

Best Management Practices

for Pennsylvania Forests

**Promoting forest stewardship
through education, cooperation,
and voluntary action**



PENNSTATE



College of
Agricultural Sciences

Prepared by the Best Management Practices task force, under the auspices of the Forest Issues Working Group, Shelby E. Chunko, editor

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Foreword

Forest Issues Working Group

The Forest Issues Working Group (FIWG) provides a forum where a diverse group of professional natural resource managers, forest landowners, scientists, environmental organizations, and other citizens concerned about Pennsylvania's forests can exchange views, concerns, and information with the objective of promoting better understanding and cooperation on key forestry issues. It was formed in 1991 as a joint effort of the Penn State School of Forest Resources, the Pennsylvania Hardwoods Development Council, and Maurice Forrester of the Susquehanna Economic Development Authority—Council of Governments.

The Best Management Practices (BMPs) project grew out of discussions held at a 1993 meeting of the FIWG, during which the group identified the need to establish and publish minimal acceptable forest management guidelines that could be used and applied by landowners, loggers, foresters, and other natural resource professionals throughout Pennsylvania. They agreed that a broadly representative task force should be created to draft and seek consensus on a set of BMPs. This publication is the result of that process.

Members of the FIWG have made significant contributions, some serving on the task force, others reviewing drafts of this publication. Consistent with its approach to other issues, however, the FIWG as a body has not taken a position on the details of this publication, and continued support for these BMPs and any subsequent revisions will depend on the actions of individual members.

Those who have participated in compiling this publication hope its contents serve as a useful "educator," "thought stimulator," and "refresher course" for all who are directly responsible for and care about the future of Pennsylvania's forests. The publication and the discussions of BMPs are designed to stimulate the readers to consider carefully the effects of planned activities on the future of forest resources. Compilers have tried to include enough information on each subject area to make the various aspects of BMPs implementation easy to understand, regardless of background or professional expertise of readers.

Best Management Practices: need and objectives

BMPs for silvicultural activities in forested wetlands and for controlling erosion and sedimentation from timber harvesting operations already have been established for Pennsylvania forests. (See references, pages 26 and 28.) The BMPs outlined in this publication are designed to supplement existing BMPs to benefit a wider array of forest resources and values. They reflect what we know today about using forest resources wisely and well.

Many of the trees on Pennsylvania's forested acres are now of *sawtimber* size (see Glossary of Forest Terms), and demand for our hardwood species has never been higher. The potential for an accelerated level of harvesting

activity in Pennsylvania forests is high. Timber harvesting and other forest management activities have both short- and long-term effects on the entire forest ecosystem. Therefore, it is imperative that we employ BMPs in all aspects of forest management activities so that those effects are positive. *Sustainable forestry* requires that we think and act in the “long term” rather than only in the “short run.” Planning for the long term is not always easy for people to do, but if we don’t, we run the risk of reducing the value and future availability of our forest resources.

BMPs must remain flexible over time, to accommodate changes in the social, economic, and environmental contexts of forest resource use; our education in this area must be ongoing. Through reading and applying the information compiled here, you will be reminded of how proper management and silvicultural practices can help us reap continuous economic benefits from the forest while still maintaining or improving wildlife habitat, protecting forest soils and waters, and ensuring the continuation of productive forest ecosystems.

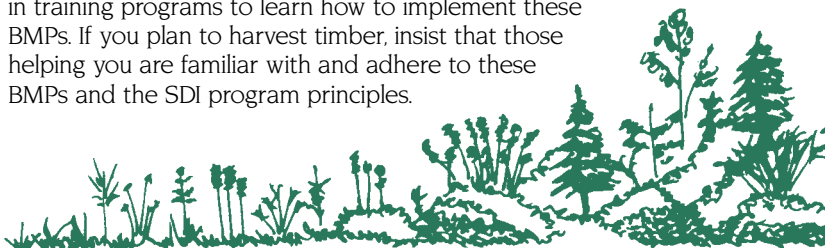
Implementation: voluntary or mandatory

Which approach to implementing BMPs—voluntary or mandatory—will better ensure the future health and productivity of Pennsylvania forests? This publication is written under the assumption that voluntary compliance, reinforced with education, will serve all of us better in the long run, both economically and socially.

Ethics are fundamental to voluntary compliance. The stewardship ethic implies that we who own or work in our forest lands have a moral obligation to leave them in better condition than we found them. In practical terms, voluntary compliance in implementing BMPs can help avoid the establishment of additional regulatory statutes, many of which can be burdensome, time consuming, costly, and not necessarily conducive to long-term forest health and productivity.

BMPs and the Sustainable Forestry InitiativeSM of Pennsylvania

The Sustainable Forestry Initiative (SFI) is an industry-sponsored and supported program with a mission of implementing sustainable forestry practices nationwide. The SFI of Pennsylvania is interested in ensuring that these practices occur on every timber harvest conducted in the state. Therefore, they have embraced the BMPs described in this publication as upholding the principles and objectives of their program. SFI encourages timber harvesters and foresters in Pennsylvania to participate in training programs to learn how to implement these BMPs. If you plan to harvest timber, insist that those helping you are familiar with and adhere to these BMPs and the SDI program principles.



How to use this book

Best Management Practices for Pennsylvania Forests is a nontechnical guide to forest resource management intended for use by natural resource professionals and lay persons alike. All words and terms that may not be familiar to the reader are *italicized* the first time they appear and are defined in the glossary of forest terms at the end of this book.

The first two sections of the book, Introduction and Forest Management Basics, provide a brief overview of Pennsylvania forests—their history and importance, as well as basic information about forest ecology, silvicultural practices, and forest health. Regardless of the extent of your background in forest resource management, you will find it useful to read or review these two sections.

The third section, Best Management Practices, is the “meat” of the book. The Best Management Practices (BMPs) section provides guidelines for pursuing various components of forest resource management—including planning, forest renewal and tending, and protecting nontimber forest resources, such as aesthetics and wildlife habitat. (Regional BMPs may also be available. Check with the Department of Conservation and Natural Resources, Bureau of Forestry.) Each forest resource management component includes an objective, the primary issue upon which the BMPs are based, considerations and concerns regarding the management component, and a checklist of BMPs that address those considerations and concerns. The checklist is provided in general terms. If needed, the reader can get more detailed information and specific parameters from the publications listed at the end of each management component, under “For Additional Information.”

Relevant laws and regulations are referenced as applicable throughout the text and detailed in the fourth section, Regulations Affecting Forest Management.

Introduction

Pennsylvania's forests: importance, history, and description

Nearly 60 percent of the 28 million acres within Pennsylvania borders is covered with forests. Forests provide benefits we simply cannot live without. These benefits can be grouped into three categories: economic, environmental, and aesthetic.

Economic: Nearly 30 percent of Pennsylvania's economy is based on the forest. Our state's forest products are in demand worldwide. More than 100,000 people are employed in our \$4.5 billion forest products industry, the fourth largest industry in the state. Each year, we produce more than one billion *board feet* of hardwood lumber and use approximately three-quarters of a million *cords* of *pulpwood* to produce paper and building board products. Approximately 20 percent of our private households supplement their winter heating with 250,000 cords of firewood—higher wood fuel usage than in any other state. Our forests are home to abundant populations of nongame and game animals. Wildlife watchers willingly spend money to feed, house, and otherwise care for the animals that dwell in or near the forest. Fishing and hunting licenses add more than \$25 million to Pennsylvania's average annual state revenue. Other forms of recreation and tourism add to the high economic contribution from our forests.

Environmental: Forests protect soils from erosion, provide high-quality water (Pennsylvania has 25,000 miles of forested waterways), and improve air quality. (For every ton of new wood that grows, about 1.47 tons of carbon dioxide are removed from the air, and 1.07 tons of life-giving oxygen are produced.) The diversity of plants and animals that inhabit our forest lands across the state represent a wealth of cultural, medicinal, and environmental resources that we are just beginning to discover. The health of our forests is a prime indicator of the health of our total environment.

Aesthetic: There are few who venture into the forest who do not recognize the human need for the natural beauty and peace of mind that the forest provides. As the pace of our lives and the demands on our time seem only to increase, the value of time spent in the forest—whether we camp, hunt, hike, watch wildlife, or simply collect our thoughts—becomes more important. The forest also fulfills the aesthetic needs of those who simply enjoy viewing the wooded landscape from afar, as well as those who feel good just knowing the forest is "there," even if they never venture into it.

Several hundred years ago, Pennsylvania forests stretched from border to border. From the Piedmont region in southern Pennsylvania to the Northern Tier, a variety of hardwood species were intermingled with *stands* of Eastern white pine and hemlock. As settlers came in droves from Europe, the forests of Pennsylvania began to fall in their path. Farmers cleared forestland for agriculture. Lumber towns sprang up as Pennsylvania led the race to supply the growing nation with timber. By the early 1900s very little of the state's original forest remained. In the haste to harvest timber, other forest resources often were ignored. Steep hillsides were left bare, soil

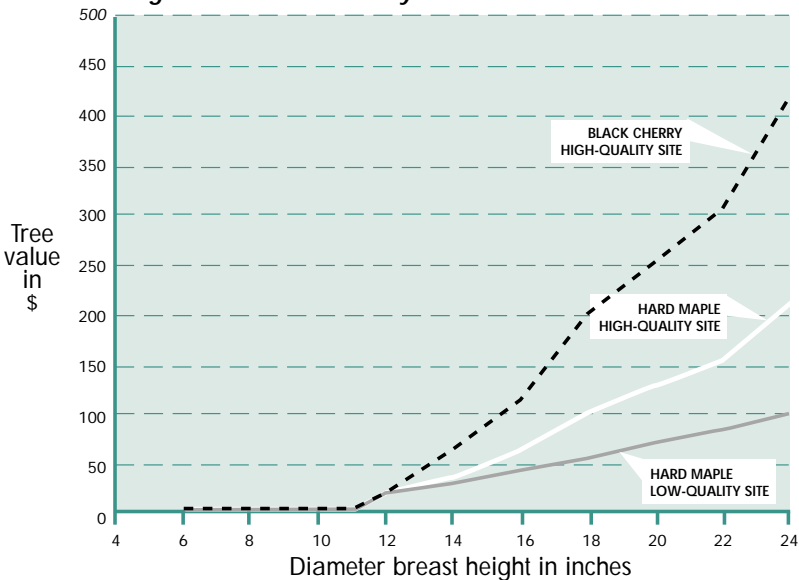
washed into streams and rivers, fires burned out of control, and wildlife habitats were drastically altered.

