoring for forest health issues should occur more frequently, at least two or three times a year to look for signs and symptoms of insects or disease during different seasons. Timber harvest operations should be monitored by the landowner and/or forester weekly as negative impacts can occur in a matter of days if improperly implemented.

Incorporating monitoring results into forest management decisions is critical for ensuring that activities are advancing the forest management goals in the most effective way. All forest management plans should also be adaptable and flexible enough to accommodate changes in landowner goals or forest resources over a ten to twenty-year planning period. Amendments to the plan can be due to changing conditions like a forest pest outbreak or changes to landowner goal.

Forest Stewardship Monitoring Forms

Record of Forest Management Activities						
Unit	**Acres**	**Activity Description**	**Dates**		**Cost**	**Profit**
			Planned	**Completed**		

Amendments to the Forest Management Plan			
Date	Unit(s)	Amendment to Plan	Reason for Amendment

Appendix

Glossary of Forestry Terms

Acceptable Growing Stock: Saleable trees that are of good form, species and quality and would be satisfactory as crop trees. .

Adaptive management: A dynamic approach to forest management in which the effects of treatments and decisions are continually monitored and used to modify management on a continuing basis to ensure that objectives are being met (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Aerial Photo: Photo taken from an elevated position like on an aircraft.

Afforestation: the establishment of a forest or a stand in an area where the preceding vegetation or land was not forest. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Age Class: A distinct aggregation of tree that originated at the same time, from a single natural event or regeneration activity or a grouping of trees (e.g. ten year age class) as used in inventory or management. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Aspect: The direction that a slope faces (north, south, etc.)

Basal Area: The cross-sectional area of a tree, in square feet, at 4.5 feet from the ground (at breast height). When the basal area of all the trees in a stand are added together, the result is expressed as square feet of basal area per acre, which is a measure of a stand's density.

Canopy: The more or less continuous cover of branches and foliage formed collectively by the tops, or crowns of adjacent trees.

Clearcut: 1. a stand in which essentially all trees have been removed in one operation – *note* depending on management objectives, a clearcut may or may not have reserve trees left to attain goals other than regeneration. 2. a regeneration or harvest method that removes essentially all trees in a stand. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Crop Tree: A tree identified to be grown to maturity for the final harvest cut, usually on the basis of its location with respect to other trees and its timber quality.

Desired species: Those species of flora and fauna designated in the landowner's management plan and not known to cause negative impacts on the local environment.

Diameter Breast Height (DBH): The diameter of a tree at 4.5 feet above the ground.

Even-Aged Management: Forest management with periodic harvest of all trees on part of the forest at one time or over a short period to produce stands containing trees all the same or nearly the same age or size.

Forest product: [Forest Produce] Any raw material yielded by a forest. Generally defined in Forest Acts or Ordinances, and subdivided conventionally into major forest products, i.e. timber and fuelwood, and minor forest products, i.e. all other products including leaves, fruit, grass, fungi, resins, gums, animal parts, water, soil, gravel, stone and other minerals on forest land (F. C. Ford –Robertson, Terminology of Forest Science Technology, Practice, and Products, Society of American Foresters, 1971.

Forest Stand Improvement: See timber stand improvement.

Forest type: A category of forest usually defined by it trees, particularly its dominant tree species as based on percentage cover of trees, e.g. red oak – mixed hardwoods, white pine – mixed hardwoods.

Girdling: Completely encircling the trunk of a tree with a cut that severs the bark and cambium of the tree. Herbicide is sometimes injected into the cut to ensure death of the tree.

Hack-n-squirt: A tree treatment method where an axe or hatchet is used to make "hacks" (injections) into the tree's cambium layer. A plastic "squirt" bottle is used to spray a specific amount of herbicide into the cuts placed around the tree.

Harvesting: the felling skidding, on-site processing, and loading of trees or logs onto trucks. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

High-grading: Cutting only the high-value trees from a forest property, leaving a stand of poor quality with decreased future timber productivity.

Assistance Programs: State and federal agencies will offer landowners the opportunity to apply for assistance programs that provide technical support and financial assistance to implement forestry and agroforestry related practices through conservation programs.

Assistance can also be provided for multi-year and permanent easements to conserve forest land to meet program goals. For more information on the federal programs, see Appendix 4.

I**nvasive Species**: is a species that is 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Invasive species can be plants, animals, and other organisms (e.g., insects, microbes, etc.). Human actions are the primary means of invasive species introductions. (Invasive Species Definition Clarification and Guidance White Paper Submitted by the Definitions Subcommittee of the Invasive Species Advisory Committee (ISAC), Approved by ISAC Apr 27, 2006.)

Mast: Nuts of trees, such as oak, walnut, and hickory, that serve as food for many species of wildlife.

Midstory: The layer of vegetation existing between the smallest (*understory*) and tallest (*overstory*) trees in a forest.

Overstocked: A forest stand condition where too many trees are present for optimum tree growth.

Overstory: That portion of the trees in a stand forming the upper crown cover.

Overstory removal: the cutting of trees constituting an upper canopy layer to release trees or other vegetation in an understory. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Pesticide: Pesticides include chemicals commonly known as herbicides and insecticides.

Pole Timber: Trees from 6 inches to 12 inches in diameter at breast height.

Prescribed Burn/Fire: To deliberately burn natural fuels under specific weather conditions, which allows the fire to be confined to a predetermined area and produces the fire intensity to meet predetermined objectives. A fire ignited by management to meet specific objectives (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998).

Pulpwood: Wood cut primarily for manufacture of paper, fiberboard, or other wood fiber products.