In all but a few small patches, the forests we have today grew on their own; vigorous fire control and prevention and low deer populations allowed *natural regeneration* to occur on abandoned farm fields and cut-over forests following several decades of widespread disturbance around the turn of the century. Consequently, most of the forests in the state are roughly the same age, give or take 25 years. A walk in a typical Pennsylvania woodland reveals that, in most areas, Eastern white pine and hemlock have become subordinate to a variety of mixed hardwoods—oak, cherry, hickory, maple, yellow poplar, and other species. Blight has reduced the once plentiful American chestnut to a shrub. White and red oaks and cherry have been joined by red maple as the *dominant* species in the *overstory*. In some areas of Pennsylvania, naturally induced mortality in the *deciduous canopy* is allowing Eastern white pine to make a comeback.

Economics and sustainable forestry

The promise of economic gain is a powerful lure. More significantly, economic gain, in the great majority of cases, provides the means to implement other management practices that can maintain and improve our forests for wildlife, recreation, *biological diversity*, and future woodland health and productivity. In realizing economic gain from the use of forest resources, we need to recognize that what we consume today can affect the resources available to our children. Ongoing management practices demonstrate that managing and using our forests wisely can provide at least as much as we need to sustain us now without jeopardizing the future resource, economically (Figure 1) and environmentally.

Figure 1. In some cases, the value of a tree will increase dramatically if it is allowed to grow for several more years.



Forest management basics

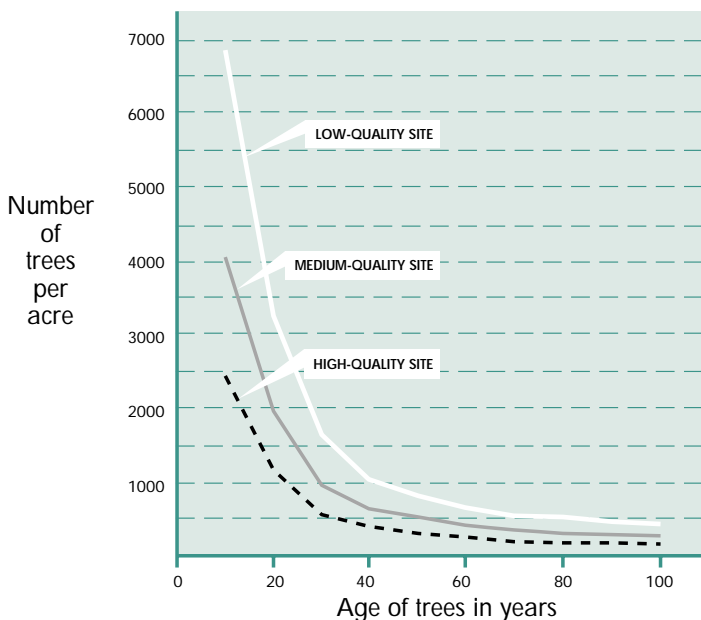
Ecological principles and processes

Forest *ecology* is the study of the forest as a biological community, with emphasis on the interrelationships among the various trees and other organisms constituting the entire community, and on the interrelationships between these organisms and the physical environment in which they exist. These interrelationships define or describe a forest *ecosystem*.

The forest ecosystem is dynamic—as in all living systems, change is inevitable (Figure 2). We can, to a degree, predict what will happen during the *successional* stages of a forest, and we are increasing our knowledge of the patterns of natural disturbances, such as winds, fires, damaging ice and snow, and outbreaks of native insects or diseases. We are less able to predict invasion by unexpected plant and animal species. Even for those disturbances whose patterns we can describe, it is difficult to predict their impact on a particular place at a particular time. What is certain is that no ecosystem remains forever the same. The domain of natural science has come to realize that management plans and techniques should try to work with, rather than prevent, changes in ecosystems.

The development of a forest is influenced by many factors—soil types and depths; groundwater patterns; the steepness and directional slope of the terrain; various microbial populations; the presence and fluctuating population sizes of numerous species of fungi, plants, and animals; the

Figure 2. Even without human intervention, the number of trees per acre decreases overtime.



regional climate; the microclimate on the forest floor; the conditions that exist in adjacent or nearby areas; human activity; and the never-ending, cyclic process of growth, aging, death, decay, and *renewal*.

The vegetation that succeeds on any given site under some set of environmental circumstances and conditions has a great influence on the types and species of microbial and animal life that will thrive there. And the types and levels of microbial and animal populations, in turn, affect the future success and composition of the plant life.

As we have acquired some degree of understanding of the complex web of ecological principles at work in the forest, we have found ways to speed up or slow down these natural successional processes. The art and science of manipulating the pace of nature in the forest and controlling forest establishment, composition, *structure*, and individual tree growth is called *silviculture*.

The role of timber harvesting

Humans have always needed products from the forest, and over time that demand has increased with our overall standard of living. Timber harvesting is a vital tool in renewing or enhancing and improving the vigor, diversity, and beauty of the forest while providing benefits to society. In the process of cutting trees for wood products, we modify wildlife habitat and alter natural systems (e.g., increase or decrease water flow, increase or decrease *mast* production, or change species composition).

In any discussion of forestry practices, of which timber harvesting is just one, it is useful to define a "stand" and make the distinction between a stand and a forest. A stand is an area of forest with similar species composition, age, and site conditions. A stand can be *pure* (at least 90 percent of the dominant trees are of one species) or *mixed*. It also can be *even-aged* (all the trees in the stand are approximately the same age) or *uneven-aged* (trees in the stand are of different ages). A pure, even-aged stand has the simplest structure, while a mixed, uneven-aged stand has the most complex.

The forest is the sum of its stands. Keeping that in mind, it is easy to understand that the forest, as a whole, can be sustained even while timber harvesting and other regeneration practices are being carried out on individual stands.

Although timber harvesting accounts for only a small portion of our working forests' life cycles, how and when timber is harvested play a major role in determining the character of the forest far into the future. Experience has indicated that disturbance may contribute to higher diversity. We know that timber harvesting can be pivotal for *forest renewal* and forest improvement in areas that previously have been misused.

Timber harvesting can play an important role in forest management, regardless of the owner's objectives. Properly planned timber harvesting promotes the growth of desirable trees and other plants, stimulates regeneration, and alters wildlife habitat to favor certain species. Timber harvesting also can temporarily alter the aesthetic or recreational value of the forest. Timber harvesting should be done only when there are benefits to be gained, and it should always be done in a way that is intended to improve or renew a forest. However, it should not be a foregone conclusion

that timber harvesting will be a part of every landowner's management plan. When timber harvesting is incorporated into management plans, it should be done to help landowners meet their objectives, whatever they might be.

Silvicultural practices

The goals of silviculture are the improvement and successful renewal of a forest community. Silvicultural practices are generalized procedures, usually involving cutting, that foresters adapt into individualized prescriptions for specific stands.

Classic silvicultural practices include *intermediate treatments* (*cleanings*, *thinnings*, and *improvement cuts*) and *regeneration methods* (done with the goal of starting a new forest). The complex mix of conditions from stand to stand dictates that silvicultural practices be modified or combined to suit site-specific conditions. Motives for managing forests have changed considerably since the early twentieth century, making the successful application of silvicultural practices an increasingly complex art. Objectives have expanded from timber management to multiple-use management to ecosystem management, in which maintaining the health, productivity, and continuity of the entire forest ecosystem is our principal goal.

The basic silvicultural practices in use today are briefly outlined here. Their application will be discussed more fully in the next section.

INTERMEDIATE TREATMENTS

Intermediate treatments are done while the forest is still growing to *economic* or *biological maturity*. Intermediate treatments are usually applied sufficiently before the forest reaches economic or biological maturity (economic maturity occurring before biological maturity) so that the *residual stand* will be able to respond to increased light, water, and nutrients or to reduced competition.

- *Cleanings*, which may also be thought of as "weedings," occur early in the life of a stand. They are made to favor species desired by the landowner by removing non-merchantable, undesirable (as defined by the landowner) *herbaceous* and *woody* species, including *invasive*, *non-native* species. Cleanings typically are not done past the *sapling* stage of the stand being treated. Because they do not have an immediate payoff, cleanings must be regarded as an investment in the future mature forest.
- *Thinnings and improvement cuts* have the goals of controlling *stand density*, increasing tree vigor, and selecting the species and individuals that will constitute the future forest. Thinnings and improvement cuts conducted in the latter stages of forest growth (or *rotation*, if timber management is the goal) frequently yield merchantable volume. The differences between thinnings and improvement cuts are sometimes difficult to discern, since they both are conducted using similar means to achieve similar ends. Thinning takes tree *spacing* into account, focusing on removing trees that are judged to be poor "competitors" and will probably die before they reach maturity. Improvement cuts, on the other hand, while not ignoring individual trees' competitive abilities, focus on removing trees of

undesirable species or form to concentrate growth potential on the most desirable species and individuals.

The net results of intermediate treatments are that undesirable trees are removed from the stand, and resources (sunlight, moisture, nutrients, and space), and therefore growth, are redistributed to selected trees. Intermediate treatments also can help check the spread of infectious agents.

REGENERATION METHODS

Regeneration methods mimic the creation of openings in the forest by natural disturbances. The most important goal of the regeneration process is to re-establish a healthy forest. It is important to understand that regeneration in Pennsylvania's forest types almost always occurs naturally, either by stump sprouts (new trees arising from residual stumps), by root sprouts, or by naturally dispersed seed. Planting and seeding (artificial regeneration) sometimes are used to regenerate Pennsylvania forests, especially to establish or renew pine plantations. A focal point of regeneration is to renew not only the trees, but also the other beneficial woody and herbaceous vegetation that contributes to a functioning forest ecosystem.

There are four requirements to consider before making a regeneration cut: (1) abundant advanced regeneration (seedlings and sprouts) should be present on the forest floor, or there should be ample seed in the forest-floor *litter* that can germinate after the overstory is removed; (2) seedlings and sprouts should be well distributed; (3) they should be desirable species; and (4) vegetation that will inhibit the growth and development of seedlings and sprouts should be controlled. In Pennsylvania, there often is a fifth requirement: protecting seedlings and sprouts from over-browsing by white-tailed deer.

Once the above requirements are met, the regeneration cut can proceed under several methods. Usually, as mentioned earlier, these methods are combined or modified according to the conditions of the area to be harvested. Regeneration cuts usually generate income from timber, regardless of whether the objective is to make some money, to salvage a dead or dying stand, or to alter wildlife habitat.

■ *The single-tree selection and group selection methods* mimic the natural processes of single trees or relatively small groups of trees dying and falling or being blown down by a localized burst of wind. Both methods favor the regeneration of *shade-tolerant* species. *Selection* cutting should be applied with skill and care because it easily can degenerate into "selective" cutting, also known as diameter-limit cutting or high-grading (see page 15). Under both methods, establishing areas of advanced regeneration is an ongoing process, from the time of the first cut through each successive cut.

– *The single-tree selection method* removes individually selected trees throughout all diameter classes, creating 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. Advanced regeneration established before the harvest must be of shade-tolerant species that are known to grow well in the low-light conditions that persist even after harvest.

- *The group selection method* removes trees in a number of 0.1- to 1-acre areas to create openings in the forest canopy. The larger the opening, the more likely that regeneration of sun-loving (*shade-intolerant*) species will develop and persist in the openings. Shade-tolerant species are more likely to sprout and survive near the edges of the opening and in the uncut forest between the openings. For shade-tolerant species to compete successfully with shade-intolerant species in the openings, they should be present as advanced regeneration before the harvest.
- *Shelterwood, seed tree, and clear-cut methods* mimic nature's more catastrophic processes, such as wildfires, tornadoes, and hurricanes, which can bring down multiple acres of trees in one fell swoop. These three methods are used to regenerate tree species whose best germination and growth occur with full or nearly full sunlight.
 - *The shelterwood method* leaves a large number of trees standing long enough to establish and protect "advanced regeneration" sites until the seedlings and saplings are well established. (Because the residual trees also serve as a continuing seed source, the shelterwood method is desirable when insufficient advanced regeneration is present.) After regeneration is well established, the sheltering trees are harvested, permitting the advanced regeneration to occupy the site fully.
 - *The seed tree method* leaves a few of the best trees standing to become the parent trees of the new forest. This method has limited application in Pennsylvania forests.
 - *The clear-cut method*, in its pure form, removes all the trees in a multi-acre area in a single cut. However, as management plans have evolved to include multiple objectives, it is not unusual to find that even in a clearcut area, some tree species are reserved in the interests of biodiversity, wildlife habitat, or aesthetics. These include rare or slow-growing species, good mast producers, and wolf trees, den trees, and some snags. This method is the most controversial and often the target of public outcry. However, there are biologically based justifications for clear-cutting, given that the four (often five) requirements for regeneration listed above have been satisfied. Clear-cutting may be the best way to promote early successional forests that are essential for numerous plant and wildlife species. Clear-cutting is the best method for regenerating those tree species (such as black cherry, aspen, and yellow poplar) that require full sunlight, at least in their early life.

CROP TREE METHOD

The crop tree method is a relatively new, hybrid method that combines features of both intermediate treatments and regeneration methods. Currently, the crop tree method is being used to release trees selected for retention to meet an owner's objective. Regeneration may become established as openings around the crop trees are created. This regeneration will be released when the crop trees are harvested in the future. Since most regeneration will develop in partial shade, the crop tree method appears to favor shade-tolerant species.

Forest protection and health

Pennsylvania forests are subject to attack by insects, diseases, and fire. Gypsy moth has decimated untold acres of oak stands. Chestnut blight has virtually eliminated one tree species. Beech, hemlock, and dogwood are each battling their own pests. In many areas of the state, tree seedlings, shrubs, and wildflowers are losing the battle to over-browsing by white-tailed deer. Wind, snow, ice, and drought also take their annual toll on forest vegetation.

Some losses are unavoidable, but they can be minimized by incorporating BMPs that support a landowner's objectives into a sound forest management plan. Sometimes the best way to minimize a loss is through a salvage cut—literally, a harvesting operation conducted to salvage timber that has been damaged or killed by insects, disease, weather, or other natural phenomena. Details on BMPs that will protect and improve forestland and minimize the adverse effects of forest management operations are presented in the next section.

High-Grading

There is concern among all sectors of the forestry community that high-grading—the harvesting of only those trees that will give the highest immediate economic return—may lead to a widespread decline in forest resource quality. Two practices, diameter-limit cutting and selective cutting, generally fall into this category. In diameter-limit cutting, all saleable trees above a certain diameter are harvested. Selective cutting usually removes the largest, most valuable trees and may leave large-diameter, poor-quality, low-value trees. In each case, most of the trees that remain after the harvest are genetically inferior or physically defective. Neither method gives any thought to the composition of the future forest.

In even-aged forests such as those in Pennsylvania, smaller-diameter trees are not necessarily younger trees. It is more probable that these smaller trees are:

1. slow-growing species of the same age as different, fast-growing species;
2. the same species of the same age but growing on an inferior *microsite*; or
3. the same species of the same age but genetically inferior to their larger-diameter counterparts.

Because slower-growing and poor-quality trees are retained, high-grading diminishes the diversity and economic value of the future forest. Landowners may agree to high-grading because of a lack of knowledge about the practice and its undesirable consequences. High-grading also can be driven by short-term economic considerations. Immediate cash flow may be higher with high-grading, but potential environmental degradation and decreased future timber values will more than cancel the immediate cash advantage.

Stewardship requires that landowners consider the future consequences of high-grading when making a decision whether or not to accept the use of the practice on their land. Resource professionals and harvesters also have an obligation to look beyond the present when recommending forest management practices to landowners.



Best Management Practices

Introduction

The Best Management Practices that follow are divided into three components of forest management: planning, forest operations, and forest values. Planning is essential for successful forest operations and the protection of forest values.

Aerial photographs and county soil surveys are two useful and recommended tools to help landowners and natural resource professionals plan forest management activities. Aerial photographs are available for viewing from Bureau of Forestry county service foresters and at county offices of the Farm Service Agency (FSA, formerly ASCS). You can order your own copies of aerial photographs through FSA offices. County soil surveys are available at county offices of the Natural Resources Conservation Service (NRCS, formerly SCS).

Forest operations include regeneration and tending. Without successful regeneration, the future of the forest is jeopardized. In Pennsylvania, forest regeneration is a critical issue. Tending focuses on the stand—the residual stand as well as the effects of insects, diseases, and fire—and on site quality maintenance, which includes soil productivity and water resources.

Forest values, in addition to the timber, soil, and water resources addressed under forest operations, include aesthetics, wildlife habitats, species of special concern, and unique habitats.

All three components of good forest management emphasize the future of the forest. Landowners must understand that they have the ultimate responsibility for what happens on their land. They also must understand that the effects of their activities can extend beyond their property boundaries. The first step in managing forestland with a stewardship ethic is to develop a working relationship with those who can help you. For landowners, that means working with at least one natural resource professional, such as a forester, wildlife specialist, botanist, or ecologist. For natural resource professionals, it means establishing an interdisciplinary network of colleagues. Forest landowners, natural resource professionals, and timber harvesters all should follow BMPs when planning and implementing land-management activities, and be aware of the short- and long-term effects of those activities.

As stewards, we gather the knowledge of a forest that we need to evaluate both the short-term and long-term consequences of our actions. That knowledge helps us make responsible choices and trade-offs among the alternatives, weighing immediate financial gain against long-term financial and environmental benefits and costs.

Accommodating a variety of wildlife and plant species requires providing them with a variety of suitable growing conditions. Normal forest management operations can be used to develop a mix of age classes and stand structures, and this mixture may contribute to the desired variety of habitats. When landowner goals emphasize particular species, the mixture of stand types and age classes on the landscape will be dictated by the

needs of those species. Both for variety and for particular species, additional special actions can and should be incorporated into the overall plan.

When management plans call for a harvesting operation, special attention to water resources is essential. Water resources are most susceptible to off-site impacts. Heavy sediment loads can travel for miles and adversely affect fish habitat, stream vegetation, and human uses far downstream. Changes in forest cover near streams can cause changes in water temperature, which may result in changes in aquatic plant and animal habitat.

Timber harvesting can result in a major change to the appearance of the harvested area. Frequently this change, especially in areas highly visible to neighbors or the general public, creates opposition to timber harvesting. Landowners and harvesters can modify the operation to minimize the impact of harvesting on the physical appearance of the area. The parties involved need to understand that lower *stumpage* values or lower return to the harvester may result from the modification.

There are other trade-offs that landowners, resource professionals, and harvesters must consider when planning forest management strategies. Improving appearance by removing snags and *cavity trees* may lower wildlife values. On the other hand, retaining snags, dead trees, and cavity trees, while improving wildlife values, may provide operational hazards for the harvester and make it more difficult to operate safely. Familiarity with BMPs can help us recognize the trade-offs and make intelligent decisions about forest management activities.