Qualified natural resource professional: A person who by training and experience can make forest management recommendations. Examples include foresters, soil scientists, hydrologists, forest engineers, forest ecologists, fishery and wildlife biologists or technically trained specialists in such fields.

Reforestation: the reestablishment of forest cover either naturally (by natural seeding, coppice, or root suckers) or artificially (by direct seeding or planting) – *note* reforestation usually maintains the same forest type and is done promptly after the previous stand or forest was removed. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Regeneration: The number of seedlings or saplings existing in a stand. The process by which a forest is renewed by direct seeding, planting, or naturally by self-sown seeds and sprouts.

Regeneration Cut: Any removal of trees intended to assist regeneration already present or to make regeneration possible.

Release: To free trees from competition by cutting, removing, or killing nearby vegetation.

Riparian: related to, living or located in conjunction with a wetland, on the bank of a river or stream but also at the edge of a lake or tidewater – *note* the riparian community significantly influences and is significantly influenced by, the neighboring body of water. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Riparian Zone: The area adjacent to or on the bank of rivers and streams.

Sapling: Trees from 2 inches to 6 inches in diameter at breast height.

Sawtimber: Trees at least 12 inches in diameter at breast height from which a sawed product can be produced.

Seedling: a young plant.

Seed-tree Harvest: A harvest and regeneration method where nearly all trees are removed at one time except for scattered trees to provide seed for a new forest.

Selection Harvest: Harvesting trees to regenerate and maintain a multi-aged structure by removing some trees in all size classes either singly or in small groups.

Shelterwood Harvest: A harvesting and regeneration method that entails a series of partial cuttings over a period of years in the mature stand. Early cuttings improve the vigor and seed production of the remaining trees. The trees that are retained produce seed and also shelter the young seedlings. Subsequent cuttings harvest shelterwood trees and allow the regeneration to develop as an even-aged stand.

Single Tree Selection: Individual trees of all size classes are removed more or less uniformly throughout the stand, to promote growth of remaining trees and to provide space for regeneration. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Site Index: An expression of forest site quality based on the height of a free-growing dominant or co-dominant tree at age 50 (or age 100 in the western United States).

Skid Trail: A road or trail over which equipment or horses drag logs from the stump to a landing.

Slash: the residue, e.g., treetops and branches, left on the ground after logging or accumulating as a result of storm, fire, girdling, or delimbing. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Snag: a standing, generally un-merchantable dead tree from which the leaves and most of the branches have fallen – *note* for wildlife habitat purposes, a snag is sometimes regarded as being at least 10 inches in diameter at breast height and at least 6 feet tall; a hard snag is composed primarily of sound wood, generally merchantable, and a soft snag is composed primarily of wood in advanced stages of decay and deterioration. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Soil Compaction: The process by which the soil grains are rearranged, resulting in a decrease in void space and increasing bulk density. Can occur from applied loads, vibration or pressure from harvesting or site preparation equipment. Compaction can cause decreased tree growth, increased water runoff and soil erosion. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Soil map: A map showing the distribution of soils or other soil map units in relation to prominent physical and cultural features of the earth's surface. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Stand: A group of trees with similar characteristics, such as species, age, or condition that can be distinguished from adjacent groups. In this management plan, a Stand is synonymous with a Management Unit.

Stand Density: A measure of the stocking of a stand of trees based on the number of trees per area and diameter at breast height of the tree of average basal area.

Stand Management Recommendations: The recommended management activities that should be done in that stand, based on the landowner's goals and objectives.

Stand Structure: The horizontal and vertical distribution of plants in the forest, including the height, diameter, crown layers, and stems of trees, shrubs, understory plants, snags and down woody debris. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

State forestry best management practice(s) (BMPs): Forestry BMPs are generally accepted forest management guidelines that have been developed by state forestry agencies with broad public stakeholder input.

Stocking: An indication of the number of trees in a stand in relation to the desirable number of trees for best growth and management.

Sustainability: The capacity of forests, ranging from stands to ecoregions, to maintain their health, productivity, diversity and overall integrity, in the long run, in the context of human activity (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998).

Sustainable forest management: The practice of meeting the forest resource needs and values of the present without compromising the similar capability of future generations (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998). *Note* – AFF's Standards of Sustainability reflect criteria of sustainability based on the Montreal Process, 1993, and the Pan-European Operational- Level Guidelines (PEOLGs).

Thinning: a cultural treatment made to reduce stand density of trees primarily to improve growth, enhance forest health, or recover potential mortality. Types of thinning include: chemical, crown, free, low, mechanical, selection. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Timber Stand Improvement (TSI): A thinning made in immature stands to improve the composition, structure, condition, health, and growth of the remaining trees.

Undesirable Growing Stock: Trees of low quality or less valuable species that should be removed in a thinning.

Understocked: Insufficiently stocked with trees.

Understory: all forest vegetation growing under an overstory. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Uneven-Aged Management or Stand: A stand of trees containing at least three age classes intermingled on the same area.

Volume: The amount of wood in a tree, stand of trees, or log according to some unit of measurement, such as board foot, cubic foot, etc.

Watershed: the area of land where all of the water that is under it or drains off of it goes into the same place. For example the Mississippi River watershed includes all the land that drains into the Mississippi River. This watershed is the fourth largest in the world and includes water from 31 states.

Wetland: A transitional area between water and land that is inundated for periods long enough to produce wet soil and support plants adapted to that environment. (Helms et al, The Dictionary of Forestry, Society of American Foresters, 1998)

Wolf Tree: A very large, overmature tree that is or was open grown. These trees tend to have large full crowns and numerous branches.