BMPs are universally accepted activities that have positive effects or minimize negative effects on the forest ecosystem. Their impacts can be limited to individual stands or spread over multiple ownerships. Some BMPs are multipurpose. For example, *buffer strips* along streams designed to control sedimentation can also serve as wildlife travel corridors, result in habitat diversity, and maintain stream water temperature and nutrient levels. The BMPs in this publication are organized to take you through the full range of forest management activities that follow.

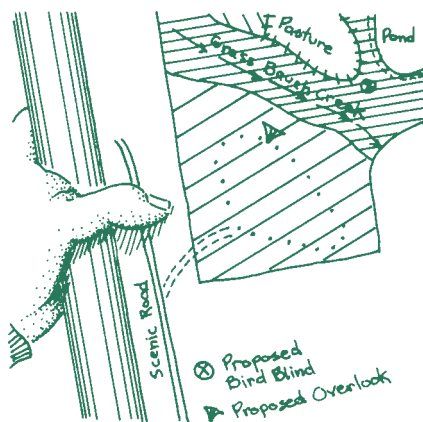
The BMPs provide the basics—minimal acceptable standards—of good forest management, although some landowners may choose to do more. By becoming familiar with the BMPs and using them as a guideline for both short-term and long-term forest management activities, each of us who holds some responsibility for the future of Pennsylvania's forests can become a better steward and contribute to a bright future for Penn's Woods.

Please note that the considerations and concerns, as well as the BMP strategies to address them, are merely a checklist. More detailed information is available in the publications listed at the end of each forest resource management component.

Planning

Objective: To optimize short-term and long-term benefits of forest management activities through adequate planning.

Issue: Management activities undertaken without planning can produce undesirable environmental, economic, and aesthetic consequences.



Considerations and Concerns:

1. Many private landowners are not aware of the values available from their forestland.
2. Many private landowners do not define what they want from their forestland.
3. Many private landowners do not involve resource professionals in forest management planning.
4. Forest management activities, particularly harvesting, are often undertaken for short-term gain, without thought for the forest's future. (See Figure 1, page 8, and sidebar, page 15.)

BMPs:

1. Inventory resources on the property, including general plant/tree communities, water resources (*streams, spring seeps, wetlands, vernal ponds*), soils, and unique areas (*endangered, threatened, or rare species habitat, rock outcroppings, notable views*).
 - a. Initially inventory at a level of detail necessary to address preliminary goals and objectives.
 - b. Later conduct a more detailed analysis to meet specific landowner operational needs, such as harvesting.
 - c. Be aware of how the resources on the property fit in with the surrounding landscape.
2. Landowner, working with a natural resource professional, should identify preliminary goals and objectives.
3. Mark and maintain property boundary lines. (See Regulations Affecting Forest Management: Timber Trespass Law.)
4. Develop realistic goals and objectives based on the resource inventory and available landowner time and finances. Be as specific as possible when enumerating objectives (e.g., does "managing for wildlife" mean creating habitat for a wide variety of wildlife or concentrating on habitat requirements for one or two species).

5. Consider the effects of planned activities on surrounding properties.
6. Create a written management plan based on the resource inventory and landowner objectives. Include a map showing stands or management units and a timetable for completion of recommended activities.

For Additional Information:

Fajvan, Mary Ann. *Pennsylvania Woodlands No. 9: Developing a Woodland Management Plan*. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.

Finley, James C. *Pennsylvania Woodlands No. 3: Resource Evaluation*. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.

Forest Advisory Services. *Directory of Consulting and Industrial Foresters*. DCNR Bureau of Forestry, Harrisburg, Pa.

Forest Advisory Services. *Forest Districts, District and County Service Foresters*. DCNR Bureau of Forestry, Harrisburg, Pa.

Harvey, Helene and James C. Finley. *Forest Stewardship Bulletin No. 6: Planning Your Forest's Future*. DCNR Bureau of Forestry, Harrisburg, Pa.

Jones, Stephen B. and Roe S. Cochran. *Pennsylvania Woodlands No. 11: Managing Your Woodlot with the Help of a Consulting Forester*. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.

Pennsylvania Forest Stewardship Program. *Directory of Resource Professionals Available to Write Forest Stewardship Plans*. DCNR Bureau of Forestry, Harrisburg, Pa.

Forest operations

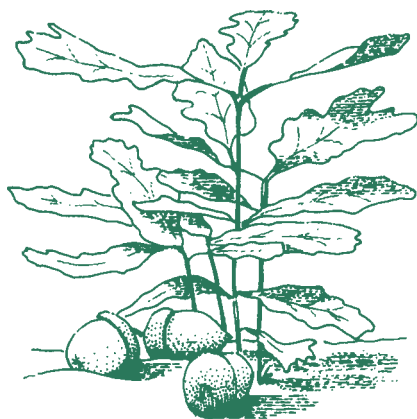
REGENERATION AND RENEWAL

Objective: To ensure that the forest of the future is a productive forest.

Issue: Timber is being harvested without regard for forest regeneration and renewal.

Considerations and Concerns:

1. Pennsylvania's forests are maturing; harvesting should lead to renewal.
2. Preharvest assessment of advanced regeneration and potential problems will minimize the possibility of regeneration failure.
3. Deer are having a major impact on forest regeneration.
4. Pennsylvania forests lack advanced regeneration of desirable species.
5. Once seed sources of desirable species are gone, it is difficult to reproduce a productive forest for the future.



BMPs:

1. Assess advanced regeneration, seed sources for postharvest regeneration, and potential stump and root sprouting.
2. Assess and, if necessary, control competing vegetation such as ferns, grasses, and other undesirable *understory* tree and shrub species.
3. Assess and, if necessary, control the potential loss of seed, seedlings, and sprouts to deer and other wildlife.
4. Provide for regeneration each time harvests are made under the uneven-aged system.
5. Consider the biological requirements of the species you want to regenerate, whether by natural reproduction or planting.

For Additional Information:

Bihun, Yuri, James C. Finley, Stephen B. Jones, and Ellen Roane. *Forest Stewardship Bulletin No. 7: Timber Harvesting: An Essential Tool of Forest Stewardship*. DCNR Bureau of Forestry, Harrisburg, Pa.

Gingrich, Samuel F. and Benjamin A. Roach. 1968. *Even-aged Silviculture for Upland Central Hardwoods*. Agriculture Handbook 355. USDA Forest Service Northeastern Forest Experiment Station, Radnor, Pa.

Grace, James R. *Pennsylvania Woodlands No. 8: Principles of Silviculture*. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.

Grace, James R. *Pennsylvania Woodlands No. 10: Hardwood Management for Economic Return*. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.

Marquis, David A. and Ronnie Brenneman. 1981. *The Impact of Deer on Forest Vegetation in Pennsylvania*. Gen. Tech. Rep. NE-65. USDA Forest Service Northeastern Forest Experiment Station, Radnor, Pa.

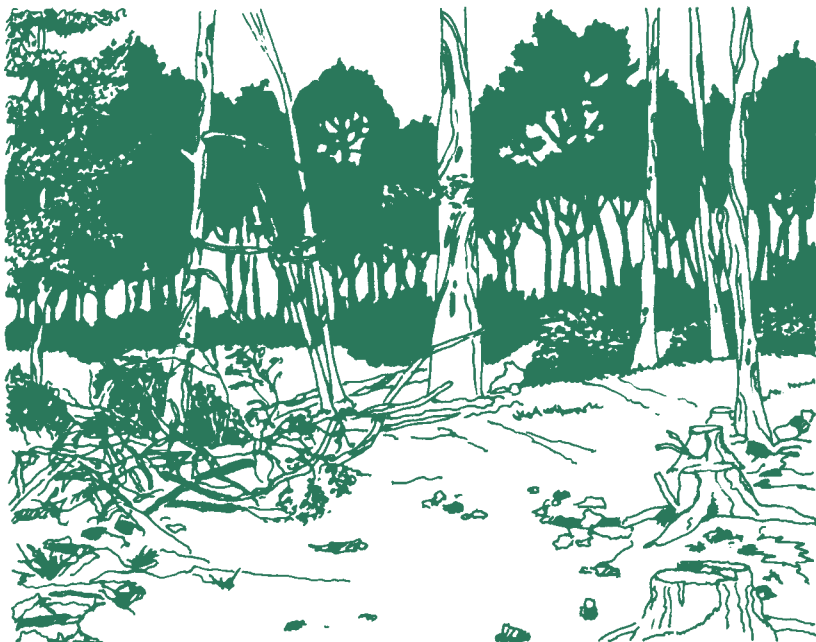
Marquis, David A., Richard L. Ernst, and Susan L. Stout. *Prescribing Silvicultural Treatments in Hardwood Stands of the Alleghenies*. Gen. Tech. Rep. NE-96. USDA Forest Service Northeastern Forest Experiment Station, Radnor, Pa.

Perkey, Arlyn W., Brenda L. Wilkins, and H. Clay Smith. *Crop Tree Management in Eastern Hardwoods*. (NA-TP-19-93). USDA Forest Service, Northeastern Area State and Private Forestry, Morgantown, W. Va.

Forest operations

TENDING

Stand—residual stand protection



Objective: To minimize the negative impacts of management activities on vegetation remaining on the site.

Issue: The stand that will remain after intermediate treatments is subject to damage or degradation during forest management operations.

Considerations and Concerns:

1. Intermediate treatments should leave the forest in better condition than it was in before the activity was undertaken.
2. Careless operation of equipment results in damaged trees.
3. Proper planning can minimize the chances of damaging or degrading the residual stand.

BMPs:

1. Focus on protection of the residual stand rather than on the trees being removed.
2. During intermediate operations, retain seed source of species needed to achieve long-term management objectives.
3. Avoid intermediate cuttings that may increase interfering plant communities, such as grasses and ferns, or be prepared to treat interfering vegetation before the regeneration cut.

4. Design and lay out *skid trails* and *skid roads* to minimize damage by avoiding residual trees and using *bumper trees* to protect them from skidding damage.
5. Exercise special care when harvesting trees during the growing season (usually between April and August), when residual trees are most susceptible to felling and skidding damage.
6. Identify and mark unique vegetation to be protected.
7. Ensure that a stand compatible with long-term management objectives remains after intermediate treatments. Instead of selecting for cutting, select for retention:
 - a. species adapted to the site
 - b. trees not likely to develop *epicormic branching* from exposure to increased sunlight
 - c. properly spaced trees
8. Avoid high-grading (page 15).

For Additional Information:

Gingrich, Samuel F. and Benjamin A. Roach. 1968. *Even-aged Silviculture for Upland Central Hardwoods*. Agriculture Handbook 355. USDA Forest Service Northeastern Forest Experiment Station, Radnor, Pa.

Grace, James R. *Pennsylvania Woodlands No. 10: Hardwood Management for Economic Return*. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.

Marquis, David A. and Ronnie Brenneman. 1981. *The Impact of Deer on Forest Vegetation in Pennsylvania*. Gen. Tech. Rep. NE-65. USDA Forest Service Northeastern Forest Experiment Station, Radnor, Pa.

Marquis, David A., Richard L. Ernst, and Susan L. Stout. *Prescribing Silvicultural Treatments in Hardwood Stands of the Alleghenies*. Gen. Tech. Rep. NE-96. USDA Forest Service Northeastern Forest Experiment Station, Radnor, Pa.

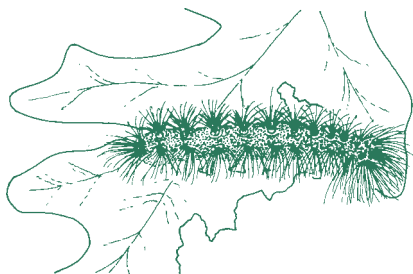
Perkey, Arlyn W., Brenda L. Wilkins, and H. Clay Smith. *Crop Tree Management in Eastern Hardwoods*. (NA-TP-19-93). USDA Forest Service, Northeastern Area State and Private Forestry, Morgantown, W.Va.

Forest operations

TENDING

Stand—insects, diseases, and fire

Objective: To minimize the adverse impacts on forest resources from insects, diseases, and fire.



Issue: Insects, diseases, and fire can make it difficult to accomplish forest management goals and objectives.

Considerations and Concerns:

1. Most landowners and some resource professionals fail to recognize the effects of insects and diseases on forests.
2. Proper management can minimize the impacts of insects and diseases.
3. Landowner objectives may have to be modified to deal with insects and diseases.

BMPs:

1. Monitor insect and disease populations.
2. Take appropriate control measures when insects or diseases are likely to prevent the accomplishment of landowner goals and objectives.
3. Consider increasing species diversity, changing species composition, or changing stand structure to minimize susceptibility to insect and disease attack.
4. Maintain access roads to facilitate fire control.
5. Consider a timber harvest to salvage dead and dying trees.

For Additional Information:

National Acid Precipitation Assessment Program. *Diagnosing Injury to Eastern Forest Trees*. USDA Forest Service, Forest Pest Management, Atlanta, Ga., and Penn State Department of Plant Pathology, University Park, Pa.

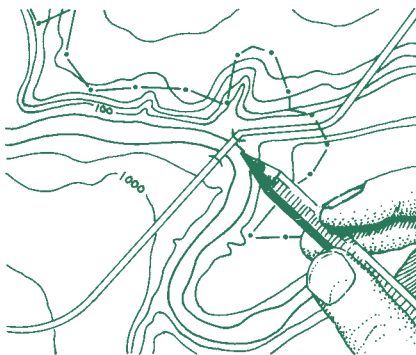
Forest operations

TENDING

Site quality protection—productivity

Objective: To protect the ability of the soil to sustain desired plant and animal communities.

Issue: Operations at the wrong location and during inappropriate weather can damage soil structure and lower *site quality*.



Considerations and Concerns:

1. Current equipment makes it possible to move large volumes of timber in all kinds of weather and soil conditions.
2. Careful removal of forest products can be the key to having a productive forest in the future.
3. Soil compaction inhibits regeneration.
4. Deep ruts can damage roots, which can lead to decay, stain, reduced growth, and mortality.

BMPs:

1. Minimize soil compaction and rutting by matching operating techniques, season of operation, and equipment to soil types and moisture levels.
2. Use soil surveys, topographic maps, and on-site evaluations as guides when planning *log landing*, *skid road*, and *haul road* locations.
3. Modify landing and road locations to reflect actual soil, *parent material*, and topographic conditions.
4. Keep landing and road network at minimum size necessary to remove harvested timber efficiently.
5. Do not contaminate soils with fuels, lubricants, and other chemicals.

For Additional Information:

Brown, Darlene B., ed. 1993. *Best Management Practices for Silvicultural Activities in Pennsylvania's Forest Wetlands*. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.

DEP Bureau of Land and Water Conservation, Cambria County Conservation District, and College of Agricultural Sciences Penn State Cooperative Extension. *Controlling Erosion and Sedimentation from Timber Harvesting Operations*. 1992. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.

Forest operations

TENDING

Site quality protection—water resources



Objective: To minimize the movement of soil into water resources during forest management operations.

Issue: Erosion and sedimentation from forest management activities can affect water quality.

Considerations and Concerns:

1. Operations that affect soil and water are regulated by law. (See Regulations Affecting Forest Management Activities: Environmental Regulations.)
2. Small changes in the operation can eliminate many of the negative impacts.
3. Forested wetlands are often difficult to identify, especially during dry seasons.

BMPs:

1. Comply with all provisions of Chapter 102 and Chapter 105 of the Clean Streams Law and the Dam Safety and Encroachments Act, respectively. (See Regulations Affecting Forest Management Activities: Environmental Regulations.)
2. Design roads to shed surface water quickly.
3. Design roads and landings to prevent or divert surface water flow.
4. Avoid locating roads and landings on *seasonally wet* soils.
5. Consider slope when laying out roads and landings.
6. Provide adequate riparian buffers between disturbed areas, such as roads or landings, and streams or wetlands.

7. Bridges and culverts are the preferred methods of crossing *intermittent* and *perennial* streams. When *fords* are used for truck crossings, stabilize the bottom with clean rock.
8. Cross wetlands only when absolutely necessary.
9. If forest operations necessitate taking heavy equipment into wetlands, conduct those operations, whenever possible, during the driest periods or when the wet area is solidly frozen.
10. Do not skid through water courses or spring seeps.
11. Do not contaminate water bodies and soil with forest management chemicals and petroleum products.
12. Retire the road network properly at the completion of operations.

For Additional Information:

Brown, Darlene B., ed. 1993. *Best Management Practices for Silvicultural Activities in Pennsylvania's Forest Wetlands*. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.

DEP Bureau of Land and Water Conservation, Cambria County Conservation District, and College of Agricultural Sciences Penn State Cooperative Extension. *Controlling Erosion and Sedimentation from Timber Harvesting Operations*. 1992. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.

Welsch, David J. 1991. *Riparian Forest Buffers: Function and Design for Protection and Enhancement of Water Resources*. NA-PR-07-91. USDA Forest Service, Northeastern Area State and Private Forestry, Radnor, Pa.

Forest values

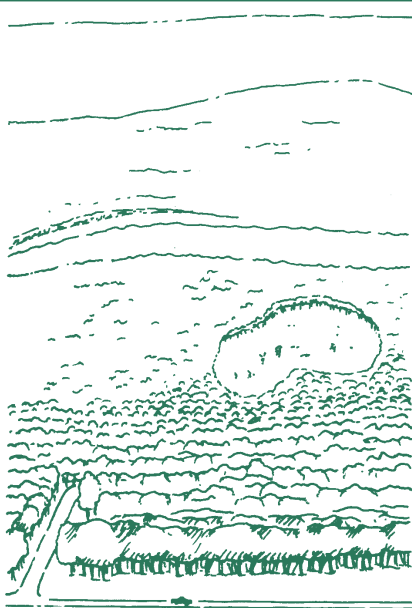
AESTHETIC CONSIDERATIONS

Objective: To minimize the adverse visual effects from harvesting and other forest management activities.

Issue: Much of the opposition to forest management activities, particularly harvesting, is due to the changed physical appearance of the area.

Considerations and Concerns:

1. Most landowners are concerned about the appearance of their property.
2. Acceptance of forest management activities by the general public is increased by having the job look good.



BMPs:

1. Cut all broken trees, *leaners*, and badly scarred trees except where they are being retained for a specific purpose.
2. Locate landings away from public view.
3. Protect and release from competition trees with unusual shapes and colors.
4. Design cutting areas to take advantage of natural contours; avoid straight lines when possible.
5. Lop tops of harvested trees near public roads, frequently used trails, recreational areas, and residential sites. (Note: This might increase the adverse impacts of deer on regeneration, because intact tree tops left behind help protect young growth.)
6. Use as much of the harvested wood as possible to minimize debris. (Note: This might reduce habitat for small mammals, reptiles, amphibians, and beneficial insects.)
7. Clean up all *refuse* daily.
8. Regrade and seed landings, using native grasses wherever possible.
9. Keep mud off public roads and out of streams.
10. Consider leaving a visual buffer along traveled roads.

For Additional Information:

Jones, Geoff. 1993. *A Guide to Logging Aesthetics: Practical Tips for Loggers, Foresters, and Landowners*. NRAES-60. University of New Hampshire Cooperative Extension, Northeast Forestry Resource Extension Council Series, Northeast Regional Agriculture Engineering Service, Ithaca, N.Y.

Jones, Geoff and Douglas Weisman. 1994. *The Careful Timber Harvest: A Video Guide to Logging Aesthetics*. Weisman Video Productions, Watertown, Mass. (Sponsored by the Society for Protection of New Hampshire Forests; cosponsored by the New Hampshire Division of Forest and Lands and the University of New Hampshire Cooperative Extension.)

Kendra, Angelina and Ellen M. O'Donnell. *Forest Stewardship Bulletin No. 8: Planning for Beauty and Enjoyment*. DCNR Bureau of Forestry, Harrisburg, Pa.

Forest values

UNDERSTANDING WILDLIFE HABITATS

Objective: To consider the impacts of forest management activities on wildlife resources and understand the trade-offs necessary to accomplish landowner goals and objectives.

Issue: Forest management activities have positive and negative effects on wildlife resources.



Considerations and Concerns:

1. Wildlife is important to landowners and the general public.
2. The effects of forest management activities on wildlife are often overlooked.

BMPs:

1. Inventory habitat features on the property, and be aware of their relationship to surrounding lands.
2. Protect sensitive habitats, such as spring seeps, vernal ponds, riparian zones, cliffs, caves, and *rubble land*.
3. Develop missing special habitats, such as evergreen cover, grape arbors, and herbaceous openings, through planting, cutting, or other manipulations.
4. Protect cavity trees, snags, and food-producing shrubs and vines.
5. Maintain overhead shade along cold-water streams.
6. Use forest management activities to develop habitats required by species desired by the landowner.

For Additional Information:

Brooks, Robert P., Daniel A. Devlin, and Jerry Hassinger. 1994. *Wetlands and Wildlife*. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.

DeGraaf, Richard M. and Alex L. Shigo. 1985. *Managing Cavity Trees for Wildlife in the Northeast*. Gen. Tech. Rep. NE-101. USDA Forest Service Northeast Forest Experiment Station, Radnor, Pa.

DeGraaf, Richard M., Mariko Yamasaki, William B. Leak, and John W. Lanier. 1992. *New England Wildlife Management of Forested Habitats*. Gen. Tech. Rep. NE-144. USDA Forest Service Northeast Forest Experiment Station, Radnor, Pa.

- Devlin, Daniel and Jack Payne. *Pennsylvania Woodlands No. 6: Woodland Wildlife Management*. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.
- Green, Duane. 1991. *Trees and Shrubs for Living, for Wildlife, for Conservation in the Mid-Atlantic*. USDA Forest Service, Northeastern Area State & Private Forestry, Morgantown, W.Va.
- Hassinger, Jerry, Lou Hoffman, Michael J. Puglisi, Terry D. Rader, and Robert G. Wingard. 1979. *Woodlands and Wildlife*. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.
- Hassinger, Jerry and Jack Payne. *Pennsylvania Woodlands No. 7: Dead Wood for Wildlife*. College of Agricultural Sciences Penn State Cooperative Extension, University Park, Pa.
- Hassinger, Jerry, Charles E. Schwarz, and Robert G. Wingard. 1981. *Timber Sales and Wildlife*. Pennsylvania Game Commission, Harrisburg, Pa.
- Hobson, Scott S., John S. Barclay, and Stephen H. Broderick. 1993. *Enhancing Wildlife Habitats: A Practical Guide for Forest Landowners*. NRAES-64. Northeast Forest Resource Extension Council Series, Northeast Regional Agriculture Engineering Service, Ithaca, N.Y.
- Sullivan, Kristi L. and Margaret C. Brittingham. *Forest Stewardship Bulletin No. 5: Wildlife*. DCNR Bureau of Forestry, Harrisburg, Pa.

Forest values

SPECIES OF SPECIAL CONCERN AND UNIQUE HABITATS

Objective: To recognize the importance and contribution of unique or special resources to the ecological integrity of the property and the Commonwealth.



Issue: Unique areas and plant and animal species of special concern need to receive specific attention in forest management activities.

Considerations and Concerns:

1. Landowners often are unaware of the existence of species of special concern or unique areas on their properties.
2. Many landowners would be willing to protect special resources on their properties if they had information and advice on what actions to take to protect them.
3. The loss of additional endangered, threatened, or rare species will diminish the biological wealth of our state.

BMPs:

1. Become aware of the presence of and protect endangered, threatened, and rare species' habitats and unique habitat features.
2. Know the habitat requirements of endangered, threatened, and rare species on the property so that activities can be planned either to avoid disturbing or to enhance these habitats.
3. Keep in mind that plant habitats can be very small and specific. Learn to recognize these special microsites.
4. Develop specific management plans for unique areas and habitats with the help of a resource professional.

For Additional Information:

Genoways, Hugh H. and Fred J. Brenner. 1985. *Species of Special Concern in Pennsylvania*. Carnegie Museum of Natural History, Pittsburgh, Pa.

Majumdar, Shyamal K., Fred J. Brenner, and Ann F. Rhoads. 1986. *Endangered and Threatened Species Programs in Pennsylvania and Other States: Causes, Issues and Management*. Pennsylvania Academy of Science, Philadelphia, Pa.

McGuinness, Barbara J., ed. 1995. *A Heritage for the 21st Century: Conserving Pennsylvania's Native Biological Diversity*. Pennsylvania Fish and Boat Commission, Harrisburg, Pa.

Pennsylvania Fish and Boat Commission and Pennsylvania Game Commission. 1985. *Endangered and Threatened Species of Pennsylvania*. Wild Resource Conservation Fund, Harrisburg, Pa.



Regulations affecting forest management

Environmental regulations

Several laws and regulations address earth-moving activities that have the potential to degrade the quality of waters of the Commonwealth of Pennsylvania. Since timber harvesting involves earth moving, individuals involved in harvesting forest products should be familiar with these laws and regulations. The following list includes current federal, state, and local laws and regulations that normally affect timber harvesting operations. While the road bonding regulations included in this discussion do not directly relate to water quality, they are provided in order to assist logging operators in developing a harvesting plan.

FEDERAL

Federal Water Pollution Control Act Amendments of 1972, Section 404.

Brief description: This legislation established a permit program to be administered by the U.S. Army Corps of Engineers to regulate discharges of dredged or fill material into the "waters of the United States." Discharge of fill material includes road fills at stream crossings. A major emphasis of Section 404 is the protection of wetlands.

Application: Most logging road stream crossings are exempt from permitting under Section 404 because they are classified as "minor road crossing fills." To gain this exemption, the following four conditions must be met:

1. Fill actually placed into a stream channel cannot exceed 200 cubic yards.
2. The stream must be properly bridged (must pass expected high flows).
3. Wetlands must not be affected.
4. All other best management practices must be followed.

The Corps of Engineers and the Pennsylvania DEP, Bureau of Dams and Waterways Management have a joint permit application process. One application is submitted for both federal and state permits. Since the responsibilities of these two agencies overlap to a great degree, their compliance activities complement each other.

Establishing contact with the Pennsylvania DEP, Bureau of Dams and Waterways Management, will ensure that the timber harvester is advised on the applicability of Section 404 to a particular stream crossing situation.

Chapter 102, Erosion Control Rules and Regulations—issued under Act of June 22, 1937, P.L. 1987 (Clean Streams Law).

Brief description: Chapter 102 requires that an erosion control plan be developed, implemented, and maintained for every earth disturbing activity within the Commonwealth. The plan must consider the control of erosion and sediment during the activity, as well as proper restoration after the activity. The plan should consider the control of all factors that relate to the causes of erosion and sediment.

Application: Timber harvesting operations that involve earth disturbance of more than 25 acres require a permit from DEP. Additional information and applications concerning earth disturbance permits can be obtained by county conservation districts. Most timber harvests disturb less than 10 percent of the harvested area.

Chapter 105, Dam Safety and Waterway Management Rules and Regulations—issued under Act of 1978, P.L. 1375, No. 325 (Dam Safety and Encroachments Act).

Brief description: Chapter 105 requires proper planning, design, construction, maintenance, and monitoring of all dams, reservoirs, water obstructions, and encroachments. Conservation of water and protection of the water quality, natural regime, and carrying capacity of water courses are the primary thrusts of Chapter 105.

Application: All persons planning to construct, operate, maintain, modify, enlarge, or abandon any dam, water obstruction, or encroachment must apply for a permit from DEP, Bureau of Dams and Waterways Management. This requirement applies to all water courses. (A water course is defined as "any channel of conveyance of surface water having defined bed and banks, whether natural or artificial, with perennial or intermittent flow.") Chapter 105 regulates any encroachment construction within the defined boundary of the 100-year frequency floodway (provided by the Federal Emergency Management Agency—FEMA) or, in the absence of such mapping or contrary evidence, within 50 feet from the top of the streambank. DEP regulations may waive permit requirements for water obstructions on streams with drainage areas of less than 100 acres.

All permit applications, pursuant to Chapter 105, must be accompanied by an erosion and sediment control plan meeting the requirements of Chapter 102. Conservation districts review and determine the adequacy of erosion and sediment control plans, and their statement as to the plan's adequacy must accompany the encroachment permit application. For temporary road crossings permitted under General Permit No. 8 (GP-8), applicants need not acquire approval of their proposed erosion and sediment control plan before applying for an encroachment permit. However, the applicant must acquire approval of the erosion and sediment control plan from the appropriate conservation district prior to construction. To use GP-8, applicants must notify the Bureau or the local conservation district of their intent to use the General Permit.

Applicants may *not* begin work until they have notified and received from the Bureau an acknowledgment letter of their notification to perform work. Section 5 of the General Permit requires the applicant to notify the Bureau of Dams and Waterways Management of their planned work, including the required information. The Bureau's acknowledgment letter does not approve any drawings, details, or specifications of the proposed work, but acknowledges the applicant's intent to perform the work described. The applicant is responsible for ensuring that the work is done in accordance with the sample drawings and conditions of the General Permit and any conditions noted in the acknowledgment letter. The Fish and Boat Commission and the township and county in which the project is located must also be notified. (See Municipal Notification of DEP Permit Application Submittal, page 38.)

Fish and Boat Code—Act 175

Brief description: The Fish and Boat Code states "No person shall alter or disturb any stream, stream bed, fish habitat, water, or watershed in any manner that might cause damage to or loss of such without necessary permits." "Necessary permits" include any permits required pursuant to Chapter 102 and Chapter 105. The Fish and Boat Code further states that no person, regardless of intent, shall allow any substances deleterious (to fish life) to run, flow, wash, or be emptied into the waters of the Commonwealth of Pennsylvania.

Chapter 441, Access to and Occupancy of Highways by Driveways and Local Roads—issued under Act of June 1, 1945, (P.L. 1242, No. 428 (36 P.S. Sec. 670–420).

Brief description: Chapter 441 requires a permit for all driveways, local roads, and drainage facilities or structures constructed or altered within state highway rights-of-way. Permit applications must be submitted, in the name of the *owner* of property, to either the district or county PennDOT office having jurisdiction where the work will be performed. The permit application must be submitted before construction.

Application: Any harvest operation that will involve accessing a state highway by constructing a new or modifying an existing access point will require PennDOT approval. The local PennDOT office should be contacted about the specifics of a particular situation. PennDOT personnel will then help prepare the required permit application. Logging roads usually qualify for a "Minimum Use Driveway" permit.

Chapter 189, Road Bonding Regulations: Hauling in Excess of Posted Weight Limit on Highways—officially decreed under authority of Title 75, Sections 4902 and 6103 of the Vehicle Code.

Brief description: This chapter regulates the use of highways posted with weight restrictions for vehicles and combinations having a gross weight in excess of the posted weight limit, and applies to both state highways and highways under the jurisdiction of local authorities. Local traffic may exceed posted weight limits if the posting authority determines that vehicles over

the posted weight are not likely to damage the highway. For vehicles determined likely to damage a posted highway, a permit must be obtained from the posting authority. The permit to exceed a posted weight limit is issued on condition that the permittee agrees to accept financial responsibility for excess maintenance of the posted highway or portion thereof to be used by the permittee.

Application: Persons proposing to haul over posted roads or bridges should contact the authority responsible for maintenance of the particular roads or bridges. This may be the county, the township, or PennDOT.

Municipal Notification of DEP Permit Application Submittal—

Act 14 (H.B. 682)

Brief description: DEP must require all applicants for a permit or permit revision to provide written notice to each municipality in which activities are located (usually township *and* county).

Application: DEP may not issue or deny any permit or permit revision until 30 days after the municipalities have *received* the required written notices. (In the case of solid and hazardous waste permits, a 60-day waiting period is imposed.) The act does not apply to any permits relating to coal-mining activities.

This act has a direct impact on timber harvest operations that will require any type of DEP permit, specifically stream encroachment permits (including GP-8) and earth disturbance permits.

If a municipality does not request the right to review and comment on a permit application within 30 days of receiving *notification from the applicant*, the municipality forfeits its opportunity to comment. This 30-day period can be reduced if the applicant approaches the municipalities and obtains written statements relinquishing their rights to review.

Notification is the responsibility of the applicant.

LOCAL

Local municipal regulations concerning earth moving, timber harvesting, and other activities associated with forest management vary considerably. Therefore, it is advisable for earth movers, landowners, resource professionals, and timber harvesters to become familiar early in the planning stages with codes and ordinances currently enforced by the municipality in which work is anticipated.

Zoning and Land Use

As of early 1995, timber harvesting ordinances were known to exist in at least 135 Pennsylvania townships. It is advisable to check with the appropriate township(s) before any timber harvesting activities are planned or executed (see page 42). For more information, read the publication *Timber Harvesting in Pennsylvania: Information for Citizens and Local Government Officials*, available from the Penn State Cooperative Extension office in your county.

Compliance

Certified Conservation District personnel, DEP compliance specialists and engineers, and Waterways Conservation officers have the legal power to enter private property for the purpose of administering applicable laws and regulations. Conservation district staff are often the first regulatory personnel to contact anyone involved in an earth moving activity. Situations involving compliance questions are resolved most easily when the district inspectors and timber harvesters work in a cooperative, positive manner.

Individuals or companies who persist in violating any of the laws or regulations intended to protect Pennsylvania streams are subject to substantial fines and penalties. Willful or negligent violations carry even heavier penalties.

Individuals from as many as five different agencies are responsible for ensuring compliance with applicable laws and regulations. Their areas of responsibility are indicated in the chart on the following two pages.

Responsibilities of agencies for erosion and sedimentation control

AGENCY	RESPONSIBLE PERSON	RESPONSIBILITY
Conservation District	Conservation district manager	Review of E & S plans in accordance with Chapter 102
	and/or	Processing of earth disturbance permits in accordance with Chapter 102 ^a
	Conservation district E & S technician	Compliance inspections of earth moving activities in accordance with Chapter 102 ^a
DEP Regional Office, Soils and Waterways Section	Regional engineer	Compliance inspections, compliance actions, and enforcement of Chapter 102
	and/or Compliance specialist	Field support to conservation district administration of Chapter 102
DEP Regional Office, Soils and Waterways Section	Hydraulic engineer	Issuance of water obstruction permits in accordance with Chapter 105 ^b
		Compliance inspections, compliance actions, and enforcement of Chapter 105
Pennsylvania Fish and Boat Commission	Waterways Conservation officer	Compliance inspections, compliance actions, and enforcement of the Fish and Boat Code
Pennsylvania Department of Transportation	PennDOT representative(s)	Issuance of driveway permits in accordance with Chapter 441
		Compliance inspections, compliance actions, and enforcement of Chapter 441

(continued on next page)

		<p>Issuance of excess maintenance permits (road bonding) for state highways in accordance with Chapter 189</p> <p>Compliance inspections, compliance actions, and enforcement of Chapter 189, as it pertains to state highways</p>
US Army Corps of Engineers	Army Corps representative(s)	<p>Issuance of "dredge and fill" permits in accordance with Section 404 of the Federal Clean Water Act of 1977</p> <p>Administer federal regulations pertaining to wetlands</p> <p>Compliance inspections, compliance actions, and enforcement of Section 404 of the Federal Clean Water Act of 1977</p> <p>(Note: Army Corps activities are closely coordinated with management efforts of the DEP Bureau of Dams and Waterways Management.)</p>
Local municipality	Supervisors or township representative(s)	<p>Enforcement of local codes and ordinances (including township highway bonding, in accordance with Chapter 189)</p>

^a Chapter 102 responsibilities of conservation districts vary with the level of involvement endorsed by the district directors. Most districts (63 of 66) have accepted inspection and compliance responsibilities.

^b The DEP Bureau of Dams, Waterways, and Wetlands has initiated a program in which some inspection duties, general permit review and issuance, and permit exemption determinations, pursuant to Chapter 105, have been delegated to certain conservation districts.

Occupational Safety and Health Administration (OSHA) regulations

The Occupational Safety and Health Administration logging standards that went into effect in February 1995 replace the OSHA pulpwood logging safety standards and are designated in the OSHA safety standards package as Sec. 1910.266 Logging Operations. All logging operations, regardless of the product produced, are covered. The new standards do not cover the construction or use of cable yarding systems, which are detailed in state logging safety standards in most Western states.

Detailed information is available in the following publications:

- *The Logger's Guide to the New OSHA Logging Safety Standards*. Oct. 1994. American Pulpwood Association Inc., Washington, D.C.
- *The Federal Register, Part II: Logging Operations: Final Rule*. U.S. Department of Labor, Occupational Safety and Health Administration. 29 CFR Parts 1910 and 1928.

Other regulations

The Pennsylvania Municipalities Code (Act 67 and 68) and the Right to Practice Forestry Act—53 P.S. §10603(f)

Brief description: The Municipalities Code (MPC) and the Right to Practice Forestry Act both state that zoning ordinances may not unreasonably restrict forestry activities. The MPC goes further by saying that "...to encourage maintenance and management of forested or wooded open space and promote the conduct of forestry as a sound and economically viable use of forested land throughout this Commonwealth, forestry activities, including, but not limited to, timber harvesting, shall be permitted use by right in all zoning districts in every municipality."

Application: The intent of these statutes is to make it easier to carry out forestry activities by limiting the scope of zoning. Given this broad legislative mandate, municipalities that regulate forestry activities will have to craft ordinance provisions that are based on sound forestry principles and practices. The statute does not define "unreasonable," and no appellate court decisions have yet interpreted it. If a zoning ordinance prohibits timber harvesting in zoning districts with significant forests or makes timbering a special exception or conditional use subject to many burdensome and time-consuming requirements, the ordinance is subject to challenge by landowners and loggers alike.

Timber Trespass Law—Act 10 of 1994, P.S. §831I

Brief description: The Timber Trespass Law allows landowners to bring a civil lawsuit to recover three times the value of the timber cut or removed in cases of intentional trespass or two times that value for negligent trespass. Landowners also can recover the costs of establishing the value of the timber cut or removed and of complying with state erosion and sedimentation control rules. The specific wording of the law is as follows:

§831I. Damages in actions for conversion of timber.

- (a) General rule.—In lieu of all other damages or civil remedies provided by law, a person who cuts or removes the timber of another person without the consent of that person shall be liable to that person in a civil action for an amount of damages equal to:
- (1) the usual and customary costs of establishing the value of the timber cut or removed and of complying with the erosion and sedimentation control regulations contained in 25 Pa. Code Ch. 102 (relating to erosion control); and
 - (2) one of the following:
 - (i) three times the market value of the timber cut or removed if the act is determined to have been deliberate;
 - (ii) two times the market value of the timber cut or removed if the act is determined to have been negligent; or
 - (iii) the market value of the timber cut or removed if the defendant is determined to have had a reasonable basis for believing that the land on which the act was committed was his or that of the person in whose service or by whose direction the act was done.
- (b) Restitution.—Any damages awarded under this section shall be reduced by any restitution which is made under 18 Pa. C.S. §1107 (relating to restitution for theft of timber).
- (c) Definitions.—As used in this section, the following words and phrases shall have the meanings given to them in this subsection:

Timber. Standing trees, logs, or parts of trees that are commonly merchandised as wood products.

Market value. The value of the standing timber at local market prices for the species and quality of timber cut or removed at the time it was cut or removed.



Glossary of forest terms

Age class—a distinct aggregation of trees originating from a single natural disturbance or regeneration cutting.

Biodiversity—biological diversity; the variety of plants and animals, the communities they form, and the ecological functions they perform at the genetic, stand, landscape, and regional levels.

Biological diversity—see Biodiversity.

Biological maturity—the stage before decline in the life cycle of a tree when annual growth is offset by breakage and decay.

Board foot—a unit of wood 1 inch thick, 12 inches long, and 12 inches wide.

Buffer strip—forestland, usually along a road or waterway, managed to lessen visual or environmental impacts of timber harvesting.

Bumper trees—trees intentionally left standing adjacent to skid trails and roads to protect residual trees from damage when harvested timber is moved to the log landing site. Bumper trees are cut at the end of the harvesting operation.

Canopy—the upper level of a forest, consisting of branches and leaves of taller trees.

Cavity tree—a tree with cavities in which birds, mammals, or insects such as bees may nest (also called den tree).

Cord—a stack of wood measuring 4 by 4 by 8 feet.

Cleaning—a release treatment made in an age class not past the sapling stage in order to free the favored trees from less desirable individuals of the same age class that overtop them or are likely to do so.

Deciduous—losing or shedding leaves at the end of the growing season.

Den Tree—see cavity tree.

Dominant—trees with leaf-bearing branches (crowns) extending above the general level of the main canopy and receiving full sunlight from above and partial light from the sides.

Dormant—resting, or nongrowth, phase.

Ecology—the study of interactions between living organisms and their environment.

Economic maturity—the time in the life cycle of a tree or stand when harvesting can be most profitable.

Ecosystem—a natural unit comprising living organisms and their interactions with their environment, including the circulation, transformation, and accumulation of energy and matter.

Endangered species—species in danger of extinction throughout all or a

significant part of their range. Protection mandated by the United States Endangered Species Act, 1973.

Epicormic branching—delayed shoot development, or branching that occurs after other branches have developed higher on the tree trunk, often the result of the exposure of a maturing tree to previously unavailable sunlight. Epicormic branches typically arise from dormant buds that have maintained their vascular connection.

Ford—a shallow section of a stream that is stabilized with stone and used for crossing.

Forest renewal—the growth of a new forest, which includes not only the trees but also the other beneficial woody and herbaceous vegetation that contributes to the overall integrity, diversity, and health of the entire forest community and its interdependent ecological functions.

Haul road—a road designed for use by trucks to transport harvested timber from the log landing to its destination.

Herbaceous—pertaining to nonwoody vegetation, such as grasses and wildflowers.

Improvement cutting—a cutting made in a stand past the sapling stage primarily to improve composition and quality by removing less desirable trees of any species.

Intermediate treatment—a collective term for any treatment designed to enhance growth, quality, vigor, and composition of the stand after the establishment of advanced regeneration and before the final harvest.

Intermittent—refers to streams that do not flow continuously throughout the year.

Leaners—damaged trees that have been tipped or dislodged from the soil during a harvesting operation.

Litter—the uppermost layer of the forest floor consisting chiefly of decaying organic matter.

Log Landing—the area at the end of a skid road where harvested timber is stored or prepared for transport from the woodlot.

Lop—cut up the tops of harvested trees to reduce their height.

Mast—all fruits of trees and shrubs used as food by wildlife. Hard mast includes nutlike fruits such as acorns, beechnuts, and chestnuts. Soft mast includes the fleshy fruits of black cherry, dogwood, and serviceberry.

Microsite—a small area in which soil nutrients, water availability, sunlight, and other resources affect the growth and development of only one or a few trees and other plants.

Natural regeneration—the replacement of one forest stand by another through natural seeding or sprouting.

Overstory—trees in the upper level, or canopy, of the forest.

Parent material—the type of rock from which a soil type is derived.

Perennial—refers to streams and wetlands that contain water at or near the surface throughout the year.

Pulpwood—timber used to make paper and wood products other than lumber.

Rare species—species that exist only in one or a few restricted geographic areas or habitats or occur in low numbers over a relatively broad area.

Refuse—man-made debris.

Regeneration method—a cutting method designed to promote and enhance natural establishment of trees. Even-aged stands are perpetuated by seed tree, shelterwood, and clearcutting methods. Uneven-aged stands are perpetuated by selecting individual or small groups of trees for removal.

Renewal—see forest renewal.

Residual stand—trees remaining following any cutting operation.

Riparian zone—an area adjoining a body of water, normally having soils and vegetation characteristic of floodplains or areas transitional to upland zones. These areas help protect the water by removing or buffering the effects of excessive nutrients, sediments, organic matter, pesticides, and pollutants.

Rotation—the planned time interval between regeneration cuts in a forest.

Rubble land—an area characterized by its high content of large rock fragments.

Sapling—a small tree, usually defined as being between 2 and 4 inches in diameter at breast height.

Sawtimber—a relatively well-formed tree large enough to yield at least one sawlog, which is used for lumber. Usually the small end of a sawlog must be at least 10 to 12 inches in diameter for hardwoods.

Seasonally wet—refers to wetlands that have water at or near the surface only during periods of abundant rainfall or snow melt.

Seedling—a young tree originating from seed that is less than 4 feet tall and smaller than 2 inches in diameter at ground level.

Selection cut—the removal of trees singly or in small groups for the purpose of regeneration. A well-designed selection cut removes trees of lesser quality and trees in all diameter classes along with merchantable and mature, high-quality timber.

Selective cut—the removal of high-quality trees singly or in small groups based on a minimum diameter limit. Selective cuts often equate to high-grading and can compromise the quality of the future stand.

Shade intolerant—the inability of a tree to become established and survive at relatively low levels of sunlight. Shade-intolerant species, such as black cherry, aspen, and yellow poplar, germinate and grow best in full sunlight.

Shade tolerant—the ability of a tree to become established and survive at relatively low levels of sunlight. Sugar maple, Eastern hemlock, and beech can persist for many years in the shady understory.

Silviculture—the art, science, and practice of establishing, tending, and reproducing forest stands.

Site quality—the potential productive capacity of a site, usually expressed as volume production of a given species.

Skid—drag logs by lifting one end off the ground to reduce resistance.

Skid road—a road designed for frequent use by skidding equipment. Skid roads typically incorporate water-control structures.

Skid trail—a trail requiring less construction than a skid road because it is used less frequently by skidding equipment.

Snag—a standing dead tree with few branches, or the standing portion of a broken-off tree. Snags may provide feeding and nesting sites for wildlife.

Spring seep—a class of wetland created by groundwater emerging in small pools surrounded by vegetation. Spring seeps create snow-free zones critical for wildlife feeding during the winter.

Stand—a grouping of vegetation sufficiently uniform in species composition, age, and condition to be distinguished from surrounding vegetation types and managed as a single unit.

Stand density—a quantitative, absolute measure of tree occupancy per unit of land area in such terms as numbers of trees, basal area (cross-sectional area of a tree trunk at breast height), or volume.

Stem—the main trunk of a tree (also called bole).

Structure—the species composition of a forest stand *by age class*.

Stumpage—the commercial value of standing trees.

Succession—the natural series of replacements of one plant community (and the associated fauna) by another over time and in the absence of disturbance.

Sustainable forestry—the management of forests to meet the needs of the present without compromising the ability of future generations to meet their own needs.

Thinning—a cutting that reduces stand density of trees, made primarily to improve growth, enhance forest health, or recover potential mortality.

Threatened species—a species likely to become endangered in the foreseeable future, throughout all or a significant portion of its range, unless protected.

Understory—the smaller vegetation (shrubs, seedlings, saplings, small trees) within a forest stand, occupying the vertical zone between the overstory and the herbaceous plants of the forest floor.

Vernal (or autumnal) pond—a class of wetland characterized by small, shallow, temporary pools of fresh water present in spring and fall, which typically do not support fish but are important breeding grounds for many species of amphibians. Some species, such as spring peepers and mole salamanders, are totally dependent upon such ponds.

Wetland—area that is either transitional between land and water (where the water table is at or near the land surface) or area of land covered by shallow water (such as a marsh, swamp, bog, and fen). Although only 2 percent of Pennsylvania remains as wetlands today, these areas fulfill an essential role in our landscapes by maintaining water quality, stabilizing shores and stream banks, controlling floods and erosion, and providing critical habitat to many plant and animal species.

Wolf tree—a large, branchy tree that occupies more space in the forest than similar trees of the same diameter. Wolf trees may have high wildlife and aesthetic value but little, if any, timber value.

The Forest Stewardship Program is administered nationally by the USDA Forest Service and is directed in Pennsylvania by the DCNR Bureau of Forestry with assistance from a statewide steering committee. The Forest Stewardship Program assists forest landowners in better managing their forestlands by providing information, education, and technical assistance. For more information about program services and publications contact: The Pennsylvania Forest Stewardship Program, DCNR Bureau of Forestry, P.O. Box 8552, Harrisburg, PA 17105-8552. Phone: (800) 235-WISE, or (717) 787-2105.

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Penn State College of Agricultural Sciences research, extension, and resident education programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

This publication is available from the Publications Distribution Center, The Pennsylvania State University, 112 Agricultural Administration Building, University Park, PA 16802. For information telephone (814) 865-6713.

Issued in furtherance of Cooperative Extension Work, Acts of Congress May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture and the Pennsylvania Legislature. T. R. Alter, Director of Cooperative Extension, The Pennsylvania State University.

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